



2014 | Faculty of Law

DOCTORAL DISSERTATION

Chemical liability in risk society

A comparative quest for an optimal approach of complex causation in toxic tort

Doctoral dissertation submitted to obtain the degree of doctor of Law,
to be defended by

Marianne Hoppenbrouwers

Promoter: Prof. Dr Bernard Vanheusden | UHasselt / tUL



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Marianne Hoppenbrouwers

The transnational University Limburg (tUL) is a cooperation between Hasselt University and Maastricht University and can be considered as a single university based in two countries.



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D/2014/2451/40

"There is no inherent uncertainty about what caused something to happen in the past or about whether something which happened in the past will cause something to happen in the future. Everything is determined by causality. What we lack is knowledge and the law deals with lack of knowledge by the concept of the burden of proof." (Lord Hoffmann)¹

Acknowledgements

Promoter:

Prof. Dr. Bernard Vanheusden – University of Hasselt

Jury

Prof. Dr. Anne Mie Draye – University of Hasselt

Prof. Dr. Michael Faure – University of Maastricht

Prof. Dr. Geert Van Calster – University of Leuven

Prof. Dr. Maria Lee – University College of London

Prof. Dr. Tim Nawrot – University of Hasselt

Firstly, I want to thank my promoter and the professors for their mentoring and guidance. They were always, with an open mind, prepared to share their knowledge, to answer questions and to discuss insights and ideas, making it possible to complete this project on chemical liability. With respect for their contribution I plan to use the acquired knowledge and to continue learning with the objective to contribute, however minor, to a positive and sustainable future for humanity and the world.

A doctorate is an interesting and profound experience, with many learnings both professionally and personally. It is also confrontational. Therefore I wish to thank Eric, who continued to support and motivate me, despite all the limitations and hardship a doctorate student induce.

Certainly, I'm also grateful for the fantastic colleagues I have, as well in law as in other sciences. Several of them luckily reminded me of the life beside a Ph.D., others clarified legal issues, and some increased my knowledge in science and engineering. But each of them were indispensable.

¹ Gregg v Scott (House of Lords January 27, 2005).

Last but not least, I ask forgiveness from Claire, Stefan and friends, who succumbed and disappeared to the background for the "absolute" priority of a fantastic and important personal project. Thank you for your understanding and support.

Nederlandse samenvatting

Chemische stoffen zijn heel belangrijk in onze maatschappij. Ze zorgen voor welvaart, gezondheid en voeding. Spijtig genoeg veroorzaken ze soms ook schade aan onze gezondheid.

Mensen die denken getroffen te zijn door een schadelijke chemische substantie en daar nadeel van ondervinden, kunnen schadevergoeding eisen via gerechtelijke weg, namelijk een klacht indienen voor burgerlijke aansprakelijkheid. Dit lijkt eenvoudig, maar dat is het niet.

Vooraleer men een schadevergoeding kan krijgen, moet men ondermeer bewijzen dat de schade veroorzaakt is door een specifieke chemische stof. Dit causaal verband tussen de stof en de schade is in praktijk moeilijk vast te stellen en nog moeilijker te bewijzen. Over die moeilijkheden gaat deze studie. Daarbij ligt de nadruk op het (wetenschappelijk) bewijs van het causaal verband en de competenties die aanwezig zijn of zouden moeten zijn in de rechtbanken. Het is niet voldoende om beroep te doen op deskundigen.

Het doel van de studie is om op basis van onderzoek van de verschillende ervaringen en benaderingen te komen tot een praktisch advies over hoe om te gaan met deze schadegevallen. De onderliggende gedachte is dat het beter is om voorbereid te zijn, dan om achter de feiten aan te lopen. De uitdaging is het samenbrengen van wetenschappelijke en juridische kennis en redenering, terwijl de objectieven van het aansprakelijkheidsrecht gehandhaafd blijven en kwalitatief goede uitspraken te garanderen. Deze noden zijn universeel, men komt ze in alle rechtssystemen tegen.

Daarom worden vier landen bestudeerd: het Verenigd Koninkrijk en de Verenigde Staten voor het Common Law systeem, Nederland en Frankrijk voor het Continentale systeem. De redenen daarvoor zijn:

- In Europa hebben we minder ervaring met aansprakelijkheid voor schade aan de gezondheid veroorzaakt door chemicaliën, maar het aantal klachten en rechtszaken stijgt.
- De Verenigde Staten hebben daarentegen een uitgebreide ervaring met deze materie.

De algemene conclusie is dat het bewijs van een oorzakelijk verband tussen de blootstelling aan een chemische stof en de ziekte of lichamelijke schade van de

aanklager/eiser een uitdaging blijft. Een algemene oplossing, of het nu een formule of een principe is, blijkt niet mogelijk. Elke individuele situatie moet apart in alle aspecten beoordeeld worden. Daarbij zullen wetenschappers en juridisch geschoolden moeten samen werken. Belangrijk is dus dat beide partijen elkaar leren begrijpen.

Daarom wordt gepleit voor:

- Rechters en andere betrokken bij een rechtszaak zouden een basiskennis moeten hebben van wetenschappelijk denken, methodologie en communicatie;
- Chemische aansprakelijkheid is in essentie transdisciplinair. Ingrijpende scholing in één tak van de wetenschap heeft dus geen nut, noch is het nuttig om een expert aan de rechtbank toe te voegen.
- Handleidingen en informatie in verband met de wetenschappelijke bewijsvoering zouden moeten beschikbaar zijn voor juristen.
- Wetenschap evolueert voortdurend, en er zijn steeds meer specialisaties, daarom zou een wetenschappelijk comité op het niveau van (bijvoorbeeld) Europa nuttig zijn. Dit comité zou assistentie verlenen aan rechters die geconfronteerd worden met complexe zaken betreffende chemische stoffen. Het voordeel van een internationaal comité is ook dat de samenstelling meer kan variëren naargelang de behoeften.
- De kwaliteit en de coherentie van de rechtspraak in deze materie zou er baat bij hebben als bepaalde rechtbanken zich vertrouwd zouden maken met de eigenheden van chemische aansprakelijkheid. Op die basis kunnen zij beter het wetenschappelijk denken, het taalgebruik en de waarde van bevindingen kunnen evalueren.

Als besluit kan men stellen dat het duidelijk is dat men niet van juristen kan en mag verwachten dat zij kennis hebben van alle wetenschappelijke disciplines. Een basiskennis is nodig, opdat de fouten die nu gemaakt worden zouden verdwijnen.

Een rechter zal in zijn uiteindelijke beslissing meestal verder moeten kijken dat de puur feitelijke situatie. Dit wordt 'belief probability' genoemd. In andere woorden de rechter moet overtuigd zijn van de juistheid van zijn beslissing. Daarbij kan hij gebruik maken van principes, zoals het voorzorgsbeginsel, het

preventiebeginsel (om er twee te noemen) en vooral ook zijn beslissingen grondig motiveren.

Er is eveneens nood aan een coherente benadering van deze aansprakelijkheid. Rechtbanken verschillen nogal in hun benadering en evaluatie van wetenschappelijk bewijs. De verschillende vormen van aansprakelijkheidssystemen, zoals bijvoorbeeld product aansprakelijkheid, omkering van de bewijslast, aansprakelijkheid voor zaken, kennen dezelfde moeilijkheden met betrekking tot het bewijs van het causaal verband tussen blootstelling en persoonlijke schade.

Mits het voorzien van de nodige ondersteuning (vb. wetenschappelijke comités, gespecialiseerde rechtbanken, aandacht voor opleiding, beschikbaar van (begrijpbare) informatie) is het mogelijk om ook in deze complexe zaken de 'rule of law' te respecteren en de rechtszekerheid te vrijwaren.

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Part 0 - INTRODUCTION

Chemicals present in the environment, chemicals causing adverse health effects, chemicals polluting nature worry many people. Legislation and private actions do not seem able to counter the increasing health risks. In an attempt to get recovery of personal injury caused by chemicals, people turn to tort. A comparative study of the practice and doctrine of tort related to chemical substances aims at providing advice and solutions for the observed difficulties when trying to prove a causal link between the exposure to a chemical and a disease or any other personal injury. The motivation for the research is to assist, judges and legal practitioners when confronted with such complex and difficult proof of causation.

0.1 The impact of chemicals on human health as a contemporary challenge in nowadays risk society

Chemicals bring welfare and wellbeing. Their use in healthcare is one example, their use as plant protection for food and feed another. Chemicals are also toxic and can cause harm. Some substances may have serious and irreversible effects on human health and the environment.

Chemical substances can have properties like carcinogenicity, mutagenicity, reproductive toxicity or they can be bio-accumulative, endocrine disruptive or just plain toxic. On the other hand some of these toxic substances are at this moment irreplaceable. Pharmaceuticals have obvious benefits, but their presence in the environment can affect human health negatively. Toxic phthalates are added to plastics to increase their flexibility, transparency, durability, and longevity. We all use plastics and they are part of our comfort, but some substances, like to phthalates in plastic products can be noxious in certain circumstances.

The annual growth rate for chemical products in developed countries is estimated to be approximately 4 per cent per annum for the period 2012-2050.² The average growth of chemical production will be even higher in the developing and emerging countries (including the European emerging countries).

² KEMT, E. (ed.) (2013). *Global Chemicals Outlook - Towards Sound Management of Chemicals*. Kenya: United Nations Environment Programme. P. 13.

Several of these produced chemicals are toxic.

Toxic chemicals should be handled and management correctly, with the necessary prudence. New legislation, like the European Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), or proposal to reform of the US Toxic Substances Control Act (TSCA), what is at this moment (June 2014) under review) translate safe production and safe use of chemical substances into concrete obligations.³ However, science and society develop faster than law.

It is estimated that there are more than 140,000 chemicals on the EU market. The CAS registry, the official database of chemicals, contains 8 million unique organic and inorganic chemical substances.⁴ This number has certainly increased. Man continues to develop synthetic chemicals. In the US Environmental Protection Agency adds an average of about 700 new chemicals per year to the Toxic Substances Control Act (TSCA) inventory.⁵

On the basis of above observation that chemicals cannot be banned because of their beneficial impact on life, and because of their relation with our lifestyle, harm caused by toxic chemicals will continue to exist.

People wrongfully exposed to toxic substances are within the Western law systems entitled to seek compensation. The principle that a (legal) person incorrectly causing damage to another person should be held liable, also applies in these cases. In reality it is not easy.

Toxic tort cases are complicated. The most difficult hurdle to take is proving that a specific chemical caused the specific disease or harm the plaintiff is suffering from. Proving this involves science. Judges and lawyers are not trained in chemistry, epidemiology, toxicology, biology and medicine. Neither are they familiar with the thought processes of scientists. It is thus not surprising that

³ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC; The Toxic Substances Control Act (TSCA) is a United States law and can be found at 15 USC (C. 53).

⁴ CAS REGISTRY at www.cas.org/content/chemical-substances. Accessed on 23 June 2014.

⁵ KEMT, E. (ed.) (2013). *Global Chemicals Outlook - Towards Sound Management of Chemicals*. Kenya: United Nations Environment Programme. p 10.

courts find it difficult to assess the validity of scientific proof. They regularly struggle, often to the extent that it impacts their decisions.

Many examples of these difficulties and the resulting errors can be found. To give an idea of the difficulties and the errors that can be made, a few cases are cited.

The first one is an example of a court having to assess scientific research methodologies. It concerns a young mother, Rene Junk, who was pregnant when her home was treated with Dursban for the presence of spiders.⁶ This treatment continued over three consecutive years, namely from February 1992 to September 1994. Their son, Tyler, was born in August 1992. Tyler suffers from physical, neurological, and psychological problems. In 2005 an action was filed against Terminex, Dow Chemical, and Dow AgroSciences claiming Tyler's problems were caused by exposure to chlorpyrifos, a chemical in Dursban.

Expert testimony was necessary to prove if the exposure caused Tyler's harm. Dr. Bearer gave the opinion that Tyler's neurodevelopmental delay was the result of his exposure to Dursban both in utero and in the early years of his life. The court did not accept this conclusion and stated that expert's methodological approach in this particular case was not sufficiently reliable. Comparing the exposure rates of the plaintiff with exposures that occurred in academic studies was considered speculative, as was the use of differential diagnosis for concluding on the link between the exposure and the disease. Were these decisions correct? Both methods were accepted and frequently used in the scientific community. Plaintiffs lost their case at trial level, a decision that was later confirmed by the Court of Appeals.⁷ It is fair to say that the courts erred in its appreciation by its rejection of a scientifically recognized methodology, as it happens in more cases.

Courts are often nervous and very cautious when assessing experts' testimonies, as is shown in the following citation:

“[T]he court must recognize that due to the difficulty of evaluating their testimony, expert witnesses have the potential to “be both powerful and

⁶ Junk versus Obrecht, 839 N.W.2d 675 (Court of Appeals of Iowa September 5, 2013).

⁷ However with one judge dissenting. Junk versus Terminex Intern. Co. Ltd. Partnership, 594 F.Supp.2d 1062 (United States District Court, S.D. Iowa, Central Division October 31, 2008); Junk versus Obrecht, 839 N.W.2d 675 (Court of Appeals of Iowa September 5, 2013) with Judge Doyle, dissenting.

quite misleading.” And, given the potential persuasiveness of expert testimony, proffered evidence that has a greater potential to mislead than to enlighten should be excluded.”⁸

In the second example the plaintiff had to prove that her husband died from smoking. The judge explicitly expressed his difficulties with understanding the expert evidence and:

“felt unable to conclude on the basis of epidemiologic evidence that there was a general causal link between smoking and lung cancer, because the epidemiologists failed to instruct him in a way that he was able to form his own judgement on the matter.”⁹

Some courts chose to be cautious in view of the complexity of toxic causation. A good example is the pilot claiming that he became sick from exposure to a toxic substance (TriCresylPhosphate or ToCP) coming from the motor oil of the airplane. The substance was known as a proven neurotoxin. The airline admitted that the substance was present in the cabin, but declared that the concentrations were too low for causing damage. On his own initiative the pilot had several investigations done. The concentrations of the substance on his clothes was assessed by a laboratory. His blood was examined and ToCP was found. The pilot’s symptoms fitted the profile of such an intoxication. On the other hand a neurological examination by the medical doctor of the airline did not find any link with ToCP and the expert concluded that the plaintiff’s symptoms were caused by stress. In short: several studies and reports were examined, but it still was not clear if ToCP caused the plaintiff’s condition. The court decided that the company should investigate potentially harmful concentrations of substances in the cabin. If the causal link is as uncertain as in this case, all the proof is up to the plaintiff. The reversal of proof cannot be applied.¹⁰

⁸ Westberry versus Gislaved Gummi AB, 178 F.3d 257 (United States Court of Appeals, Fourth Circuit May 20, 1999).

⁹ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005).

¹⁰ Hoge Raad 7 June 2013, ECLI:NL:HR:2013:BZ1717, *Jurisprudentie Arbeidsrecht* 2013/17; Hoge Raad 7 June 2013, ECLI:NL:HR:2013: BZ1721, *Jurisprudentie Arbeidsrecht* 2013/178.

People are afraid of chemicals. They regularly state that their disease, like cancer, is caused by an exposure to a chemical substance. Some of these people file claims in tort, seeking recovery from the alleged tortfeasor. However, going to court means that they have to prove the causal link between the chemical and their condition. Generally people can be confronted with three problems:

1. The exposure is not certain and/or the chemical is not identified – a plaintiff should prove that he was exposed to a specific chemical or specific chemicals;
2. The origin of the chemical(s) exposed to is unknown or not attributable to a defendant;
3. Lack of (scientific) knowledge.

This study focuses on the third situation and the difficulties encountered in relation thereto. First of all judges¹¹ are not schooled as chemists, medical doctors or epidemiologists. They are confronted in toxic cases with an area of knowledge they are not used to and rarely fully understand. How should courts handle these cases?

0.1.1 Objectives of the research

The first part of this research aims to pinpoint the elements that make toxic tort such a challenge for courts. Thereby the investigation goes further than the obvious remark that 'science is not up to it' or 'judges are not able to understand and work with science'.

The final objective of the study is to make recommendations for ameliorating proof of causation in toxic tort.

The problems with liability litigation concerning personal injury allegedly caused by chemicals are universal. Suggestions are aiming at general advices, but with priority for the Continental Law system and particularly also Belgium.¹² The reason therefore is that

- Continental Law is less familiar with claims for damage caused by chemicals;

¹¹ For reasons of transparency and understandability of the text, the term 'judge' includes the juries (as used in the US) whenever appropriate.

¹² See remark on page 8.

- Toxic tort cases increase everywhere and Europe, including Belgium will most probably not escape this evolution;
- It is always better to be prepared, than to run after the facts.

It is the challenge created by the need for understanding science, for using it in the decision process and for safeguarding the objectives of tort, combined with the increase in toxic tort cases that led to following research questions.

0.1.2 Research question(s)

In a pluralistic society, where values are disputed, there is no spontaneous tendency to regulatory convenience.¹³ Brownsword sees however two values that are widely accepted. The first is that one should not harm others. The second is that precaution should be exercised in the face of uncertain but potentially serious and irreversible risks.¹⁴

Tort is concerned with both, as is toxic tort. Though the latter is confronted with specific issues. These led to the following research questions.

How can it be proved that a specific chemical caused harm to a specific individual in such a way that recovery for the plaintiff, becomes possible.

Or further refined:

1. Is the actual (toxic) tort system up to this challenge, particularly are judges and courts capable of dealing with complex scientific issues?
2. Is it possible to develop a set of principles that efficiently facilitate toxic tort cases?
3. Given the gaps and uncertainties in knowledge, how can causation be proved in toxic tort, whilst respecting the basic tort principles?

These questions will be researched with the focus on the role of scientific evidence, the competencies courts have and/or should have, and the evolution of knowledge and science.

This research question is in the next paragraphs defined within a substantive and geographical frame.

¹³ BROWNSWORD, R. (2008). Rights, Regulation, and the Technological Revolution. Oxford University Press, pp. 100-101.

¹⁴ BROWNSWORD, R. (2008). Rights, Regulation, and the Technological Revolution. Oxford University Press, p. 101.

0.2 The joy of complexity and the need to accept limitations

0.2.1 Methodology

The research is based on an analysis of litigation. Litigation is important since tort is, as well in Continental Law as in Common Law, a pragmatic area of law. Doctrine is of course also important. It generates ideas and concepts that are not yet realised in the existing court system. It discusses and confronts habits and innovation. Consequently several court cases and academic writings are analysed in order to have a sound basis for the inference of conclusions.

The objective of the empirical research is to collect data to get insight in the issues and practices surrounding complex causation in toxic tort. This information can be quantitative or qualitative. Cases are selected on the basis of their added value in innovative thinking about the issue of complex causation. Of course, well accepted/known approaches are also considered. However, it must be noted that so called 'state of law', 'key' or benchmark cases are not the sole focus. Such a restriction would limit 'thinking out of the box' too much and impede novel ideas.

The number of court cases studied is / should be a reliable sample. Not all cases and literature studied are cited in the texts and the bibliography only mentions those who are cited.¹⁵

Obviously, the analysis of court cases is then linked to generic and theoretical research based on doctrine and legislation. Together they cover the main information sources.

In all this tort is analysed in relation to its objectives and its practical methods of assessing liability of a defendant.

Elements that are involved in this aspect are the objectives of tort as elaborated in doctrine. Also included are the basic principles like duty of care, foreseeability, proximity and not in the least, the doctrines of causation.

The information gathered is analysed on its relevance to causal issues relating to personal injury caused by chemicals. The aim is not to give a complete overview of existing doctrines and causal theories or philosophies, but to make a selection on the basis the relevance for the topic of this study.

¹⁵ The number of cases studied exceeds 500, but somewhere during the process I stopped counting.

The split between empirical and theoretical is however rather artificial. Many doctrines and norms invoke empirical arguments to support their points. The distinction between theory and practice is mainly used as a methodological tool to bring structure and quality into the study.

The methodological sequence (first litigation then theory) is chosen in order to attain an effective selection of relevant factors and to equally minimize overlooks of relevant aspects. It also enables useful cross references that can lead to new insights.¹⁶ In line with the progress of the research both theory and pragmatic concepts will be analysed simultaneously.

The study is essentially comparative. Not only is the subject international (see supra), the different experiences in the chosen countries add value. Four countries were chosen for their different legal approach: the United Kingdom (UK) and the United States (US) for Common Law and the Netherlands and France as representatives of respectively the German tradition and the Napoleonic civil code, both part of the Continental Law. Belgium is not included in the research because of the scarcity of relevant information and experience. The presence of France in the study should allow to make it possible to include the Belgian tort system in the suggestions.

0.2.2 Limiting the research

0.2.2.1 The substantive borders and assumptions

Tort as an area of law has to be understood in relation to its objectives and its practical methods of assessing the liability of a defendant. Subsequently the information gathered will be studied in more detail in relation to its relevance for the topic of this study. Thereafter the search is narrowed to the aspects of causation and its proof, including the evidential tools used in toxic tort.

First the (toxic) tort system as such will be studied in relation to its relevance for personal injury caused by chemicals. Thereafter the search is narrowed to the

¹⁶ It is not without importance to note that differences in the use of terms, geographically or historically based, are disregarded in this study for reasons of structure and transparency. Therefore the terms 'tort', 'plaintiff', 'defendant' used. 'Disease' and 'harm' are to be understood as damage caused to the plaintiff without any connotation to a specific condition, unless stated otherwise. Last but not least, the House of Lords is now called the Supreme Court. The name used in the court documents is used, whilst adding (UK) in the reference.

aspects of causation and its proof, including evidential tools that are or can be used in toxic tort.

Although the selection is mainly based on the analysis of empirical and generic data (see method of investigation), a personal influence based on (practical) experience with chemical industry and chemical legislation is also present.

a) Definition of toxic tort

Toxic tort involves the 'whole' spectrum of chemicals that allegedly caused personal injury and damage to property. The chemicals can be pure, incorporated into products, waste, medicinal products, the environment, food, etc.

This study focuses on personal injury (not nuisance) and considers tort claims based on all sorts of chemicals.

b) Focus on causation and proof thereof

Compensation of damage, proof of exposure, identification of the actual tortfeasor amongst several potential tortfeasors, legal presumptions, proportional liability, reversal of the burden of proof, compensation of the harm and the like are *sensu stricto* not part of the research. This does not exclude reference to these aspects when beneficial for the analysis and the policy recommendations concerning chemical liability.

c) Some causal links are easier to prove

Indeed some chemicals are easier to track down as the cause of an injury. They are less relevant for a study on the difficulties of proving causation because of their specific properties (signature diseases) or specific exposure (pharmaceuticals). The following paragraphs will explain each in more detail, starting with the concept of a 'signature disease'.

A signature disease is a harm that is caused by a specific chemical (or biological agent) whereby that the exposure to the substance gives a very strong, even certain, proof of a causal link when that disease develops. Simply said, the disease is specific for the exposure. In a claim for a signature disease, courts often consider causation proved when the exposure to the related substance is certain. Signature diseases are quite exceptional. Mesothelioma caused by asbestos is probable the best known, but there are others: the Minamata

disease caused by mercury poisoning, benzene causing acute myelogenous leukaemia.

Pharmaceuticals are also different. The use of pharmaceuticals happens in controlled circumstances. Exposure, dose and impact are monitored and damage is thus easier to link to the substance. However, difficulties in relation to causation exist. Although pharmaceuticals are thoroughly tested 'surprises' can still happen.

Once the toxic property is proved, a causal link between the exposure to the substance and the disease is often accepted. Alternative causes are then not considered. A benchmark case concerning pharmaceuticals is the Bendectin litigation¹⁷ in the US and the DES cases in the Netherlands¹⁸ and France.¹⁹ Exposure in utero of the victim, when it is certain that the mother took the medicine is sufficient to accept a causal link. A major difficulty in these cases lies in the finding of the culpable defendant amongst several potential defendants. This challenge is however beyond the scope of this study.

Last but not least, the former observations do not fully exclude these liability claims from the study. They are included as examples whenever the logic and reasoning of the court is of particular importance for the research.

d) Transdisciplinary efforts are essential

This research cannot be done in isolation. Input from other disciplines is necessary. Complex causal links between chemicals and their (alleged) damage rely on scientific insights that should help the judge to decide in a case.

Consequently scientific methodology and scientific conclusions should be studied in order to understand where the bottlenecks are when this scientific information is presented in court. Firstly, an understanding of chemistry and chemicals is necessary. This includes the hazardous properties of chemicals, their behaviour in the environment (pathways to exposure), and their impact on exposed

¹⁷ Several cases have been judged concerning this pharmaceutical. The benchmark case of Daubert is one of them: Trial: Daubert versus Merrell Dow Pharmaceuticals, Inc., 727 F.Supp. 575 (United States District Court, S.D. California December 14, 1989). Appeal: Daubert versus Merrell Dow Pharmaceuticals, Inc., 951 F.2d 1128 (United States Court of Appeals, Ninth Circuit December 20, 1991). Supreme Court: Daubert versus Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579 (Supreme Court of the United States June 28, 1993).

¹⁸ For example: Hof Amsterdam 1 June 2006, LJV AX6440, *Nederlandse Jurisprudentie* 2006/461.

¹⁹ For example: Cour de Cassation Civile (1re chambre), 24 September 2009, Bulletin Civile 2009.I.187.

humans. Secondly, epidemiology, statistics and medicine are also considered. However an in-depth insight in all disciplines is not only impossible, it is also not necessary. It is only essential to be able to appreciate the particularities of the science used for proving causation.

Relevant information in literature, reports, specific scientific articles and research documents is used for this part of the study. In concreto the research starts with the analysis of toxic tort cases to get insight on the used scientific evidence. Thereafter the scientific methodologies frequently used in court are selected and further investigated. The investigation does not so much concern the content of the provided evidence, but focuses on its reliability, delivery and appreciation in court. This process leads to an understanding of the used scientific methods.

0.2.2.2 Delineation of the research: different systems and different countries

Looking at foreign case law gives useful information. It increases the information on how courts are dealing with certain difficult legal problems, and lead to an increased exposure to a variation of methods.

Chemicals and environmental pollution cannot be studied locally in view of the transnational migration of chemicals (see Part I) and lessons can be learned from different legal systems, in particular the Common Law and the Continental Law.²⁰

A comparative research on best practices in toxic tort is thus valuable and is beneficial for countries not familiar with this type of claims. It also seems to become increasing unavoidable, if not for the increase in knowledge it provides, then for the increased interaction of judges, especially of the national highest courts, with their counterparts in other countries. This interaction does not only concern the study of international and foreign legal materials, but also the exchange of legal ideas.²¹

It cannot be denied that the US has more experience in the area of toxic tort than any other country in the world. Europe, with its different societal structure

²⁰ The term Continental Law (system) will be used in order to avoid confusion with the Civil Law as a domain of legislation/jurisprudence.

²¹ MAK, E. (2011, Vol. 70, issue 2). Why do Dutch and UK judges cite foreign law? Cambridge Law Journal, pp. 420.

has much less of these claims. However, an increase is noticeable. Most likely, with the strain put on (especially) collective insurance (ex. Social Security) systems, the continuously increasing cost of medical care, but also the growing awareness and assertiveness of citizens²² concerning their exposure to toxic substances, toxic tort cases will for a long time continue to increase in the European region.

Four countries, two of the Common Law system and two of Continental Law system, are selected: the United States (US), the United Kingdom (UK), the Netherlands and France. The reasons and motivation behind this is explained in individual paragraphs, but first relevant differences between the two law systems are discussed.

a) Common Law and Continental Law: differences to know before starting

In Continental Law legal reasoning is usually deductive. A rule/law is taken as the starting point against which the facts of a case are appreciated and subsequently the law will be applied to the situation.

In Common Law the thinking process is mainly inductive. The factual situation is the basis and the rules are the consequence.

This is a fundamental difference in the sense that it makes the Common Law system more flexible and adaptive than the Continental Law system. Together with the cultural differences, and in particular the differences in collective insurance systems (like Social Security) taking care of the treatment of personal injuries regardless of their cause, the comparison of both systems is an added value.

b) Why these countries

For the Common Law both the UK and the US will be analysed. The first because of its membership of the European Community and the applicability of European legislation, whilst still adhering to the British legal tradition and the Common Law. The second is selected because of its experience in toxic tort, the accessibility of legal and academic sources and the influence this nation still has on the global economy and politics.

²² A few concrete examples of the involvement of the public are the influence of non-governmental organisations, the private initiative of industry sectors and the mandatory consultations of the public when developing legislation or granting permits.

Concerning Continental Law a more difficult choice had to be made. The European Group on Tort law finds the notion of interference with protected interest in most of the legal tort systems in Europe, but the use of the concept differs.²³ In general three different systems are distinguished in European Continental Law: the Latin (Napoleonic) system, the German system and a mixed system in the Netherlands.

All these law families differ not only in judicial style, but also in their approach of the role and format of legislation.²⁴ Professor Van Gerven illustrates this with following sentence:

“[...] English judgments continue to reflect the spoken language from a Judge sitting on the bench, whilst German judgments continue to resemble highly reasoned academic Legal writings, and French judgments continue to be formulated in the same authoritative way as statutes promulgated by a legislature”.²⁵

In this study the Netherlands (for its Napoleonic and German influences) and France (for its Napoleonic culture, comparable to the Belgian legal culture) are selected.

i) The United Kingdom

The UK adheres to the Common Law. Consequently courts and judges are central in the development of the substance of tort law. Judgments are based on preceding decisions and can be changed in line with new needs or opinions, mostly by the highest courts.

The House of Lords and the new Supreme Court include in their judgements the individual opinions of the judges.²⁶ These individual opinions are a good source

²³ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer; VON BAR, C. (2009). *Principles of European Law on non-contractual liability arising out of damage caused to another*. Munich: Sellier.

²⁴ VAN GERVEN, W., & LIERMAN, S. (2010). *Veertig jaar later: privaats- en publiekrecht in een meergelaagd kader van regelgeving, rechtsvorming en regeltoepassing*. Kluwer, p. 205.

²⁵ VAN GERVEN, W., & LIERMAN, S. (2010). *Veertig jaar later: privaats- en publiekrecht in een meergelaagd kader van regelgeving, rechtsvorming en regeltoepassing*. Kluwer, p. 206.

²⁶ On 30 July 2009, the judicial function of the House of Lords and its role as the final - and highest - appeal court in the UK ended, www.parliament.uk; www.supremecourt.gov.uk/procedures/practice-directions.html>.

of information, although frequently lengthy. The judgements can include discussions of foreign legal materials and academic writings.²⁷

ii) The United States

Undoubtedly the US has a wealth of experience and research in toxic and cannot be ignored in a comparative study. Although this country is organised in a structure distinct from the other three that did not turn out to be an obstacle. The reason therefore can be found in the subject of the study, namely proof of causation in toxic tort. The research focuses on judicial reasoning and methodologies used in toxic tort cases. The variations in approach and assessments of causal links brought additional viewpoints and opinions into the study.

In view of above observation, a brief outline of the US system is provided.²⁸

The U.S. Constitution created a governmental structure known as federalism that calls for the sharing of powers between the national and state governments. The Constitution gives certain powers to the federal government and reserves the remaining for the states.

The courts of the US follow this structure and are situated at the state and the federal level.

The federal courts form the judicial branch of the Federal government of the United States and operate under the authority of the United States Constitution and federal law. The federal courts handle cases involving litigants from two or more states, violations of federal laws, treaties, and the Constitution, admiralty, bankruptcy, and related issues.²⁹ Concerning tort the federal courts are generally only qualified if parties come from more than one state.

The state and territorial courts of the individual U.S. states and territories operate under the authority of the state and territorial constitutions and state

²⁷ MAK, E. (2011, Vol. 70, issue 2). Why do Dutch and UK judges cite foreign law? *Cambridge Law Journal*, p. 429.

²⁸ Information can be found at: About the Court. United States Court of International Trade, www.cit.uscourts.gov/informational/about.htm; The Judicial Branch: Interpreting the Constitution. Department of State: International Information Programs, <http://usinfo.state.gov/products/pubs/outusgov/ch5.htm>; National Center for State Courts, www.ncsconline.org; Understanding the Federal Courts. Administrative Office of the U.S. Courts, www.uscourts.gov/understand02/index.html.

²⁹ Understanding the Federal Courts. Administrative Office of the U.S. Courts, www.uscourts.gov/educational-resources/get-informed/federal-court-basics.aspx

and territorial law. The state courts are free to operate in ways that vary widely from those of the federal government, and from one another. In practice every state has at least two court levels, and almost all have three levels: trial, appeal and Supreme Court. State courts deal with their respective state constitutions and the legal issues that the US Constitution did not give to the federal government or explicitly denied to the states. (See supra) The majority of tort cases are processed by state courts.

In federal and state tort trial courts, often called District Courts³⁰, jurors decide the cases. Jury duty is an essential part of the US judicial system.³¹ A discussion of the benefits and disadvantages of a jury system will not be held here. Critics of American tort law often question the ability of lay jurors to make factual determinations in trials involving complex scientific evidence. A growing body of research indicates that jurors' comprehension of law and fact is often quite weak.³²

Concerning toxic tort no defenders of jury litigation could be found. However, in the analysis of this study the fact that the trial courts judge by jurors is no obstacle for two reasons. Firstly, the preliminary rulings on admissibility of evidence is (since Daubert) done by the trial judge, without involvement of a jury. The jury decides on the believability of the evidence and is thereby guided by the pleadings. Secondly, Courts of Appeals and Supreme Courts³³ work without juries.

Either side may appeal in a civil case after a judgement at the trial level. An action in appeal has to be based on a legal error affecting the outcome of the case. The arguments in writing are submitted to a panel of three judges. The court of appeal bases its decision on the record of the case and does not solicit new testimony or evidence. Some courts do allow for oral arguments.

The decision of a Court of Appeal is final unless the case is sent back to the trial court.

³⁰ In the state of New York, the trial court is called 'Supreme Court.' The highest court in that state is the Court of Appeals.

³¹ WILKIBS MACHENRY, K. (2014, June). Arizona's Civil Verdicts 2013. *Arizona attorney*, p. 39.

³² SANDERS, J. (1993, November). From science to evidence: the testimony on causation in the bencectin cases. *Stanford Law Review*, pp. 1-106.

³³ As the highest instance of review (not as understood in New York)

But a party who loses in appeals can submit petition, *id est* an official request for the Supreme Court (a writ of certiorari) to review the case. Federal and State Supreme Courts are not obliged to hear a case. The Constitution gives the Federal Supreme Court the discretion to decide whether or not to do so.³⁴ Generally the court hears the case if multiple appellate courts have interpreted the law differently or if an important legal principle is at stake. Most state supreme courts have implemented "discretionary review," in line with the discretion attributed to the Federal Supreme Court.

Rules exist regarding the presentation of evidence. For federal courts these rules are laid down in laws. State courts have their own rules, sometimes they use the federal rules. Judges might have their own rules guiding conduct in their courtrooms.³⁵

iii) The Netherlands

The Netherlands are chosen because they now have a particular legal system. Originally it was a Latin system closely linked to the French legal family. Gradually the influence of Germany became important. The new Civil Code of the Netherlands approved in 1992 is highly influenced by the German legal approach.³⁶ The Dutch court system is however still based on the French model.³⁷

iv) France

France is adhering to their civil tradition with the theory of equivalence as the dominant approach. The country is chosen because of its representative value for the Latin law family. Many aspects can still be retrieved in the legislation of other European countries, especially Belgium.

³⁴ Article III, Section II of the Constitution

³⁵ Understanding the Federal Courts. Administrative Office of the U.S. Courts, www.uscourts.gov/understand02/index.html.

³⁶ HONDIUS, E. (2010). The development of medical liability in the Netherlands. In E. HONDIUS, *The development of medical liability* (pp. 132-159). Cambridge: Cambridge University Press, p. 132.

³⁷ MAK, E. (2011, Vol. 70, issue 2). Why do Dutch and UK judges cite foreign law? *Cambridge Law Journal*, p. 427.

c) Why not Belgium?

Far from denying or ignoring the continuous efforts made by the chemical industry and the government to make the use and production of chemicals safe, it is certain that Belgium, is vulnerable for damage caused by these substances.

Belgium is the number one chemical country in the world on a per capita basis.³⁸ More than 300 different chemical substances and more than 500 chemical manufacturers are present in Antwerp, making this chemical cluster the biggest in Europe and the second in the world.³⁹

Belgium has however very little experience with liability for personal injury (allegedly) caused by toxic chemicals. The lack of relevant and useable information made it impossible to include the country as a source of information and a reference for toxic tort.

However, since the importance of the chemical industry and the likelihood that toxic tort cases will occur in the future, the objective is to that the results of this study will be evaluated in a manner relevant for those countries with little or no experience in toxic tort. This includes Belgium, but probably also other European countries that now are at the start of the economic development.

0.3 The different parts of the study

The study is divided into an introduction and seven following sections (parts).

Part 0 or the introduction defines the reason for the study, its objectives and research questions. Methodologically it explains the substantive focus and its limits. It also describes the method and reason of the choice for a comparative study.

After the introduction, Part I situates the 'danger' of chemicals in our risk society. Topics like the influence of social evolution, the perception of risk in nowadays world, and the role of chemicals therein are discussed.

Situating the topic into a broader context, the essence of tort is analysed in part II. For an analysis of tort and toxic tort it is important to consider the objectives

³⁸ www.essencia.be

³⁹ www.ditisvlaanderen.be/dit-is-vlaanderen/creatieve-economie-nieuwe-industrie/de-chemie-van-vlaanderen

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of the tort system. Both the doctrine of law and economics and the doctrine of justice are discussed. Immediately thereafter the role of causation in achieving said objectives is questioned. Do we need to prove causation within the judicial domain of tort? What are the benefits of proof of a causal link?

Subsequently the basic principles of tort are explained. This enables the reader to have a clear view on the place and importance of proof of causation in the process of finding liability.

Two main tort categories, accounting for the majority of cases, are analysed in more detail: negligence is studied in chapter 2.3 and strict liability in chapter 2.4.

Part III is fully dedicated to causation, as a necessary condition for liability. What is causation? Why use a two-step process when assessing causal links? This part includes a chapter on the role of common sense. Intuitive thinking is inherent to human activity and cannot be ignored. The idea behind the inclusion of this topic is that understanding the use of common sense in tort leads to a better assessment of it. Once the answers on these questions are formulated, a confrontation with the *sine qua non principle* leads to the investigation of alternatives for finding proof in complex causation. Only a few were considered as relevant for toxic tort. The selection was made along the lines of the particularities of damage caused by chemicals.

Risk is an important topic in our society. People fear danger, they also fear chemicals. Risk creation in the sense of emitting (for example) a toxic substance in the water or the air, leads to the question if such risk creation can be a cause of action in toxic tort. The answer is elaborated in Part IV, however under the assumption that environmental permits and other legally imposed limits are respected.

Part V is specific for toxic tort. It deals with the challenge of proving harm caused by chemicals. How are scientific findings communicated in court. Is the evidence understandable? The former is not only an issue of using the same language, but also relates to the types of studies that are used. Epidemiology, toxicology, bio monitoring and differential diagnosis are explained.

The final chapter of part V deals with the concepts of general and specific causation. The distinction is made because each of the two requires another

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'level of proof'. General causation can be delivered on group basis. It concerns mainly the question if the substance can cause harm. Specific causation requires evidence that the substance did cause the plaintiff's harm. The distinction between both is important and using the concept explicitly has benefits.

Part VI analyses the most used scientific methodologies. It explains the impact of scientific uncertainty and the need to use probability. It also investigates if all probabilities can be expressed in figures and if general principle for the evaluation of uncertainty can be defined. The conclusion is that probability leads to the use of 'belief'. The judge, who has to judge, will finally have to decide what he believes. Is it possible to quantify this belief, or to put it in a formula?

Whilst the first six parts are more analytical than normative, the last part provides an assessment of the toxic tort system coupled with evaluations and suggestions. Lessons learned in the six previous parts are brought together in Part VII, from causation theories, over science in court, to the role of the courts. All are leading to various (normative) conclusions and suggestions for improvement in Part VIII, appreciation of what already exists and tips for legal practitioners.

Then a brief summary of this study is provided, together with some suggestions for further research specifically aimed at chemicals.

The sources of information can be found in part IX, structured following the nature of the sources: litigation, doctrine in books and articles and specific internet sources.

Part I - Chemicals in risk society: a social risk?

Exposure to chemicals can involve consumer products, pharmaceuticals, industrial chemicals, chemicals in the environment, waste, etc. In the Western judicial system people filing a claim of harm should provide evidence, in particular proof of a causal link between the exposures they have allegedly experienced and the specific harm that has incurred.

1.1 A risk society

"It is to be hoped, now that the precise source of the deleterious dust is known, that the precautions which can be taken by [...] men will overcome the risks of the past, and the problems of the proper assessment of damages to which these cases would have given rise had our decision permitted damages at all, may not again call for consideration in a similar form."⁴⁰

Risk and harm caused by chemicals are increasingly known. However, non-knowing is still as important.⁴¹ Scientists can determine risks posed by chemicals, but only as a probability. The effects of exposure to chemicals are partially unknown, as is the aetiology of the diseases these substances allegedly cause.

Toxic tort is an area of law that deals with harm caused by chemical substances. It is continuously confronted with (1) the ubiquitous exposure of humans to chemicals and (2) the alleged negative consequences of such exposure. Courts have to decide in cases of personal injury where the non-knowing is a menace to the proof of causation. The challenges related thereto are the subject of this dissertation.

1.1.1 Chemicals and life, a love-hate relationship

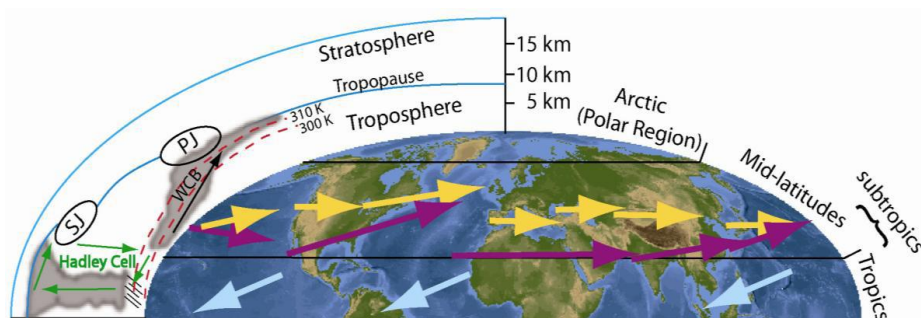
Chemicals are everywhere. They are used to manufacture nearly everything and to support our way of life and well-being. They are ingredients of the products we use and are ubiquitous in the environment. Some of these chemicals have accumulated in our bodies, most of the time without any visible negative effects.

⁴⁰ Judge Sellers in *Cartledge and Others versus Jopling & Sons Ltd*, [1963] 2 W.L.R. 210 (House of Lords January 17, 1963).

⁴¹ See Beck's analysis of the Chernobyl accident. BECK, U. (2009). *World at risk*. Cambridge: Polity Press, pp. 115-119.

Chemicals proved on top that they have a transboundary impact and are transported over long distances far away from their original source. They can travel vast distances by air or water and are also absorbed by wildlife and humans through the skin or ingested in food and water.

The intercontinental hemispheric transport of chemicals contributes to serious health problems and damages human health, environment and ecosystems globally.



The average location of the jet stream is shown across the entire Northern Hemisphere for winter (magenta arrows) and summer (yellow arrows); locations of the tropical easterlies are also shown (light blue arrows). Also shown are the winter locations of the 300 K and 310 K potential temperature surfaces (red).⁴²

POPs⁴³ have the potential for long-range transport⁴⁴ across continents. Even metals can be transported over long distances through the atmosphere. The levels of mercury in the Arctic are increasing every year.⁴⁵ High levels of these and other toxic substances, originating from the industrialised regions, are found in the Arctic, more particularly in Inuit and polar bears. Other substances are very persistent. For example, DDT remains present in the environment long

⁴² TASK FORCE on Hemispheric Transport of Air Pollution. (2010). *Hemispheric transport of air pollution 2010 - answers to policy-relevant science questions*. New York, Geneva: United Nations, p.9.

⁴³ Persistent Organic Pollutants.

⁴⁴ BENNETT, D. H. (2001, Vol. 35 No. 6). Predicting long-range transport : A systematic evaluation of two multimedia transport models. *Environmental Science & technology* , pp. 1181-1189.

⁴⁵ EUROPEAN ENVIRONMENT AGENCY. (2003, October). *Europe's environment: the third assessment*, European Environment Agency, Kiev,. Retrieved September 23, 2010, from European Environment Agency: reports.eea.europa.eu/environmental_assessment_report_2003_10/en?, p. 137.

after its use. In Belgium DDT⁴⁶ is still found in some chicken eggs and home grown vegetables, despite the fact that in our region this insecticide has now been forbidden for many years.

Knowledge on the impact of chemicals is growing. Much more is now known about the role of these substances in developing cancers. Toxicological research has shown mechanisms for a range of diseases whereby very low levels of exposure can influence the risk on developing the disease.⁴⁷ Two major classes of factors influence the incidence of cancer: hereditary factors and acquired (environmental) factors. The environmental factors include life style, infectious agents, certain medical treatments, and exposure to toxic substances. Some sources claim that environmental factors cause 75-80 % of all cancers.⁴⁸ Certain types of exposures are linked to specific cancers, but toxic chemicals can cause also other diseases than cancer.

Most of us know about the infamous example of Bhopal. The Bhopal disaster was caused by a gas leak in an industrial plant of Union Carbide India Ltd. During the night of 2 to 3 December 1984 poisonous gas (methyl isocyanate) and other chemicals used to produce pesticides, escaped. The toxicity⁴⁹ was such that a huge number of people died: 3500 victims immediately and more than 15 000 victims in the years thereafter.⁵⁰ On the longer term, even more people suffered

⁴⁶ Dichlorodiphenyltrichloroethane is one of the best known synthetic pesticides, banned worldwide for use in agriculture since the 1970s.

⁴⁷ For example, multiple toxicological studies have demonstrated that exposure to low doses of the chemical bisphenol A in utero can cause alterations that increase the risk of diseases such as diabetes, prostate cancer and breast cancer later in life.²⁷⁸ Or the case-control epidemiologic study that observed that girls exposed to DDT during puberty were five times more likely than controls to develop breast cancer when they reached middle age. For details see MASSEY, R., & JACOBS, M. (2013). *Global Chemicals Outlook - trends and indicators*. In E. KEMT, *Global Chemicals Outlook - Towards Sound Management of Chemicals* (pp. 2-108). Kenya: United Nations Environment Programme, p. 49.

⁴⁸ AMERICAN CANCER SOCIETY. (2014). *Cancer facts & figures 2014*. Retrieved from American Cancer Society: <http://www.cancer.org/acs/groups/content/@research/documents/webcontent/acspc-042151.pdf>

⁴⁹ Methyl isocyanate is very toxic by inhalation and can be absorbed through the skin. It is 500 times more poisonous than cyanide and five times more noxious than the phosgene gas used in World War I.

Sources: <http://cameochemicals.noaa.gov/chemical/1112>; Agency for Toxic Substances and disease registry, April 2002, <http://www.atsdr.cdc.gov/toxfaqs/tfacts182.pdf>; Bhopal's never ending disaster, *The Environmentalist*, 13 October 2011, www.environmentalisonline.com/article/2011-10-13/bhopal-s-never-ending-disaster.

⁵⁰ BBC News, (2010, June 7). *Bhopal trial: Eight convicted over India gas disaster*, http://news.bbc.co.uk/2/hi/south_asia/8725140.stm (accessed 20 March 2012).

from gas-related diseases, of which several were fatal.⁵¹ Still in 2001, 17 years after the explosion, leakages of chemicals from the Indian plant continued to contaminate the groundwater.⁵² In 2002, an inquiry proved the presence of lead, dichlorobenzene, dichloromethane and chloroform in nursing breast milk of Indian women.⁵³ These substances are toxic. Additionally, carbon tetrachloride was found, this substance is a carcinogenic.⁵⁴ Other chemicals that have been linked to various forms of cancer are present at 50 times above safety limits specified by the United States Environmental Protection Agency.⁵⁵

Bhopal combines an accident clearly caused by the gas, with long term damage due to the properties of the chemicals released into the environment in 1984 and later. Whilst liability for immediate damage was provable, it is much more difficult to prove the causal links between the gas explosion and the deaths 20 years later. It is unclear how tort law would have dealt with the latter. Indeed, in 1989 an out-of-court settlement was reached and the civil litigation was closed.⁵⁶ Criminal proceedings led in 2010 to a conviction of eight Indians, all former plant employees, for 'death by negligence'. They received sentences of two-year prison.⁵⁷

Another example, closer to home, of the danger of chemicals was the Seveso disaster. On 10 July 1976 an industrial accident happened in a small chemical

⁵¹ www.mp.gov.in/bgtrrdmp/profile.htm.

⁵² CHANDER, J. (2001, January - March Vol 7). Water contamination: a legacy of the union carbide disaster in Bhopal, India. *International Journal of Occupational and Environmental Health (Int J Occup Environ Health)*, pp. 72-73.

⁵³ AGARWAL, R., NAIR, A., & WANKHADE, K. (2002). *Surviving Bhopal 2002, Toxic Present - Toxic Future*. New Delhi: Shristi, p. 20-21, 40 and 50.

⁵⁴ BCC News, (2009, December 3). *Bhopal marks 25 years since gas leak devastation*. Retrieved March 20, 2012, from BBC News: http://news.bbc.co.uk/go/pr/fr/-/2/hi/south_asia/8392206.stm.

⁵⁵ BROUGHTON, E. (2005, May 10). *The Bhopal disaster and its aftermath: a review*. Retrieved March 20, 2012, from Environmental Health (vol 4): <http://www.ehjournal.net/content/4/1/6>.

⁵⁶ In a settlement mediated by the Indian Supreme Court, UCC accepted moral responsibility and agreed to pay \$470 million to the Indian government to be distributed to claimants as a full and final settlement. Source: BROUGHTON, E. (2005, May 10). *The Bhopal disaster and its aftermath: a review*. Retrieved March 20, 2012, from Environmental Health (vol 4): <http://www.ehjournal.net/content/4/1/6>, p. 3.

⁵⁷ BCC News, (2009, December 3). *Bhopal marks 25 years since gas leak devastation*. Retrieved March 20, 2012, from BBC News: http://news.bbc.co.uk/go/pr/fr/-/2/hi/south_asia/8392206.stm.

manufacturing plant in the north of Italy.⁵⁸ The result was that the people living in the neighbourhood of the plant were exposed to a high level of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).⁵⁹ After the disaster many studies were conducted on its effects. In 1991 the most evident adverse health effect ascertained was chloracne.⁶⁰ Other reversible early effects noted were peripheral neuropathy and liver enzyme induction.⁶¹ If, at that moment, victims filed a claim for these effects, it was feasible to prove causation and potentially receive compensation for the damage. Although dioxin was proved carcinogenic to humans a new study in 2001 observed no increase in all-cause and overall cancer mortality.⁶² Despite the discovery of an excess mortality from cardiovascular and respiratory diseases, a specific increase in gastrointestinal cancer and an excess of diabetes cases, the results were classified as not conclusive on the impact of dioxin exposure. Reasons were the lack of individual exposure data and the small population size for certain cancer types. The result of this study was bad news for victims willing to file a tort claim. Proving the causal links between the injury and the dioxin was at that time as good as impossible. In 2009, another study found a significant increase in "lymphatic and haematopoietic tissue neoplasm" as well as an increased incidence of breast cancer.⁶³ Victims willing to file a claim in tort can use such a study for proving causation.

The Seveso incident is a good example of the difficulties plaintiffs in toxic tort cases will encounter when trying to prove the alleged causal link between the exposure and the harm.

⁵⁸ This accident led to Directive 2003/105/EC of the European Parliament and of the Council of 16 December 2003 amending Council Directive 96/82/EC on the control of major-accident hazards involving dangerous substances, *O.J. L. 345, 31 December 2003, p. 97-105.*

⁵⁹ ESKENAZI, B., MOCARELLI, P., WARNER, M., & e.a. (2004, January Vol 112, nr. 1). Relationship of Serum TCDD Concentrations and Age at Exposure of Female. *Environmental Health Perspectives*, pp. 22-27.

⁶⁰ Chloracne is an acne-like eruption of blackheads, cysts, and pustules associated with over-exposure to certain halogenated aromatic compounds, such as chlorinated dioxins and dibenzofurans. JU, Q., ZOUBOULIS, C., & XIA, L. (2009, May-June). Environmental pollution and acne: chloracne. *Dermato Endocrinology*, p. 125.

⁶¹ BERTAZZI, P. A. (1991, July 1). Long-term effects of chemical disasters. Lessons and results from Seveso". 106 (1-2): 5-20. *The Science of the Total Environment*, pp. 5-20.

⁶² BERTAZZI, P. A., CONSONNI, D., BACHETTI, S., & e.al. (2001, June 1). Health Effects of Dioxin Exposure: A 20-year Mortality Study. *American Journal of Epidemiology*, p. 1042.

⁶³ PESATORI, A., CONSONNI, D., & RUBAGOTTI, M. (2009). Cancer incidence in the population exposed to dioxin after the "Seveso accident": twenty years of follow-up. *Environmental Health*, www.ehjournal.net/content/8/1/39.

Awareness that, for example, environmental chemicals have significant impacts on biological systems⁶⁴, plus the inadequacy of policies and laws to counter these risks, have led to new concepts of legislation putting more responsibilities on manufacturers, users or distributors of dangerous chemicals. This change started in 2001 in Europe with the development of the Regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).⁶⁵ This regulation was implemented in 2007 and is now joined by the CLP regulation⁶⁶, the regulation concerning plant protection products⁶⁷ and the regulation.⁶⁸ New chemical regulation is undoubtedly important in order to protect human health. Theoretically with the increased knowledge acquired as a consequence of legislation like REACH could help plaintiffs to prove causation. In practice, the possibilities to keep information secret is widely used. This discussion, however valuable cannot be part of this dissertation. To prove causation in tort remains a paramount obligation and causation in itself is the subject of the study.

1.1.2 The influence of social evolution and moral norms on liability

With all the new technologies and with the growing consciousness of the need to protect life and environment, an intelligent approach towards regulation is necessary. Regulators cannot disregard tendencies in society, like the increased power and influence of trans-national companies and industry, the globalization

⁶⁴ SCHUG, T., JANESICK, A., BLUMBERG, B., & HEINDELL, J. (2011, Vol. 127). Endocrine disrupting chemicals and disease susceptibility. *Journal of steroid biochemistry and molecular biology*, p. 204.

⁶⁵ REGULATION (EC) No. 1907/2006 of the European Parliament and Council Regulation of 18 December 2006 concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Regulation (EEC) nr. 793/93 and Regulation (EC) nr. 1488/94 as well as Directive nr. 76/769/EEC and the Directives 91/155/EEG, 93/67/EEG, 93/105/EG and 2000/21/EG, *O.J. L.* 30 December 2006, 396.

⁶⁶ REGULATION (EC) No 1272/2008 of the European Parliament and Council Regulation of 16 December 2008 concerning on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006, *O.J. L.* 31 December 2008, 353.

⁶⁷ REGULATION (EC) No 1107/2009 of the European Parliament and Council Regulation of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC, *O.J. L.* 24 November 2009, 309

⁶⁸ REGULATION (EU) No 528/2012 of the European Parliament and Council Regulation of 22 May 2012 concerning the making available on the market and use of biocidal products, *O.J. L.* 27 June 2012, 167.

of economy and politics, and the growing attention for Human Rights and ethical values. As Henk Ten Have stated

“The current revolution in science and technology has led to the concern that unbridled scientific progress is not always ethically acceptable.”⁶⁹

The Commission on the Ethics of Scientific Knowledge and Technology (COMEST) is one example of the overall growing interest in balancing economic and scientific interests with ethical (societal) standards. Protecting the human health, the environment and the sustainability rises on the agenda. Undoubtedly this influences non-contractual liability. Decisions in tort always have been more or less influenced by moral values and culture.

The growing importance put on protection against hazards is partially based in the evolution of our society into more and more risk aversion. The public is concerned about several scientific developments and about the impact of these developments on the quality life, rights and freedom. Not only has each new technology and each innovation its own particularities and its own set of risks, there are also differences in risk perception across countries, individuals and social groups.⁷⁰ The development and implementation of effective risk management is a challenge.

Another observation is that some societal actors hide information for the public. It is difficult for laymen to find, for example, information on synthetic biology, on new scientific knowledge concerning the spread of genetic material, on the dangers of processes perceived by the public as sustainable, like pyrolysis⁷¹ for biochar or on the presence of nanomaterial or toxic substances⁷² in products.

⁶⁹ TEN HAVE, H., e.a., *Ethics of Science and Technology, Explorations of the frontiers of science and ethics*, United Nations Educational, Scientific and Cultural Organization, France, 2006, p. 6, unesdoc.unesco.org/images/0014/001454/145409e.pdf (accessed on 11 March 2010).

⁷⁰ SMITH, R., *The Dangers of Risk aversion*, United Kingdom, The Royal Academy of Engineering, 2007, p. 4, www.raeng.org.uk (last visited on 20 March 2010).

⁷¹ Pyrolysis is a thermo-chemical decomposition of organic material at elevated temperatures without the participation of oxygen. It involves the simultaneous change of chemical composition and physical phase, and is irreversible. Pyrolysis produces combustible and often very toxic and carcinogenic substances. Most of the pyrolysis processes are very polluting. BUEKENS, A. (2010). *Verbranding - Vergassing - Pyrolyse*. Brussel: Vlaamse Universiteit Brussel, p. 18-21; HOPPENBROUWERS, M., & VAN DEN BERGH, C. (2011, December 23). Biochar in Vlaanderen? *Landbouw & Techniek*, p. 9.

⁷² HOPPENBROUWERS, M. (2011, 8.4). The Story of the Button on the Jacket - Substances of Very High Concern in Complex Products. *Journal for European Environmental and Planning Law*, pp. 353-371.

This attitude has an impact on the ability of laypeople suffering damage to prove causal links between a substance and the harm in a tort case.

On the other hand, the awareness and assertiveness of citizens is growing. Consequently more information and more influence on policy and law making is demanded and achieved. Command and control are no longer sufficient; they might even be contra productive.⁷³ In order to develop efficient and effective regulation other tools besides command and control have to be added.⁷⁴ Pure private initiatives lead to look-alike legislation and regulate activities. Enterprises and other organizations have already self-regulated nano-technologies and other corporate activities. Well known are the Nano-risk Framework developed in 2005 by DuPont and Environmental Defence⁷⁵, the ISO certification based on obligatory working standards⁷⁶ and the “Responsible Care” programme of the Chemical Industry⁷⁷. The latter aims at sustainable work methods in the chemical industry. Several leading chemical companies (like DuPont, Dow, Bayer, BASF and Solvay) committed themselves to high environmental standards, sometimes well above those set by law.⁷⁸

These initiatives are not legally enforceable, nor can their non-compliance be punished directly. Although with the rise of principles of proper corporate governance and corporate social responsibility the potential for holding (parent) companies responsible, and thus liable, for damages has *de facto* increased.⁷⁹ Breaching these agreed upon policies can eventually be classified as a breach of the duty of care, which can be used in liability cases.

All these initiatives will have or already have an impact on liability and on proof thereof.

Thus, if formal international or national regulation does not keep up with the scientific evolution, these private initiatives will likely be setting the rules, with

⁷³ BROWNSWORD, R. (2008). *Rights, Regulation, and the Technological Revolution*. Oxford University Press, pp. 12, 284 and 291.

⁷⁴ BROWNSWORD, R. (2008). *Rights, Regulation, and the Technological Revolution*. Oxford University Press, p. 15.

⁷⁵ www.nanoriskframework.com.

⁷⁶ www.iso.org.

⁷⁷ INTERNATIONAL COUNCIL OF CHEMICAL ASSOCIATIONS, Responsible Care, www.icca-chem.org/ (accessed on 27 March 2012).

⁷⁸ www.responsiblecare.org/page.asp?p=6406&l=1.

⁷⁹ PAK, W.Q., & BERGKAMP, L. (2001, Vol. 8). Piercing the Corporate Veil: Shareholder Liability for Corporate Torts. *Maastricht Journal for European and Comparative Law*, p. 179.

consequences for non-contractual liability. A combination of self-regulation and “traditional” legislation might be the best solution. As Brownsword stated:

“regulators do not have to claim that the standard set is right... regulators must demonstrably try to do the right thing relative to the community’s particular moral commitment”.⁸⁰

Therefore various non-legal guidelines and instructions (e.g. ECHA guidelines on REACH interpretation), as well as private initiatives like standard setting (Equator Principles of the banks) or guidelines (European technology platform for Sustainable Chemistry (SusChem)) will increasingly play a role in toxic tort cases. It is thereby important to assess the influence these non-legal elements might have in future, especially on court decisions or (new) policies.

1.1.3 Without hazard and risk no liability and tort

“We each have a right that other people not impose risks of harm upon us”⁸¹

Hazard and risk are important elements in chemical liability cases. The two concepts are easily confused, whilst the difference is essential also in tort. Without hazard harm is not possible and without risk there will be no damage. Hazard is the capability of a substance to cause an adverse effect. Risk is the probability that a hazard will occur.⁸² The materialisation of a risk most of the time happens when certain specific exposure conditions are met. For example, somebody may suffer a disease as a result of being exposed to a hazardous chemical, but it is also possible that somebody else does not develop any negative effects from the same exposure. For example multiple reports indicate that some individuals are more susceptible to mesothelioma than others:

“Further, widespread exposures to asbestos, particularly environmental exposures in some parts of the world, combined with the rare incidence of mesothelioma, suggest that there may be susceptible individuals”.⁸³

⁸⁰ BROWNSWORD, R. (2008). *Rights, Regulation, and the Technological Revolution*. Oxford University Press, p. 127.

⁸¹ HANDFIELD, T., & PISCIOTTA, T. (2005, Vol. 11 Issue 4). Is the Risk-Liability Theory compatible with negligence law? *Legal Theory*, pp. 387–404; McCARTHY, D. (1997, January Vol. 107). Rights, Explanation, and Risks. *Ethics*, p. 208.

⁸² DRAGGAN, S. (2007, May 20). *Risk assessment of chemical substances*. Retrieved December 29, 2011, from The Encyclopedia of Earth: www.eoearth.org/article/Risk_assessment_of_chemical_substances.

⁸³ CHRISTENSEN, B. C., GODLESKI, J. J., ROELOFS, C. R., & e.al. (2008, June). Asbestos Bruden Predicts Survival in Pleural Mesothelioma. *Environmental Health Perspectives*, p. 726.

Indeed, the majority of people exposed to asbestos does not develop mesothelioma.⁸⁴ The hazard was there, but the risk did not materialize.

Risk is a frequently used concept in new chemical legislation. This is not surprising, since law aims at regulating future happenings. However a definition of risk could not be found. Apparently risk gets its meaning in relation to the characteristics of its source. ECHA confirms this assumption when it states that:

“[...] it depends on the chemical and how much of it you are exposed to. Even water is dangerous if you drink too much of it in one go. On the other hand, a very small exposure to very dangerous chemicals like cyanide can have disastrous effects on your health.”⁸⁵

The risk of a chemical is related to its hazard and the exposure to the substance. The term ‘risk’ has usually a negative connotation. Risk can however be considered as acceptable. This depends on perception and culture of the people involved.

The word risk is regularly used. In REACH it is mentioned 264 times, without ever defining it. Neither could a definition be found in the regulation on biocidal products, where risk appears 132 times.⁸⁶ Risk assessment and risk management receive a meaning by their purpose. They are important forming the basis for several obligations. REACH is the first regulation to impose specific assessment and management obligations. In the proposal for a new regulation on biocides risk assessment is also an important obligation. Risk assessments identify and evaluate one or more toxic hazards including carcinogenic, mutagenic, endocrine disrupting, toxic for reproduction. In fact, risk assessment defines the hazard. Then risk management typically follows by setting up a structure to control the dangers identified through the assessment.

⁸⁴ NATIONAL CANCER INSTITUTE. (n.d.). *Factsheet: Asbestos exposure and cancer risk*. Retrieved March 20, 2012, from National Cancer Institute: <http://www.cancer.gov/cancertopics/factsheet/Risk/asbestos>.

⁸⁵ echa.europa.eu/web/guest/are-they-safe- (accessed 21 February 2014).

⁸⁶ REGULATION (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products, O.J.L. 27 June 2012, 167/1.



Source: Risk assessment of chemical substances⁸⁷

Beck has elegantly formulated:

“Risk amalgamates knowledge with non-knowing within the semantic horizon of probability.”⁸⁸

Risk is the result of knowledge; it is a side effect of successful modernization. People themselves have created the conditions of manufactured, self-inflicted insecurity.⁸⁹ More science does not lead to less risk. It makes the perception of risk more acute and visible.⁹⁰ The more we know the more we are aware of risks.

This analysis can be translated to toxic tort. Risk as the source of damage, or (maybe) as the damage in itself results into more tort claims based on damage caused by the benefits of industrialization and knowledge.

Legislation with obligations to assess and manage risk of chemical substances obliges producers and professionals users or distributors to investigate more on the characteristics of their chemicals. Knowledge will improve, knowledge that subsequently can be used in toxic tort cases. The combination of liability (ex post) and regulation (ex ante) makes risk controllable and maybe refundable.⁹¹

⁸⁷ DRAGGAN, S. (2007, May 20). *Risk assessment of chemical substances*. Retrieved December 29, 2011, from The Encyclopedia of Earth: www.eoearth.org/article/Risk_assessment_of_chemical_substances.

⁸⁸ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 7.

⁸⁹ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, pp.7-8.

⁹⁰ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 8.

⁹¹ BERGKAMP, L. (2001, September 14). *The Commission July 2001 Working Paper on Environmental liability: Civil or administrative law to prevent and restore environmental harm?* Retrieved from, Available at SSRN, p 21.

1.2 Chemicals and tort: the development of a legal domain

Tort law strives to connect liability with culpability. The term 'tort' is not universally used. It is typically used in the Common Law. Whilst Continental Law mostly refers to 'non-contractual liability', the European Group on Tort Law employs the term 'tort', as one might expect already from their name.⁹² In this study the term 'tort' will be used.

Chemical liability or toxic tort concerns liability claims for personal injury arising from (alleged) exposure to chemical substances. 'Toxic torts' is also described as involving injuries caused by exposure to environmental toxins.⁹³ Toxic tort cases deviate from standard tort in the sense that the proof of causation is particularly difficult.

Damages caused by chemicals typically occur after a long period of latency between exposure and noticeable injury and therefore such tort cases mostly revolve around the issue of causation.⁹⁴ Scientific expert advice on causation is, apart from a few exceptional situations, always necessary.⁹⁵ Ordinarily courts did not have to understand science. Why this has changed is explained in the brief history of tort.

1.2.1 A brief history of tort

Although liability for damage caused to another person is a very old concept, it changed over the years. In order to understand the emergence of toxic tort, an outline of the evolution of tort as influenced by society is useful. Indeed, as from the start tort litigation was governed by the particularities of the case at hand as these were appreciated by society, its culture and its norms.

In Continental Law the systematisation of tort started around the Napoleonic era.⁹⁶ However, the different European jurisdictions took varying positions.⁹⁷ For

⁹² VON BAR, C. (2009). *Principles of European Law on Non-contractual Liability arising out of Damage caused to Another*. Munich: Sellier, p 244.

⁹³ KLEIN, A. (2008-2009, Vol. 49). Causation and uncertainty: making connections in a time of change. *Jurimetrics*, p. 6

⁹⁴ AMERICAN JURISPRUDENCE. (2012, February). Products Liability - toxic products. *American Jurisprudence*, p. 63 Am. Jur. 2d Products Liability § 71.

⁹⁵ Accidental exposure can be such an exception if the effect of the exposure is immediately observable. For example the contact with a corrosive chemical leading to immediate injuries of the skin.

⁹⁶ ZWEIGERT, K., & KOTZ, H. (1998). *An introduction to comparative law*. Oxford: Clarendon, p 615.

⁹⁷ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer.

example the meaning of wrongfulness differs between countries.⁹⁸ In some countries the result of the act should be wrongful, whilst in others the behaviour should be classified as wrongful. Dutch law refers to behaviour, whilst German law focuses on result. In France fault and wrongfulness are no longer fully separate.⁹⁹

The Common Law of Torts did not start with a theory.¹⁰⁰ First it had specific types of liability comparable to Roman law, but already in the 13th century developed into the writ system.¹⁰¹

Then, in 1611 a British court decided for the first time that a non-trespassory invasion of property could be actionable if it interfered with someone's quiet enjoyment of his land.¹⁰² This evolution is important as it was the start of the protection of rights without the need to have a fault on the side of the actor. A concept that also is important in toxic tort, namely when damage is caused by negligence without fault.

Thereafter a new era started with the first industrial evolution. The production of mass products became possible through the development and use of new production processes and machinery. The side effect that filth and smoke were emitted went unnoticed because the welfare brought by the products was overwhelming.¹⁰³

In the 19th century it was believed that an improvement in welfare could not happen without causing some hardship and damage to some individuals. If an act was performed with the necessary care and fault was lacking, the loss would stay where it fell. A person could not be held liable unless he acted negligently or faulty.

The former changed in the 20th century. Some of the results of the industrial activities, were considered to create an unbalance between the victim harmed

⁹⁸ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, p. 24.

⁹⁹ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, p. 25-26.

¹⁰⁰ HOLMES, O. (1881). Torts - Trespass and Negligence. In O. HOLMES, *The Common Law* (pp. 77-129). Boston: Little Brown and Co, p. 77.

¹⁰¹ <http://www.lawteacher.net/english-legal-system/lecture-notes/equity.php> (accessed 23 February 2014).

¹⁰² Aldred's case, 77 E.R. 816 (Court of King's Bench January 1, 1610).

¹⁰³ SPILHAUS, A. (1971, Vol. 115, issue 4). The next industrial revolution. Proceedings of the American Philosophical Society, p 324

by the activity and the professional actor. An example is the sale of a defective product. The person who bought the defective product and got harmed by it, was considered a victim having no or little defence against the more powerful manufacturer. In such cases society considered it too harsh to require plaintiffs to prove negligence or fault on behalf of the actor. Strict liability or no-fault liability was implemented for specific activities.

As time went on, increased knowledge of chemicals created new possibilities.¹⁰⁴ Chemicals became more widely and consciously used. All kind of chemicals were made: pesticides, herbicides, fertilizers, pharmaceuticals, plastics, etc. Some of these were noxious to the biological system. At first this went by unnoticed. It took however several years before the dangers of some chemical substances became apparent. In the early years of the 20th century science entered the court room.

The increasing knowledge of hazardousness of substances runs parallel with the evolution of science and the availability of information. Gradually people become more aware of the negative impact of some chemicals and the harm that results from exposures to these substances. Today scientific knowledge on the presence of (environmental) chemicals in the human body that is communicated to the public, influences the perceptions of the issues related thereto.¹⁰⁵ Information is more publicly available, since non-governmental and governmental organisations circulate results of scientific studies. The fact that these studies come with uncertainties is often overlooked by the public. Communication of environmental or chemical crises by modern media influences the perception and appreciation.¹⁰⁶

Chemicals and exposure to these substances is nowadays a sensitive issue, worrying people in many instances. It is logical that an increase in jurisdiction

¹⁰⁴ SPILHAUS, A. (1971, Vol. 115, issue 4). The next industrial revolution. Proceedings of the American Philosophical Society, p 324.

¹⁰⁵ GASIOR ALTMAN, R., MORELLO-FROSCH, R., GREEN BRODY, J., RUDEL, R., BROWN, P., & AVERICK, M. (2008, Vol. 49, issue 4). Pollution Comes Home and Gets Personal: Women's Experience of Household Chemical Exposure. *Journal of Health and Social Behavior*, pp. 417-435.

¹⁰⁶ GASIOR ALTMAN, R., MORELLO-FROSCH, R., GREEN BRODY, J., RUDEL, R., BROWN, P., & AVERICK, M. (2008, Vol. 49, issue 4). Pollution Comes Home and Gets Personal: Women's Experience of Household Chemical Exposure. *Journal of Health and Social Behavior*, pp. 417-435.429

results. This evolution is not restricted to one region or continent. It is a universal trend.

Add to the former the financial strain of increasing numbers of chemically caused diseases put on Social Security systems (as they are mainly present in Continental Europe) recourse to court becomes more probable. Today the social insurance system still takes care of most people when they develop a serious disease. It should however not be ignored that the system does not reimburse all costs resulting from such harm. Whilst in the past the incentive might have been too low to activate people to go to court for the non-covered costs, this might change when the benefits provided by the health care system are reduced.

1.2.2 Chemicals in tort: a 'new' challenge

The earliest (environmental) legislation was mainly focused on obligations and the compliance thereof. Environmental issues were considered to be local and observable. For example during the industrial revolution coal became the common and widespread generator of power. Air pollution by industrial plants was one of the observable consequences. Coal mining activities contaminated soil, often to such an extent that an effect on plant growth was noticeable. Consequently, regulators adopted laws to counter visible pollution.

In the beginning of the 20th century Judge Holmes noted that the claim in the case before him would necessarily have failed if it had been brought 50 years before, due to an absence of visible causing factors.¹⁰⁷

The public only gradually became aware of the potential harm that 'invisible' chemicals can cause. In the 1960s the first concerns about the effects of some chemicals emerged. The book of Rachel Carson, *Silent Spring*, was alerting for the negative impact of some pesticides (like DDT) on the environment and especially on birds.¹⁰⁸ Discussing the court cases concerning DDT her book raised the level of information and awareness amongst 'ordinary' people. *Silent Spring* was not accepted by the chemical industry, but it reversed the US national pesticide policy, led to a nationwide ban on DDT for agricultural uses,

¹⁰⁷ *Missouri versus Illinois*, 202 U.S. 598 (Supreme Court of the United States May 28, 1906).

¹⁰⁸ CARSON, R. (1962). *Silent Spring*. Houghton Mifflin.

and was at the basis of the creation of an environmental movement that led to the U.S. Environmental Protection Agency.¹⁰⁹

What was the cause of that influential book?

Aerial spraying of Long Island's lands, homes, gardens, and orchards with a mixture of DDT and kerosene was performed in order to eradicate the gypsy moth, an insect injurious to forests.¹¹⁰ A claim was filed. In court the extent of the danger of DDT to human health was under dispute amongst the experts.¹¹¹

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Plaintiffs lost the case. The Court of Appeals confirmed the decision but granted the plaintiffs the right, to gain injunctions against potential environmental damage by DDT in the future.¹¹³ Decades later epidemiological studies supported the conclusion that DDT is also toxic for humans.

Ten years later another warning was delivered in the book of the 'Club of Rome' 'The limits to growth'.¹¹⁴ It warns us not only for the limits of growth, but also for pollution by chemicals. Again DDT is given as an example.

1.2.3 Toxic tort and its role in contemporary society

In the US toxic tort, as the tort dealing with liability for harm caused by chemicals, has become a specialised area of law. Also in Europe, as in the other parts of the world, tort claims filed in relation to chemical harm are increasing. About 47 000 persons die every year as a result of such poisoning. Many of

¹⁰⁹ PAULL, J. (2013, July-September). *The Rachel Carson Letters and the making of Silent Spring*. SAGE Open, pp. 1-12.

¹¹⁰ The spraying consisted of one pound of DDT in one gallon of kerosene base solvent, applied at the rate of one gallon per acre. See: Murphy et al. versus Butler et al., 362 U.S. 929 (Supreme Court of the United States March 28, 1960).

¹¹¹ The District Court made the finding that:

"DDT may cause illness if ingested in massive doses, there is no danger to health in a spray of one pound per acre." Whilst also concluded that:

"One may readily comprehend the reaction of the resident, drenched with the spray, a mixture of DDT and kerosene oil, while walking to the railroad station as well as the attitudes of those meeting with similar experiences at or near their homes. It would seem that the plaintiffs' major complaint is of annoyance, rather than damage."

Murphy, et al. versus Benson, et al., 164 F.Supp. 120 (US District Court, E.D. New York June 23, 1958).

¹¹² Murphy, et al. versus Benson, et al., 164 F.Supp. 120 (US District Court, E.D. New York June 23, 1958).

¹¹³ Murphy, et al. versus Benson, et al., 270 F.2d 419 (US Court of Appeals, Second Circuit October 1, 1959).

¹¹⁴ MEADOWS, D., MEADOWS, D., RANDERS, J., & BEHRENS, W. (1972). *The limits to growth*. New York: Universe Books.

these poisonings occur in children and adolescents, are unintentional (“accidental”), and can be prevented if chemicals were appropriately stored and handled. Chronic, low-level exposure to various chemicals may result in a number of adverse outcomes, including damage to the nervous and immune systems, impairment of reproductive function and development, cancer, and organ-specific damage.¹¹⁵ Despite this knowledge Continental Law has not yet a structured approach to toxic tort. Chemical liability cases deal mainly with signature diseases (like mesothelioma) or pharmaceuticals.

But the principles of tort did not change.

The facts and circumstances of tort litigation become more and more complex and the question is if the actual legal system can deal with new claims like chemical liability. Should existing liability systems radically change to protect the core interests they claim to protect? Some environmental contaminations cause personal injury, but are also

“a wrong not only to those who happen to be within the radius of danger, but to all who might have been there – a wrong to the public at large”.

The former was said by Judge Andrews in a case on negligently assisting passengers onto a crowded train.¹¹⁶ He could have said it in a chemical liability case. However, it does not help a tort claim if the wrong is considered ‘a wrong to the public at large’. Liability litigation is in principle about individuals. The harm is translated to the individual situation and not to public damage. Although especially the ‘modern’ tort doctrine of ‘law and economics’ takes into account the impact of tort on society, the common good of society is mainly governed by policies.

What then differentiates toxic tort? The specificity is mainly linked to causation. Long elapse times make it difficult to connect damage to specific facts and circumstances in the past. The longer the latency period of an injury, the more likely that multiple causes can be found and the harder it is to reconstruct the factual circumstances.

¹¹⁵ <http://www.who.int/ceh/risks/cehchemicals/en/>

¹¹⁶ *Palsgraf versus Long Island Railroad Co.*, 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928).

On top, damage often occurs in locations outside the 'neighbourhood' perimeter where the source of the damaged originated. Environmental pollution is seldom coming from one tortfeasor or damaging one location. It is also typical for chemicals that the toxicity increases or changes by accumulation of (different) substances coming from several different sources.

Of course, all former difficulties can aggregate in one casus. A familiar example is cancer. The U.S. Environmental Protection Agency calculated that burning one quarter of one ton of wood produces the same amount of mutagenic particles as driving 13 gasoline-powered cars for 16 000 kilometres using 11 litre per 100 kilometres.¹¹⁷ Could this be used as an argument in a liability case? Surely a defendant could claim that the plaintiff is injured by burning wood and not by the pollution created by traffic congestion in front of the plaintiff's home.... The exposure to chemicals, including toxins, continuously increases.

Nowadays we are exposed to increasing amounts of chemicals from a variety of sources. They can be found in food, water, medicines, air, cosmetics, health care products, clothing and other consumer products.¹¹⁸ In fact we are exposed to a cocktail of chemical substances. Any adverse effect may be due to the mixture as a whole or to the separate individual chemicals.

Add to the former that the number of parties involved in liability cases augments and that causal uncertainty and the lack of scientific knowledge, plus the inclusion of the precautionary and prevention principle it becomes clear that liability concepts need to be studied and assessed if one does not want to run remediless behind the economic and societal evolution.

In the Common Law system several suits have frustrated judges. The complexity of claims involving toxic harm or environmental damage, are immense and have significant policy implications.¹¹⁹ The attention moves from a focus on actions between particular parties to a focus on activities with a general and potentially

¹¹⁷ MARSCHY, Leila. (2010). *The new Biomasters, Synthetic Biology and the new assault on Biodiversity and Livelihoods*. ETC Group.

¹¹⁸ <http://echa.europa.eu/web/guest/chemicals-in-our-life/hot-scientific-topics>

¹¹⁹ KYSAR, D. A. (2011, Vol 41 Issue 1). What climate change can do about tort law. *Environmental law* , p. 4.

harmful impact. Kysar reckons that the common law system is evolving to a device for deterring socially undesirable conduct.¹²⁰

1.3 Is not everything a chemical? Narrowing the research topic

The change in management rules concerning chemicals started with REACH, but other legislation will continue to put more and more responsibility on professionals producing and/or using chemicals. The image below refers to the 10 most toxic substances or groups of chemicals as they are identified by the World Health Organisation (WHO). It is clear that also in our society many of those substances are present.



Source: WHO – the 10 chemicals or groups of chemicals that are of major concern. www.who.int/ipcs/assessment/public_health/chemicals_phc/en/

However, knowledge on the presence and the potential risk of chemicals is not enough to prove the actual harm by these substances. Major challenges in this respect are: the separation of the contribution of the chemical in comparison with other agents. This is especially important in view of the multi-factorial nature of most diseases.¹²¹ Clearly chemical liability is a complex topic that needs delineation. The following three paragraphs define chemical substances, exposure to chemicals and actors in liability cases.

¹²⁰ KYSAR, D. A. (2011, Vol 41 Issue 1). What climate change can do about tort law. *Environmental law*, p. 45.

¹²¹ DENISON, R. A. (2007). *Not that innocent: a comparative analysis of Canadian, European Union and United States policies on industrial chemicals*. Washington: Environmental Defense, pp. 1-9.

1.3.1 What is a chemical substance?

Before going into the analysis of toxic tort it is important to agree upon a definition of a chemical. The meaning of the word depends on the situation it is used in and/or on the person using it. It can be said bluntly that everything is a chemical. Living organisms consist of chemicals. Matter consists of chemicals. This broad meaning of the term cannot be used when referring to toxic tort. Following circumscription is used in the dissertation.

Firstly, a chemical or a chemical substance is any material with a definite chemical composition. Meaning that the chemical is or a pure chemical element, or a particular set of molecules or ions.

A chemical can be a natural substance or a man-made one. Fact is that there are millions of organic and inorganic chemicals.¹²² Each year new chemicals are created and produced.

Chemicals can be combined. When they react with each other a new chemical is created and the original substances are "lost". When chemicals are brought together in a mixture, there is no reaction between the substances and each chemical keeps its original characteristics and profile. All these chemicals can be the subject of a tort claim. Most chemicals are beneficial, others can be harmful. Some are explosive, flammable, radioactive, corrosive, etc. The chemicals of interest for this study are substances that (allegedly) caused damage. In that sense they are toxic.

Toxicity normally refers to properties as carcinogenic, teratogenic, mutagenic, etc. In some cases chemicals can be noxious just by the amount of substances exposed to. A bit like drinking too much water at once is also toxic. The term 'toxic' is thus not equal, although similar, to the meaning of toxic in chemistry and chemical legislation.

1.3.2 Exposure

Until recently, the general opinion was that exposure to these chemicals was limited and unlikely outside of professional settings.¹²³ However, Industrial chemicals are widespread.

¹²² CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. 160.

It now is clearly proved that chemicals have accumulated in the environment and in our bodies and these substances are not always innocent. In 2003, the European Commission wrote that 70 % of the new chemical substances assessed then, showed to have one or more dangerous properties. A significant part of these chemicals will enter the environment in quantities high enough to cause adverse effects.¹²⁴ Thereby we should not forget that humans can be contaminated by chemicals via the environment, i.e. water, air, contaminated soil, by inhaling, swallowing, and skin contact. Contamination can also happen via food, when the chemicals are taken up by crops, vegetables, and wild and farm animals.¹²⁵

¹²³ DENISON, R. A. (2007). *Not that innocent: a comparative analysis of Canadian, European Union and United States policies on industrial chemicals*. Washington: Environmental Defense, p iii.

¹²⁴ EUROPEAN COMMISSION. (29 October 2003). *Extended Impact Assessment, COM(2003)644 final, Commission staff working paper, "Regulation of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restrictions of Chemicals (REACH)*. Brussels: SEC(2003)1171/3, p.27.

¹²⁵ EUROPEAN COMMISSION. (29 October 2003). *Extended Impact Assessment, COM(2003)644 final, Commission staff working paper, "Regulation of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restrictions of Chemicals (REACH)*. Brussels: SEC(2003)1171/3, p. 28.

Part II – The essence of tort

"Every institute and principle of law has a philosophy - as every object in the sun has its attendant inseparable shadow. Nowhere is the need for theoretical clarity more urgent than in tort law".¹²⁶

Tort or personal injury law is ordinarily described as dealing with events, arising out of an activity or omission¹²⁷ of a party, causing damage to another party.¹²⁸

A more comprehensive definition describes tort law in the following manner:

"[T]hat body of law which is directed toward the compensation of individuals rather than the public, for losses which they have suffered within the scope of their legally recognized interests generally, rather than one interest only, where the law considers that compensation is required."¹²⁹

This damage can be harm to a person, damage to property, to economic/non-economic interests, occurring in circumstances where it is justified to ask compensation from the party who acted or failed to act and consequently caused the negative outcome.¹³⁰

The definition above comes from US Common Law. However, it will be used as the starting point for this study, especially since in the European/Continental system there is no general definition of tort. Walter Van Gerven is convinced that the concept of tort is formed by the rules that are used when determining in which circumstances a loss can be shifted to a person other than the victim.¹³¹ Following his opinion, it is necessary for an understanding of the tort system to analyse its objectives. The first chapter of this part will analyse the objectives.

Most legal systems differentiate, at least in theory, between intentional and non-intentional tort. If there is a lack of proximity or if the plaintiff could not have foreseen the damage, the defendant is generally only held negligent if he

¹²⁶ WIGMORE, J. (1912). *Select cases on the law of torts*. Boston: Little, Brown and company, p. 465.

¹²⁷ An omission is a failure to act.

¹²⁸ This definition will be used in this essay.

¹²⁹ PROSSER, W., KEETON, R., DOBBS, D., & OWEN, D. (1984). *Prosser and Keeton on Torts*. St. Paul: West Publishing C, pp. 5-6.

¹³⁰ VAN GERVEN, W. (2000). *National, Supranational and International Tort Law*. Oxford: Hart Publishing, p. 13.

¹³¹ VAN GERVEN, W. (2000). *National, Supranational and International Tort Law*. Oxford: Hart Publishing, p. 13.

intended to cause harm.¹³² For example, if the plaintiff knowingly breached the safety rules for handling a chemical, but did not realize or should not have realized that his neighbours living 5 kilometre away would be harmed, then the defendant is only liable for resulting damage if he wanted harm to result. How important the distinction between intentional and non-intentional tort is, will be analysed in the following chapter.

Then chapter 3 analyses the aspects of tort on the basis of their importance in relation with causation and the issues of proof relating to personal injury, namely negligence. The concept of negligence is rather vague and flexible. The characteristics of negligent behaviour are analysed in the first paragraph, followed by a second paragraph containing a more detailed analysis of the 'duty of care' as a decisive element in tortious liability. Thereby foreseeability and proximity as important concepts defining the duty of care are not forgotten. The chapter ends with a subject especially relevant in relation to toxic chemicals, namely the duty of care towards third parties or damage caused by secondary exposure.

Finally, the concluding chapter connects the former analysis to specificities of liability for chemical substances.

2.1 Tort's objectives

Tort is most often approached in a practice oriented way.¹³³ Tort theories however give meaning and structure.¹³⁴ It is therefore important to analyse at least the two theories that currently dominate the area of tort, namely 'law and economics' and 'corrective justice'.¹³⁵ This analysis does not go into the

¹³² Hathaway versus Tascosa Country Club, Inc., 846 S.W.2d 614 (Court of Appeals of Texas, Amarillo March 1, 1993); Thompson versus McNeill, 559 N.E.2d 705 (Supreme Court of Ohio August 15, 1990).

¹³³ CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, p. 13.

¹³⁴ CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, p. 13.

¹³⁵ CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, pp. 14-15; CALABRESI, G. (2007, October). Toward a unified theory of torts. *Journal of Tort Law*, pp. 1-10; ROBINETTE, C. (2005, Spring). Can there be a unified theory of torts? A pluralist suggestion from history and doctrine. *Brandeis Law Journal*, pp. 369-409; POSNER, R. (1997, Vol. 17). The future of the Law and Economics movement in Europe. *International Review of Law and Economics*, pp. 3-14; SCHWARTZ, G. T. (1997, June). Mixed theories of tort law: affirming both deterrence and corrective justice. *Texas Law Review*, pp. 1801-1835.

discussions on the compatibility of the different objectives. Liability law in practice often pursues mixed objectives at the same time.¹³⁶ Consistency between court decisions is in some countries more of a problem, but that is also not in itself the object of this research.¹³⁷ Neither does the analysis attempt to give a full and detailed overview on the varieties of both theories; it aims at giving a background for the analysis of causation in chemical liability.

2.1.1 What is the objective of tort?

The overall principle is that when a person is damaged, that person should bear the loss himself, regardless of who caused the damage. However, an exception to this rule exists since long. In cases where a person damages another person, the latter should be compensated by the first, on condition there exists a legal basis for shifting the loss.¹³⁸ This implies that lawful damage is not compensated. The shift of loss to the causing person is based on tort law and that system is one of the means the state has to make and keep society viable and, at the same time, minimize some types of disruptive behaviour and activity.¹³⁹ In fact tort aims to adequately protect physical security while also allowing risky behaviour.¹⁴⁰

Consequently tort law can be described as one of the social institutions enabling the achievement of human goals.¹⁴¹ Liability shifts a loss caused by one person

¹³⁶ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International; CHAPMAN, B. (2001). Pluralism in tort and accident law: towards a reasonable accommodation. In G. POSTEMA, *Philosophy and the law of torts* (pp. 276-322); GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G. POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press;

¹³⁷ POSTEMA, G. (2007). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press, pp. 469-474; GEISTFELD, M. (2003, March). Negligence, compensation and the coherence of tort law. *Georgetown Law Journal*, pp. 585-624; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, pp. 117-118.

¹³⁸ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer; BIRKS, P. (2001 (reprinted)). The concept of a civil wrong. In D. OWEN, *Philosophical foundations of tort law* (pp. 29-52). Oxford: Oxford University Press, pp. 31-33.

¹³⁹ HONORE, T. (2001 (reprint)). Necessary and sufficient conditions in tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 363-385). Oxford: Oxford University Press. p. 76.

¹⁴⁰ GEISTFELD, M. (2003, March). Negligence, compensation and the coherence of tort law. *Georgetown Law Journal*, p. 587.

¹⁴¹ CANE, P. (1997). *The anatomy of tort law*. Oxford: Hart Publishing, p. 205.

to another person on the basis of the latter's responsibility for causing the damage.¹⁴²

The objectives of tort law are numerous: compensation, distribution of losses, allocation of risks, fairness, vindication, wealth distribution, deterrence and prevention, etc.¹⁴³ Some of these are however rather consequences of the application of tort than of its objectives. Indeed, an objective should explain the structure and the substantive rules of a system.¹⁴⁴ Compensation, for example, does not. Tort focuses on the obligation of the tortfeasor to repair the damage he unjustly inflicted and not on the entitlement of the victim to receive compensation. In other words, a plaintiff will only receive compensation if the responsible defendant is found and held liable.¹⁴⁵ Compensation is thus a function of tort.¹⁴⁶ It supports both an economic goal and an objective of justice. The first by forcing the defendant to repair the damage he caused and deterring him and others from similar behaviour. The second by restoring the balance between the tortfeasor and his victim. 'Law and economics' and justice translate the overall abstract goal of rehabilitation of the victim into concrete purposes of tort law.¹⁴⁷

¹⁴² BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, pp. 70.

¹⁴³ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 477; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 70.

¹⁴⁴ GEISTFELD, M. (2012, Winter). The coherence of compensation-deterrence theory in tort law. *DePaul Law Review*, pp. 387, 395, 397; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 71; KEATING, G. (1996, Vol. 48). Reasonableness and Rationality in negligence theory. *Stanford Law Review*, pp. 349-360; *McCarty versus Pheasant Run, Inc.*, 826 F.2d 1554 (United States Court of Appeals, Seventh Circuit July 22, 1987).

¹⁴⁵ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 477.

¹⁴⁶ COLEMAN, J. (1995). *Risks and Wrongs*. Cambridge: Cambridge University Press, p. 209; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, pp. 71.

¹⁴⁷ Critical theory is not studied in this research although it is an interesting approach. Critical theory is fundamentally interdisciplinary, and thus outside this research. For those interested to know more about this topic following book is interesting: CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, p. 13.

The economic theory has since decades a considerable influence and will be analysed first. In the second paragraph the focus is on 'distributive' and 'corrective justice', as the other important viewpoint.¹⁴⁸

2.1.1.1 Law and economics

In the theory of law and economics tort law is seen as a system of rules aimed at maximizing wealth and minimizing costs associated with activities.¹⁴⁹ Not only should victims of tortious acts be compensated, the societal costs should also be minimized.¹⁵⁰

Although the origin of law and economics lies in the US, the core of the doctrine is similar anywhere in the world. The economics part of the theory provides a basis for understanding different legal doctrines and systems. There is less functional variety between legal systems than there is doctrinal and institutional variety.¹⁵¹ The economic language is common to the four countries in the study. The former does not imply that all four use this approach. The Netherlands is probably the country on the European continent that is most open to law and economics. In the French system the application of the theory is difficult. The doctrine is perceived as contrary to the French legal culture and tradition. The Civil Code and the freedom of decision judges have are believed to be the main reasons why law and economics is not popular in France.¹⁵² Law and economics has been described as the contrast between the 'American individualism' and the 'French social contract'.¹⁵³ France rather focusses on the principle of distributive justice, with an important presence of strict liability. Deterrence is seen as a function of responsibility, and is based on a humanistic vision of society.¹⁵⁴ Each person needs to accept the consequences of his actions and is consequently

¹⁴⁸ The (recent) theory of civil recourse is not withheld because of its solely theoretical approach, disregarding empirical aspects and focussing uniquely on wrongs and accountability. For more information: see RUSTAD, M. (2013, Vol. 88). Twenty-first-century tort theories: the internalist/externalist debate. *Indiana Law Journal*, pp. 419-450.

¹⁴⁹ CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, p. 13. Citations omitted.

¹⁵⁰ CALABRESI, G. (1970). *The costs of accidents*. New Heaven and London: Yale University Press.

¹⁵¹ POSNER, R. (1997, Vol. 17). The future of the Law and Economics movement in Europe. *International Review of Law and Economics*, pp. 5-6.

¹⁵² OGUS, A., & FAURE, M. (2002). *Economie du droit: le cas Français*. Paris: LGDJ Diffuseur.

¹⁵³ GAROUPA, N., & ULEN, T. (2008, Vol. 59). The market for legal innovation: law and economics in Europe and the United States. *Alabama Law Review*, p. 1614.

¹⁵⁴ LE TOURNEAU, P. (2009 - update up to September 2013). *Répertoire de droit civil: responsabilité (en général)*. www.dalloz.fr: Dalloz, § 114.

forced to think about these consequences and thus will refrain from damaging others.¹⁵⁵

Concerning the Common Law countries, it goes without saying that the US has embraced law and economics.¹⁵⁶ The UK did not follow their example and are much more focussed on justice.

Whilst in the US elements of 'law and economics' are to be found in nearly all substantive legal discussions, the topic is much less considered in the countries of the European Union.¹⁵⁷

Still it is safe to say that the theory has quite some success, mainly because of its relatively simple and understandable basic concept. It is a powerful analytical tool and it is able to provide methods to explain developments in product liability and market share liability.¹⁵⁸

Efficiency can be rooted in the satisfaction derived from the consumption of commodities (utility) or in the net value of tangible and intangible goods and services (wealth maximization).¹⁵⁹

In the economic framework the legal obligations are set in such a way that an optimum level of efficiency and deterrence is reached. As a result the social costs (precaution costs plus expected harm), resulting from a liability judgement, are minimal.¹⁶⁰

The founding fathers of law and economics, Calabresi, Landes and Posner, observed that 'our' society is not committed to preserving life at any cost' and refer thereby to an economic view on the world in general and tort in particular.¹⁶¹ Efficiency defined in terms of wealth maximization is the core of

¹⁵⁵ LE TOURNEAU, P. (2009 - update up to September 2013). *Répertoire de droit civil: responsabilité (en général)*. Www. dalloz.fr: Dalloz, § 116.

¹⁵⁶ GAROUPA, N., & ULEN, T. (2008, Vol. 59). The market for legal innovation: law and economics in Europe and the United States. *Alabama Law Review*, p. 1575.

¹⁵⁷ GAROUPA, N., & ULEN, T. (2008, Vol. 59). The market for legal innovation: law and economics in Europe and the United States. *Alabama Law Review*, p. 1575.

¹⁵⁸ Market share liability is the liability for damage attributed to the defendants in line with their market share.

¹⁵⁹ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 77, (fn. 48 & 49).

¹⁶⁰ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 601.

¹⁶¹ CALABRESI, G. (1965, Vol. 78, issue 4). The Decision for Accidents: An Approach to No-fault Allocation of Costs. *Harvard Law Review*, p. 716.

their economic analysis.¹⁶² Their theory aims at explaining all the aspects of the tort system and their complex relations in relation to the objectives of wealth maximization as closely related to economic efficiency and prevention or deterrence.¹⁶³

According to Posner the inner economic logic of tort leads to a cost-benefit analysis aiming to induce efficient behaviour.¹⁶⁴ The fact that people are all both prospective defendants and prospective plaintiffs in tort has as a consequence that both defendants and plaintiffs desire the most efficient rules in order to maximize their future wealth/welfare.¹⁶⁵ Efficient behaviour and wealth maximization are also encouraged by deterrence, in the sense that deterrence motivates actors to change their behaviour in such a manner that damage is prevented.¹⁶⁶ Tortfeasors will take optimal care when they are held liable for the costs of their actions.¹⁶⁷

Economic theory provides the insight that people respond to incentives and that law can be used as a tool to encourage desirable behaviour, whilst at the same time discouraging undesirable conduct. Consequently the efficiency and distribution of social resources¹⁶⁸ and the development of the economy are

¹⁶² POSTEMA, G. (2007). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press, p.4.

¹⁶³ POSTEMA, G. (2007). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press, p. 4; FAURE, M., & NOLLKAEMPER, A. (2007, Vol. 43). International Liability as an Instrument to Prevent and Compensate for Climate Change. *Stanford Journal of International Law*, p. 139.

¹⁶⁴ POSNER, R. (1972, Vol. 1). A Theory of Negligence. *Journal of Legal Studies*, pp. 33, 44-49, 73.

¹⁶⁵ FAURE, M., LOONSTRA, J., PHILIPSEN, N., & VAN BOOM, W. (2011, August 18). Naar een Kostenoptimalisatie van de letselschaderegeling: een verkenning. *Aansprakelijkheid, Verzekering & Schade*, pp. 21-40.

¹⁶⁶ FAURE, M., & NOLLKAEMPER, A. (2007, Vol. 43). International Liability as an Instrument to Prevent and Compensate for Climate Change. *Stanford Journal of International Law*, p. 140.

¹⁶⁷ FAURE, M. (2008, Vol. 1 Issue 4). Calabresi and behavioural tort law and economics. *Erasmus Law Review*, p. 78.

¹⁶⁸ KOROBKIN, R., & UBEN, T. (2000, Vol. 88 issue 4). Law and behavioral science: removing the rationality assumption from Law and Economics. *California Law Review*, p. 1054.

positively influenced.¹⁶⁹ If law is not efficient, then this is to the detriment of society. Therefore legal rights must be measured against their opportunity costs.

Although the economic analysis of law can be based on insights¹⁷⁰, some models of the theory are very mathematical. A good example of such a mathematical model is the Learned Hand formula. This formula provides a quantitative tool to measure optimal care. In an efficient liability system the prevention by the actor does not cost more than the value of the damage to a victim multiplied by the probability that the damage will materialize. Liability is a function of (1) the probability that the damage will occur, (2) the gravity of the resulting damage if it occurred and (3) the burden of adequate precautions. Or in algebraic terms the burden of prevention equals the damage times the probability (P) the damage will occur.¹⁷¹ Or:

$$\text{Prevention} = \text{damage} \times P (\text{occurrence of damage})$$

When the cost of prevention is lower than the 'probable damage' the defendant committed a fault or was negligent. In this calculation it is irrelevant who gains the restitution and who bears the cost.¹⁷²

Other models are the Pareto efficiency¹⁷³ and the Kaldor-Hicks efficiency.

The Pareto efficiency is optimal when the welfare of one person cannot be increased without a loss for another person.¹⁷⁴ In tort this means that the winners fully compensate the losers.

Another formula is the Kaldor-Hicks efficiency. It is used by economists when analysing the relative impact of policies on improving global social welfare.¹⁷⁵

¹⁶⁹ FAURE, M., & SMITS, J. (2011). Does law matter? An introduction. Maastricht European Private Law Institute - working paper No. 2011/35, pp. 1-23. (available at <http://ssrn.com/abstract=1950335> – accessed on 1 October 2013)

¹⁷⁰ POSNER, R. (1997, Vol. 17). The future of the Law and Economics movement in Europe. *International Review of Law and Economics*, p. 14.

¹⁷¹ United States versus Carroll Towing Co., 159 F.2d 169 (Circuit Court of Appeals, Second Circuit January 9, 1947).

¹⁷² WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 251.

¹⁷³ Also called allocative efficiency.

¹⁷⁴ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 77.

¹⁷⁵ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 604.

This principle is thus focussed on overall wealth.¹⁷⁶ A change in wealth distribution is Kaldor-Hicks efficient when an overall increase in welfare results.¹⁷⁷ In concreto, one party should be able to compensate the other party in such a way that they both are at least as well off after the transaction as before.¹⁷⁸

Also, in the Netherlands, efforts have been made to calculate damage on a 'mathematic' basis. The idea was launched that risks should be classified and prioritized.¹⁷⁹ A judge should always make an objective cost-benefit analysis, thereby taking into account all relevant aspects in a scientifically responsible way.¹⁸⁰ But similar to the practical problems when applying the Learned Hand formula, the knowledge, time and information lacks in general to bring such a cost-benefit analysis to a good end.¹⁸¹

Calabresi searches for the 'cheapest cost avoider'. He does so without mathematical calculations, but the search for the cheapest cost avoider is equally complex.

The method follows the principle that the party who is best placed to avoid risk should be held liable. In other words, the cost (of an accident¹⁸²) should be imposed on the person who can avoid the damage at the lower cost.¹⁸³ In that

¹⁷⁶ POSNER, R. (2001 (reprint)). *Wealth maximization and tort law: a philosophical inquiry*. In D. OWEN, *Philosophical foundations of tort law* (pp. 99-111). Oxford: Oxford University Press, p. 100.

¹⁷⁷ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, pp. 77-78.

¹⁷⁸ SINDEN, A. (2010, Vol. 85). *Allocating the costs of the climate crisis: efficiency versus justice*. *Washington Law Review*, p. 300.

¹⁷⁹ VAN MAANEN, G. (2008). *De Nederlandse Kelderluikarresten. Al meer dan honderd jaar - rechtseconomisch (!) - op de goede weg in Europa*. *Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 5-16.

¹⁸⁰ VAN MAANEN, G. (2008). *De Nederlandse Kelderluikarresten. Al meer dan honderd jaar - rechtseconomisch (!) - op de goede weg in Europa*. *Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 5-16.

¹⁸¹ VAN MAANEN, G. (2008). *De Nederlandse Kelderluikarresten. Al meer dan honderd jaar - rechtseconomisch (!) - op de goede weg in Europa*. *Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 5-16.

¹⁸² The term accident should in this text be understood as an intentionally inflicted impairment and death. This is thus contrary to its meaning in common language as an "an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury". See: Oxford Dictionaries (www.oxforddictionaries.com/definition/english/accident)

¹⁸³ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 75.

process the cost of prevention should be taken into account. The lowest cost is in fact the balance between the costs of the damage and the costs of prevention. This is thus a quest for the optimal cost, not just for the lowest cost. When balancing non-quantifiable elements should be taken into account, what makes the calculations more complex.¹⁸⁴ For example the acceptance of non-quantifiable elements allows to take into account non-economic factors, like the value of rights.

A downside of efficiency analysis in tort is that assumptions have to be made about the initial distributions and entitlements and some moral decisions, which are based on public policy considerations.¹⁸⁵

Decisions balancing lives and/or harm against money or convenience are not purely economic ones.¹⁸⁶ Pure economic reasoning in such a matter was and is not possible:

“Our society is not committed to preserving life at any cost. [...] A decision balancing lives against money or convenience when made in the broadest terms is not purely an economic one.”¹⁸⁷

2.1.1.2 Deterrence

The efficiency of the tort system can also be measured in relation to its deterrent effect. Deterrence from tort consists in providing through compensation incentives to people to behave safely.¹⁸⁸ The prospect of having to pay for injuries withholds people from behaving in unsafe ways and encourages them to take the necessary precautions. The preventive effect is based on the possibility of being held liable, but it also motivates the convicted tortfeasor to

¹⁸⁴ CALABRESI, G. (1970). *The costs of accidents*. New Heaven and London: Yale University Press, p. 31.

¹⁸⁵ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, pp. 79-80.

¹⁸⁶ CALABRESI, G. (1965, Vol. 78, issue 4). *The Decision for Accidents: An Approach to No-fault Allocation of Costs*. *Harvard Law Review*, pp. 716-717.

¹⁸⁷ CALABRESI, G. (1965, Vol. 78, issue 4). *The Decision for Accidents: An Approach to No-fault Allocation of Costs*. *Harvard Law Review*, p. 716.

¹⁸⁸ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 419.

behave in the future in a more prudent way.¹⁸⁹ Prevention requires that tortfeasors are confronted with the results of their risky behaviour.¹⁹⁰

On the other hand, deterrence should not only focus on the tortfeasor. People, who are potential victims, should also avoid damage. At least some deterrence of those 'victims' is also necessary.¹⁹¹ For attaining a deterrent effect, some conditions have to be fulfilled. All parties should, for example, have access to information about the applicable tort law, about the probability and the magnitude of the damage that may occur, and about the optimal preventive measures that could efficiently and effectively reduce the risk.¹⁹²

Tort rules determine when entitlements and when ownerships can be shifted as a result of the willingness of parties to take part in activities that are charged at a price which will both limit and permit the number and type of transfers occurring.¹⁹³ That price should minimize damage to the level that the marginal costs equal the marginal benefits of the precautions taken.¹⁹⁴ Sometimes a transfer of entitlements (rights) of one party to another party is involuntary. When later on this transfer ends up in court, a 'price' will be determined. The fact that a price has to be paid by the actor to the victim deters the defendant and others on condition that there the price is higher than the benefits of the act. If on the contrary, the price is lower than the benefit, no deterrence takes place and potential actors will not be withheld to act.¹⁹⁵ Compensation to be paid after harm has been done both deters and allows at the same time.

According to Van Boom the Anglo-American concept of law and economics has a different focus than the one in the Netherlands. In the US the focus is mainly on

¹⁸⁹ FAURE, M. (2010). Economic analysis of tort law and the European Civil Code. In A. HARTKAMP, & C. JOUSTRA, *Towards a European Civil Code* (p. Available at SSRN: <http://ssrn.com/abstract=1542513>), p. 225.

¹⁹⁰ SCHWITTERS, R. (2012, May 18). Aansprekend aansprakelijkheidsrecht. *Nederlands Juristenblad*, pp. 1171-1180.

¹⁹¹ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 72.

¹⁹² FAURE, M. (2008, Vol. 1 Issue 4). Calabresi and behavioural tort law and economics. *Erasmus Law Review*, p. 78.

¹⁹³ CALABRESI, G. (2007, October). Toward a unified theory of torts. *Journal of Tort Law*, p. 2.

¹⁹⁴ FAURE, M., & NOLLKAEMPER, A. (2007, Vol. 43). International Liability as an Instrument to Prevent and Compensate for Climate Change. *Stanford Journal of International Law*, p. 140.

¹⁹⁵ CALABRESI, G. (2007, October). Toward a unified theory of torts. *Journal of Tort Law*, p. 2.

compensation.¹⁹⁶ In the Netherlands the focus is more on prevention and ex ante correction of behaviour.¹⁹⁷ Prevention is based on the deterrence caused by the ex post compensation or the ex post rehabilitation of the plaintiff.¹⁹⁸

In reality deterrence is not easy to achieve. The conditions are not always present. When, as is happening in toxic tort, the causal links are complex, the delay between act and damage is long up to very long and the outcome of the court's decision is not predictable because of the factual uncertainty in causation, the deterrent effect of liability can be doubted.

Furthermore deterrence decreases with the increase of insurances against liability. The direct link between being held liable and paying compensation to the plaintiff no longer exists when the insurance takes up the cost. Insurance is a technique for spreading risk. The risk-spreading character of an insurance is inconsistent with the responsibility principle of tort law.¹⁹⁹

On the other hand it is claimed that people will limit the maximisation of their self-interest if they are willing to be treated fairly. These persons also treat others fairly. Such a behaviour occurs mainly in complex and ambiguous situations. This 'fairness' is part of what Posner calls the non-pecuniary dimension of (overall) wealth maximization.

"Wealth is the total value of all economic and non-economic goods and services and is maximized when all goods and services are, so far as feasible, allocated to their most valuable uses."²⁰⁰

Wealth maximization relates well with several moral theories since it is based on the moral traditions found in our society, dixit Posner.²⁰¹ Wealth maximization can provide a basis for a normative theory of law. Posner has several arguments

¹⁹⁶ VAN BOOM, W. (2007, April 20). Effectuerend handhaven in privaatrecht. *Nederlands Juristenblad*, pp. 826-837.

¹⁹⁷ Van Boom refers thereby to article 3:296 Civil Code of the Netherlands. Article 6:168 Civil Code is exceptionally used. VAN BOOM, W. (2007, April 20). Effectuerend handhaven in privaatrecht. *Nederlands Juristenblad*, pp. 826-837.

¹⁹⁸ VAN BOOM, W. (2007, April 20). Effectuerend handhaven in privaatrecht. *Nederlands Juristenblad*, pp. 826-837.

¹⁹⁹ CANE, P. (2001-2002, Vol. 41). Using tort law to enforce environmental regulations. *Washburn Law Journal*, p 437.

²⁰⁰ POSNER, R. (2001 (reprint)). Wealth maximization and tort law: a philosophical inquiry. In D. OWEN, *Philosophical foundations of tort law* (pp. 99-111). Oxford: Oxford University Press, p. 99.

²⁰¹ POSNER, R. (2001 (reprint)). Wealth maximization and tort law: a philosophical inquiry. In D. OWEN, *Philosophical foundations of tort law* (pp. 99-111). Oxford: Oxford University Press, p. 103.

for defending his point that law and economics can be normative.²⁰² But he also recognizes that the moral and normative value of law and economics is a philosophical matter that can best be solved by relating law and economics to various moral traditions.²⁰³

Justice and fairness are moral aspects that most people believe a tort system should respect.²⁰⁴ The most used moral theory in tort is corrective justice, but both corrective and distributive justice are discussed in the following paragraphs.

2.1.1.3 Justice as an objective of tort

Nowadays moral objectives are again gaining ground.²⁰⁵ The theories supporting these objectives claim to counterweight the deficiencies of the economic theory in explaining the bilateral structure of tort.²⁰⁶

²⁰² POSNER, R. (1979, January). Utilitarianism, Economics, and Legal Theory. *The Journal of Legal Studies*, pp. 103-140.

²⁰³ POSNER, R. (2001). Wealth maximization and tort law: a philosophical inquiry. In D. OWEN, *Philosophical foundations of tort law* (pp. 99-111). Oxford: Oxford University Press, p. 103.

²⁰⁴ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 111.

²⁰⁵ POSNER, R. (2013, Vol. 1). Instrumental and noninstrumental theories of tort law. *Indiana Law Journal*, pp. 469-474; CALABRESI, G. (2007, October). Toward a unified theory of torts. *Journal of Tort Law*, pp. 1-10; ROBINETTE, C. (2005, Vol. 43). Can there be a unified theory of torts? A pluralist suggestion from history and doctrine. *Brandeis Law Journal*, pp. 369-409; SCHWARTZ, G. T. (1997, June). Mixed theories of tort law: affirming both deterrence and corrective justice. *Texas Law Review*, pp. 1801-1835.

²⁰⁶ RUSTAD, M. (2013, Vol. 88). Twenty-first-century tort theories: the internalist/externalist debate. *Indiana Law Journal*, pp. 419-450; HERSHOVITZ, S. (2013, Vol. 63). Harry Potter and the trouble with tort theory. *Stanford Law Review*, pp. 67-116; FRIED, B. (2012). The limits of a nonconsequentialist approach to torts. *Legal Theory*, pp. 231-255; CHAPMAN, B. (2001). Pluralism in tort and accident law: towards a reasonable accommodation. In G. POSTEMA, *Philosophy and the law of torts* (pp. 276-322); COLEMAN, J. (2001 (reprint)). The practice of corrective justice. In D. OWEN, *Philosophical foundations of tort law* (pp. 53-72). Oxford: Oxford University Press; COLEMAN, J. (2001). Tort law and tort theory: preliminary reflections on method. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 183-213). New York: Cambridge University Press; GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G. POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press; GORDLEY, J. (2001). Tort law and the Aristotelian tradition. In D. OWEN, *Philosophical foundations of tort law* (pp. 131-158). Oxford: Oxford University Press; HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press; KEATING, G. (2001). A social contract conception of the tort law of accidents. In G. POSTEMA, *Philosophy and the law of torts* (pp. 22-71). New York: Cambridge University Press; KRESS, K. (2001). The seriousness of harm thesis for abnormally dangerous activities. In D. OWEN, *Philosophical foundations of tort law* (pp. 277-298). Oxford: Oxford University Press; PERRY, S. (2001). Responsibility for Outcomes, Risk, and the Law of Torts. In G. J.

Economic objectives of tort, for example, do not provide guidance when selecting the damages that should be restored, although such a selection is necessary since it is materially impossible to compensate all losses.²⁰⁷ Neither does tort law aim at deterring all risky conduct; such prevention of all risks or losses is considered impossible.²⁰⁸ Also Calabresi was convinced that the tort system should first of all be fair and just and secondly should reduce the cost of accidents and thus reduce the social cost.²⁰⁹ Summarizing, normative grounds for compensation and deterrence are necessary, because the questions on what type of losses should be compensated and what type of behaviour should be deterred, are not answered by the economic theories. A normative theory is able to explain and justify the principle features of a system coherently.²¹⁰ Thus moral theories relate to an interpretative rather than functionalistic approach, although some economic explanations of tort can be incorporated.²¹¹

POSTEMA, *Philosophy and the Law of Torts* (pp. 72-130). Cambridge: Cambridge University Press; PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press; POSTEMA, G. (2001). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press, p. 5; SIMONS, K. (2001). Contributory negligence: conceptual and normative issues. In D. OWEN, *Philosophical foundations of tort law* (pp. 461-485). Oxford: Oxford University Press; STONE, M. (2001). The significance of doing and suffering. In G. POSTEMA, *Philosophy and the law of torts* (pp. 131-182). New York: Cambridge University Press; WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press; GOLDBERG, J., & ZIPURSKY, B. (1998, August). The moral of MacPherson. *University of Pennsylvania Law Review*, pp. 1733-1835; SCHWARTZ, G. T. (1997, June). Mixed theories of tort law: affirming both deterrence and corrective justice. *Texas Law Review*, pp. 1801-1835; COLEMAN, J., & KRAUS, J. (1986, Vol. 95, issue 1). Rethinking the Theory of Legal Rights. *The Yale Law Journal*, pp. 1335-1371; WEINRIB, E. (1983, April). Toward a Moral Theory of Negligence Law. *Law and Philosophy*, pp. 37-62; COLEMAN, J. (1982, Vol. 1, issue 3). Moral Theories of Torts: Their Scope and Limits. *Law and Philosophy*, pp. 371-390; FLEMING, J. (1958-1959, Vol. 8). Tort law in the midstream: its challenge to the judicial process. *Buffalo Law Review*, pp. 315-346.

²⁰⁷ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 159.

²⁰⁸ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 159

²⁰⁹ The moral context of accident law is not only based on what is considered fair in other fields of law, but it requires also some consistency in what is done in accident law itself. CALABRESI, G. (1970). The costs of accidents. New Heaven and London: *Yale University Press*, p. 293.

²¹⁰ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 160; WEINRIB, E. (1989, Vol. 23). Understanding tort law. *Valparaiso University Law Review*, pp.510-524.

²¹¹ CHAPMAN, B. (2001). Pluralism in tort and accident law: towards a reasonable accommodation. In G. POSTEMA, *Philosophy and the law of torts* (pp. 276-322); GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G.

Another aspect of moral theories is their workability. Contrary to the economic approach the moral theories can be used 'easily' in court. Indeed, taut formula's like the Learned Hand Formula, or the Pareto principle, can rarely be used in court lacking the necessary information to make solid financial calculations on damages and profits.²¹²

Two important moral theories are the distributive and the corrective justice doctrines. Both aim at attaining equal freedom of each person.²¹³ The equal freedom principle looks at the political and/or personal morality as externalized in distributive and corrective justice.²¹⁴ Thereby each theory approaches the equality from a different aspect. Corrective justice is based on an individual interaction, whereby both parties are equal regardless of their personal wealth, merit or need.²¹⁵ In distributive justice people are also equal but not in the sense of alike or identical. The equality is that the resources must be attributed amongst the members of a society following their (relative) ranking under some criterion of merit or need.²¹⁶

Distributive justice focuses thus mainly on society as a whole, whilst corrective justice concerns the relation between individual parties. Distributive justice establishes entitlements across society and corrective justice restores the balance when an entitlement is disturbed.²¹⁷

In the following paragraphs both are discussed further in relation to their use in tort.

POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press.

²¹² HERSHOVITZ, S. (2013, Vol. 63). Harry Potter and the trouble with tort theory. *Stanford Law Review*, p. 107; *McCarty versus Pheasant Run, Inc.*, 826 F.2d 1554 (United States Court of Appeals, Seventh Circuit July 22, 1987).

²¹³ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 168.

²¹⁴ For an historical overview see GORDLEY, J. (2001). Tort law and the Aristotelian tradition. In D. OWEN, *Philosophical foundations of tort law* (pp. 131-158). Oxford: Oxford University Press.

²¹⁵ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 167.

²¹⁶ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 167

²¹⁷ POSNER, R. (2001). Wealth maximization and tort law: a philosophical inquiry. In D. OWEN, *Philosophical foundations of tort law* (pp. 99-111). Oxford: Oxford University Press, p. 108.

a) Distributive justice concerns the distribution of goods and losses

Distributive justice is not relational, it is independent of any individual interaction. A distributive justice claim is thus based on the status in the political community (society) of the person involved, independent of any individual interaction.²¹⁸ As a consequence it is fair to have the party, who benefits from an uncertain situation over which he has control, bear the costs that result from the situation.²¹⁹ Equality is achieved if the distribution of goods and losses is in proportion to the relative ranking of each member in the community.²²⁰ The criterion used for the distribution is need or merit.²²¹ Distributive justice concerns resource allocation or 'a person's positive freedom to have access to the resources necessary to realize his humanity'.²²²

Typically a distributive justice claim concerns all members of a community. Distributive justice is multilateral.²²³

Distributive justice is used as an argument for strict liability systems.²²⁴ The reason therefore is that strict liability supports the internalisation of costs and distributes the costs amongst those who benefit from the risk imposition.²²⁵ Holding people responsible for damages resulting from an uncertain situation over which these people have some control, is considered fair.²²⁶ Control is key;

²¹⁸ Aristotle as cited in GORDLEY, J. (2001). Tort law and the Aristotelian tradition. In D. OWEN, *Philosophical foundations of tort law* (pp. 131-158). Oxford: Oxford University Press, p. 132 and WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 167.

²¹⁹ HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 83.

²²⁰ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 167.

²²¹ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 167.

²²² Aristotle as cited in WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, pp. 168-171.

²²³ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 177.

²²⁴ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 142; HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 83.

²²⁵ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 142.

²²⁶ HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 83.

fault or negligence is not necessary. For example, a company manufacturing a chemical is in a better position to control the risk, because of its knowledge on the substance and the opportunities and means to manage it.²²⁷

Strict liability is an important tool in French tort. The French system focuses on the principle of distributive justice. This approach is largely supported by doctrine. The doctrine plays an important role in explaining and interpreting judgments, mainly because court decisions are very concise and do not explicitly mention their reasoning.²²⁸ As a consequence legal writing is more pragmatic than theoretical.²²⁹

More details on strict liability can be found in chapter 2.4.

b) Corrective justice is bilateral

Corrective justice aims at correcting harm done by one party to another, thereby explaining the normative ground on which the duty of redress is based.²³⁰ It appeals intuitively to the principle of duty and the rectification of wrongs.

Guided by moral values of justice, the corrective justice theory based on equal freedom as elaborated by Aristotle and Kant is considered the more suitable doctrine to explain the normative objectives of tort law.

According to the theory tort is an institution that enforces duties of repair, whilst also correcting issues between a tortfeasor and his victim.²³¹ It is a system, based on individual moral rights²³², treating humans as moral agents with rights and responsibilities.²³³

In contrast with a distributive justice, a corrective justice claim is based on an impingement between the defendant and the plaintiff concerning the resources possessed by the parties to that interaction. These parties are equal regardless

²²⁷ This idea is also at the basis of the reversal of the burden of proof by the REACH-Regulation, however without going so far to introduce strict liability.

²²⁸ VAN DAM, C. (2006). *European Tort Law*. Oxford: Oxford University Press, pp. 43-46, nrs. 301-304.

²²⁹ VAN DAM, C. (2006). *European Tort Law*. Oxford: Oxford University Press, p. 45.

²³⁰ CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, p. 14.

²³¹ HERSHOVITZ, S. (2013, Vol. 63). Harry Potter and the trouble with tort theory. *Stanford Law Review*, p. 106.

²³² PERRY, S. (1992, January). The moral foundations of tort law. *Iowa Law Review*, p. 449.

²³³ HERSHOVITZ, S. (2013, Vol. 63). Harry Potter and the trouble with tort theory. *Stanford Law Review*, p. 109.

of their standing in the community; equality is grounded in the individual freedom of each person.²³⁴ That individual freedom is only limited by the principle that one person should not damage another.²³⁵

Although Aristotle's model of equal freedom is still widely referred to as the basis of corrective justice, his concept is also considered to be normatively incomplete.²³⁶ Aristotle does not sufficiently specify the content, neither does he determine the objectives or the function of corrective justice.²³⁷

The inclusion of Kant's notion of abstract equality of people brought a moral aspect to the structure Aristotle developed. It incorporated the concept of correlative duties and rights by linking the parties in litigation through a right.²³⁸

"The fundamental principle applicable to the interaction of self-determining beings is that action should be consistent with the freedom of whomever the action might affect. Rights [...] are the juridical manifestations of the freedom inherent in self-determining activity. Action is therefore consistent with the freedom of others when it is compatible with their rights. Having a right implies that other actors are under the moral necessity to refrain from infringing it."²³⁹

To put it in another way, right is the moral position of the victim or plaintiff and duty is the moral position of the tortfeasor or defendant.²⁴⁰ The principle of corrective justice is simple: those who without justification harm another person by their conduct or acts are required to correct the situation.²⁴¹ Corrective justice is the duty resting on the tortfeasor to repair the victim's loss, but only if

²³⁴ WEINRIB, E. (1983, April). Toward a Moral Theory of Negligence Law. *Law and Philosophy*, pp. 37-62.

²³⁵ EPSTEIN, R. (1979, Vol. 8 issue 3). Causation and corrective justice: a reply to two critics. *The Journal of Legal Studies*, p. 479.

²³⁶ WEINRIB, E. (1992, January). Corrective Justice. *Iowa Law Review*, p. 413.

²³⁷ COLEMAN, J. (2001). Tort law and tort theory: preliminary reflections on method. In G. POSTEMA, *Philosophy and the law of torts* (pp. 183-213). New York: Cambridge University Press, p. 198; WEINRIB, E. (1992, January). Corrective Justice. *Iowa Law Review*, pp. 406-407.

²³⁸ CULHANE, J. (2003, Vol. 55). Tort, compensation and two kinds of justice. *Rutgers Law Review*, p. 1072.

²³⁹ WEINRIB, E. (1994, Vol. 44). The gains and losses of corrective justice. *Duke Law Journal*, pp. 290-291.

²⁴⁰ CULHANE, J. (2003, Vol. 55q). Tort, compensation and two kinds of justice. *Rutgers Law Review*, p. 1072

²⁴¹ HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 78.

the loss is wrongful and if the tortfeasor is responsible for having brought about the loss.²⁴²

Corrective justice is bilateral and preserves the distribution of wealth; it requires to compensate somebody who loses because another gains at his expense.²⁴³ Within the theory of corrective justice the relationship is, contrary to distributive justice, only between tortfeasor and victim.²⁴⁴ A damage or loss is normatively significant because it interferes with the well-being of a person.²⁴⁵ Even if the tortfeasor 'acquired nothing' he still has abided at the other's expense because he has pursued his own objective.²⁴⁶

Corrective justice has thus an involuntary aspect in the sense that it takes away something from one person to restore the loss of another person.²⁴⁷

Another interpretation of corrective justice is more social, namely wrongful gains and losses should be eliminated or annulled.²⁴⁸ The restoration of the damage is not necessarily the responsibility of the individual.²⁴⁹ In fact this approach of justice resembles more distributive justice than corrective justice.²⁵⁰

UK tort is an example of a system that is mainly influenced by the principle of corrective justice, as it relates to fault and by the desire to regulate behaviour.

²⁴² COLEMAN, J. (2001). The practice of corrective justice. In D. OWEN, *Philosophical foundations of tort law* (pp. 53-72). Oxford: Oxford University Press, p. 56; WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, pp. 168-171.

²⁴³ GORDLEY, J. (2001 (reprint)). Tort law and the Aristotelian tradition. In D. OWEN, *Philosophical foundations of tort law* (pp. 131-158). Oxford: Oxford University Press p. 157.

²⁴⁴ "Because the normative gain and the normative loss are correlative aspects of the same wrong, the defendant's liability is identical with the plaintiff's entitlement to rectification." WEINRIB, E. (1994, Vol. 44). The gains and losses of corrective justice. *Duke Law Journal*, pp. 292-293, 297.

²⁴⁵ PERRY, S. (1992, January). The moral foundations of tort law. *Iowa Law Review*, p. 513.

²⁴⁶ The former does however not exclude that after the harm was done, people can, based on the principle of freedom, renounce compensation for damages. Each person is free to assume voluntarily a burden, even if that, according to corrective justice should rest on somebody else. GORDLEY, J. (2001). Tort law and the Aristotelian tradition. In D. OWEN, *Philosophical foundations of tort law* (pp. 131-158). Oxford: Oxford University Press p. 140.

²⁴⁷ GORDLEY, J. (2001). Tort law and the Aristotelian tradition. In D. OWEN, *Philosophical foundations of tort law* (pp. 131-158). Oxford: Oxford University Press, p. 137.

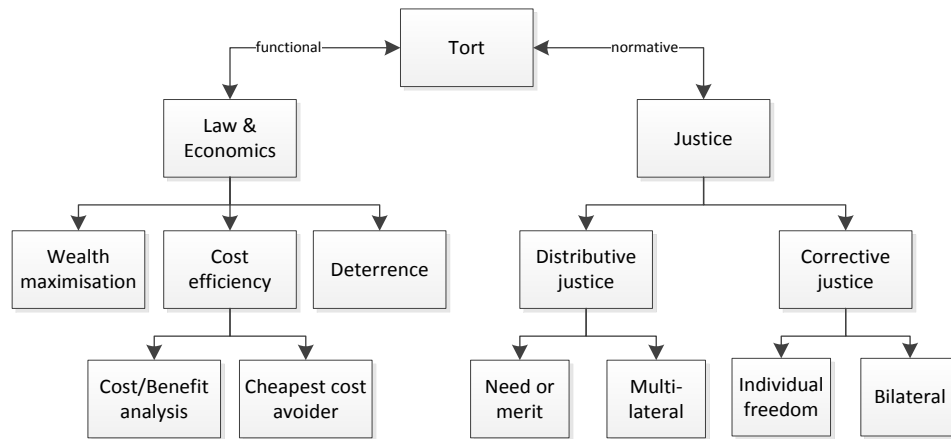
²⁴⁸ COLEMAN, J. (1982, Vol. 11). Corrective justice and wrongful gain. *Journal of Legal Studies*, pp. 421-441.

²⁴⁹ PERRY, S. (1992, January). The moral foundations of tort law. *Iowa Law Review*, p. 449.

²⁵⁰ PERRY, S. (1992, January). The moral foundations of tort law. *Iowa Law Review*, p. 473.

Despite the reputation of the UK to be a country of long traditions, the House of Lords, now the Supreme Court, has proved to be creative by finding solutions to actual problems and deviating from existing precedents.²⁵¹ Common law is built on actions and is thus pragmatic.²⁵²

2.1.2 Summarising



In practice the objectives have proved not to be mutually exclusive. In many toxic tort cases elements of both doctrines can be found.

2.2. The role of causation in achieving tort’s objectives

A plaintiff will not be compensated on the basis of tortious liability unless the damage was caused by the defendant. This is true for all types of tort liability. Tort law is based on a personal responsibility for one’s own behavior that harmed the plaintiff.²⁵³

Why is causation so important? Do exceptions exist to the requirement of proof of causation? The next paragraphs deal with these questions.

²⁵¹ See for example: *Fairchild versus Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002); *Page versus Smith*, [1996] 1 W.L.R. 855 (Court of Appeal March 12, 1996); *Wilsher versus Essex Area Health Authority*, [1988] A.C. 1074 (House of Lords March 10, 1988).

²⁵² VAN DAM, C. (2006). *European Tort Law*. Oxford: Oxford University Press, p. 123.

²⁵³ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 109.

2.2.1 Causation in general

Causation is frequently associated with a natural relation between events in the natural world. Such relations link concrete occurrences in time and place. Since they are concrete, they can be known on the basis of observation, inference, and scientific analysis.²⁵⁴ In relation to tort, it is important to note that these natural relations are considered as not holding normative or evaluative judgments.

Causation is however also associated with the explanation of what and why something happened.²⁵⁵ Explanation is an intellectual relation between facts and truths, but not between things in the natural world.²⁵⁶ It is a non-natural, rational link with a role in tort.

The word causation originally referred to responsibility as related to fault finding or giving credit. The method of causal inquiry differs depending on the law, e.g. the causation that needs to be proved in standard tort is in some aspects different from the one in strict liability. Causation in tort is used:

“to identify when a specified factor was ‘involved’ in the existence of a particular phenomenon, where the notion of ‘involvement’ identifies a contrast between the actual world and some specified hypothetical world from which we exclude (at least) that specified factor: this contrast being that, while in the former world the phenomenon exists, in the latter it does not.”²⁵⁷

Causation is necessary if the focus of the tort system is on granting the plaintiff a compensation paid for by the defendant.²⁵⁸ A causal link is not required if tort would only judge the moral quality of the tortfeasor’s behaviour.²⁵⁹

²⁵⁴ MENZIES, P. (2009). Platitudes and counterexamples. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 341-367). Oxford: Oxford University Press, p. 344.

²⁵⁵ MENZIES, P. (2009). Platitudes and counterexamples. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 341-367). Oxford: Oxford University Press, p. 343. (citations omitted)

²⁵⁶ In MENZIES, P. (2009). Platitudes and counterexamples. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 341-367). Oxford: Oxford University Press. p. 343.

²⁵⁷ STAPLETON, J. (2012). Causation in Law. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 744 - 771). Oxford: University Press, p. 744.

²⁵⁸ WEINRIB, E. (1987, Vol. 63). Causation and wrongdoing. *Chicago-Kent Law Review*, p. 414.

The fact that tort is concerned with restoring a balance between parties in a court case, with a particular focus on the damage the plaintiff suffered, makes it relevant to find who and what caused the damage. The reinstatement of the plaintiff can be approached in different ways. In the following paragraphs causation as a concept is linked to the objectives of tort as these are described by the theories of economic efficiency and corrective justice and with a special focus on damage allegedly caused by chemicals.

2.2.2 Causation and economic efficiency

Toxic tort aims at providing an effective tool to compensate victims for the harmful effects of noxious substances and to deter (corporate) polluters.²⁶⁰ Economic efficiency is part of such a tort system. It is defined as the maximization of the value of capital, labour and natural resources. All the costs and benefits of the system should be taken into account when judging a tort case, whilst attempting to minimize social costs.²⁶¹

Causation and proof of causation has an impact on economic efficiency. The question is however if causation is accommodating the economic objectives? Some economic scholars do not consider causation a necessary element.²⁶² Compensation given to the plaintiffs encourages them to sue the injurer. As a consequence the liable injurer will reduce his risk creating behaviour. If the objective of tort is to promote economic efficiency, the efficient allocation of resources would be enhanced just by holding the defendant's act in itself as the

²⁵⁹ WEINRIB, E. (1987, Vol. 63). Causation and wrongdoing. *Chicago-Kent Law Review*, p. 414.

²⁶⁰ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 535-536.

²⁶¹ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 600; LANDES, W., & POSNER, R. (1987). *The economic structure of tort law*. Cambridge, Massachusetts and London: Harvard University Press, pp. 58-62, 73-74.

²⁶² CONWAY-JONES, D. (2002, January). Factual causation in toxic tort litigation: a philosophical view of proof and certainty in uncertain disciplines. *University of Richmond Law Review*, pp. 875-937; FISHER, C. (2001, Vol. 9). The role of causation in science as law and proposed changes in the current common law toxic tort system. *Buffalo Environmental Law Journal*, pp. 35-123; BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. *Columbia Law Review*, pp. 2117-2151; LANDES, W., & POSNER, R. (1983, January). Causation in tort law: an economic approach. *Journal of Legal Studies*, pp. 109-134.

basis for compensation of the damage.²⁶³ Additionally, when actors could be held liable each time they failed to take care, regardless of the fact if they caused damage or not, then the risk-creators would always take the cost minimizing care.²⁶⁴ Thus a causal link is analytically not needed to promote economic efficiency.

Calabresi argued that the requirement to prove that a particular defendant caused the damage is 'far from essential'.²⁶⁵

2.2.2.1 Shifting the focus

Legal economists focus on increased risk instead of on actual causation. They see a causal link as the material externalization of a sequence between an act and the occurrence of a result. Thereby the act-result relation is not a one-to-one relationship; there are several acts without which a particular result will not occur. Other methods could replace causation, for example:

"Random samples of injury costs associated with certain types of behaviour might form an equally precise and far less expensive way of setting up the incentive for a correct cost-benefit analysis."²⁶⁶

Consequently, foreseeability as such has only a minor role in the economic theory.²⁶⁷

Gifford observed however, that because of the inherent ambiguity in the meaning of the concept of cheapest cost avoider, the determination in latent disease cases is made on the basis of politics and culture.²⁶⁸ Economic factors do not prevail. For example: are the tobacco manufacturers really the cheapest cost avoiders from a public health perspective? To hold the tobacco producers liable is the better option from a public health policy.²⁶⁹ But tort dealing with relations

²⁶³ LANDES, W., & POSNER, R. (1987). *The economic structure of tort law*. Cambridge, Massachusetts and London: Harvard University Press, p. 229.

²⁶⁴ GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G. POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press, p. 258.

²⁶⁵ CALABRESI, G. (1975, Vol. 43). Concerning Cause and the Law of Torts: An Essay for Harry Kalven Jr. *University of Chicago Law Review*, p. 85.

²⁶⁶ CALABRESI, G. (1975, Vol. 43). Concerning Cause and the Law of Torts: An Essay for Harry Kalven Jr. *University of Chicago Law Review*, p. 86.

²⁶⁷ LANDES, W., & POSNER, R. (1983, January). Causation in tort law: an economic approach. *Journal of Legal Studies*, p. 134.

²⁶⁸ GIFFORD, D. (2012, Vol. 64, issue 1). The peculiar challenges posed by latent diseases resulting from mass products. *Maryland Law Review*, p. 778.

²⁶⁹ GIFFORD, D. (2012, Vol. 64, issue 1). The peculiar challenges posed by latent diseases resulting from mass products. *Maryland Law Review*, p. 778-779.

between parties, would hold the individual accountable for his own decision on smoking or not.

Interestingly Dutch judges base their decisions on what they consider as 'acceptable for society'.²⁷⁰ Thereby they ignore legal economic thoughts and strict calculations as proposed by, for example, Van Boom²⁷¹, but still reach judgments that are acceptable within the framework of the doctrine of law and economic.²⁷²

2.2.2.2 Average damages

In line with the growing attention for risk creation, the use of average damages is defended. Averaging excludes the need for proof of causation. If a tortfeasor would be obliged to pay average compensation, as calculated on the basis of compensation for parties also exposed to the risk, then he would have the correct incentive to reduce risk.²⁷³ It is however difficult to calculate such average damages, since the necessary information for such an exercise is normally not available to the court.²⁷⁴ Mistakes in that area result in insufficient safety incentives when the average compensation is too low and too much care if it is too high.²⁷⁵ The former is economically not an optimal situation.

2.2.2.3 Finally: is causation useful?

Calabresi differs in opinion with those who want to abolish causation. He states that causation should be understood and justified through its function.²⁷⁶ The

²⁷⁰ VAN MAANEN, G. (2008). De Nederlandse Kelderluikarresten. Al meer dan honderd jaar -rechtseconomisch (!) - op de goede weg in Europa. *Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 5-16.

²⁷¹ W.H. van Boom, *Structurele fouten in het aansprakelijkheidsrecht*, Den Haag: Boom Juridische uitgevers 2003.

²⁷² VAN MAANEN, G. (2008). De Nederlandse Kelderluikarresten. Al meer dan honderd jaar -rechtseconomisch (!) - op de goede weg in Europa. *Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 5-16.

²⁷³ GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G. POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press, p. 258.

²⁷⁴ SHAVELL, S. (1987). *Economic analysis of accident law*. Cambridge: Harvard University Press, p. 131.

²⁷⁵ SHAVELL, S. (1987). *Economic analysis of accident law*. Cambridge: Harvard University Press, p. 131.

²⁷⁶ CALABRESI, G. (1975, Vol. 43). Concerning Cause and the Law of Torts: An Essay for Harry Kalven Jr. *University of Chicago Law Review*, p. 105.

practical definition of causation will change in line with the goal one wants to obtain.²⁷⁷

On the basis of his scepticism about the ability to analyse all goals and because causation is flexible and functional, Calabresi concludes that causation will survive, rather than be replaced by the goals which causation is now serving.²⁷⁸ Causation as a requirement in tort is only superfluous when it is restricted to natural relationships.²⁷⁹ Tort litigation between tortfeasors and victims makes economic sense. A causal link reduces errors in judgment and gives risk creators an incentive to minimize damage costs.²⁸⁰ Proof of causation generates savings through pinpointing the actual harm suffered by the plaintiff and by holding the defendant liable for the related damage.²⁸¹ It is the particular requirement of holding a specific defendant liable for paying the compensation to a specific plaintiff that makes causation pertinent.²⁸² The requirement of causation reduces some costs.

Moreover, assuming causation in cases where the cause cannot be proved under accepted principles, is turning the objective of liability, namely rehabilitate the plaintiff, upside down.²⁸³ He observes that in the tort cases where evidence of causation is the weakest, it is most likely that the defendant is not culpable.²⁸⁴ Furthermore in such cases compensation can be obtained from a defendant who

²⁷⁷ CALABRESI, G. (1965, Vol. 78, issue 4). The Decision for Accidents: An Approach to No-fault Allocation of Costs. *Harvard Law Review*, p. 107.

²⁷⁸ CALABRESI, G. (1975, Vol. 43). Concerning Cause and the Law of Torts: An Essay for Harry Kalven Jr. *University of Chicago Law Review*, p. 108.

²⁷⁹ CALABRESI, G. (1975, Vol. 43). Concerning Cause and the Law of Torts: An Essay for Harry Kalven Jr. *University of Chicago Law Review*, p. 108.

²⁸⁰ GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G. POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press, p. 259.

²⁸¹ GEISTFELD, M. (2001). Economics, moral philosophy and the positive analysis. In G. POSTEMA, *Philosophy and the law of torts* (pp. 250-275). New York: Cambridge University Press, p. 259.

²⁸² WEINRIB, E. (1987, Vol. 63). Causation and wrongdoing. *Chicago-Kent Law Review*, p. 414.

²⁸³ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 621.

²⁸⁴ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 621.

was only one part in the whole of potential causes.²⁸⁵ This lowering of standards has an economic effect, as well on wealth maximization or the level of efficiency as on deterrence. Damages paid by a non-culpable defendant disturb the balance between wrongdoers and victims and deterrence is not working on innocent people.

When evidence of causation is weak, it is thus less likely that the objectives of tort will be achieved.²⁸⁶

2.2.3 Corrective justice and causation as allies

The traditional corrective justice view of tort law is that without a causal link, there is no liability.²⁸⁷ This view is based on what the scholars of corrective justice believe is the core of the tort system, namely the tortfeasor has to repair the damage he caused by his wrongful act.²⁸⁸ Epstein understands causation in that context as causing harm with 'the use of force'.²⁸⁹ Force is the invasion of a person or a property as that invasion is connected to fright, compulsion, and dangerous conditions.²⁹⁰ The term force is, although neither fully similar, nor interchangeable with the concept of wrongdoing and is narrower than just causing harm. Causation is more than force. It focuses on the link between an act and a result.

"The claim that the plaintiff makes against the defendant presupposes that these particular persons have been linked to each other through the causation and the wrongfulness."²⁹¹

²⁸⁵ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 622.

²⁸⁶ PROSSER, W., KEETON, R., DOBBS, D., & OWEN, D. (1984). *Prosser and Keeton on Torts*. St. Paul: West Publishing CO, p. 263.

²⁸⁷ WRIGHT, R. (1987). The Efficiency Theory of causation and responsibility: unscientific formalism and false semantics. *Chicago-Kent Law Review*, p. 573.

²⁸⁸ GIFFORD, D. (2005, Vol. 62). The challenge to the individual causation requirement in mass products torts. *Washington and Lee Law Review*, p. 877; HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 80.

²⁸⁹ EPSTEIN, R. (1979, Vol. 8 issue 3). Causation and corrective justice: a reply to two critics. *The Journal of Legal Studies*, p. 479.

²⁹⁰ EPSTEIN, R. (1979, Vol. 8 issue 3). Causation and corrective justice: a reply to two critics. *The Journal of Legal Studies*, pp. 479-480.

²⁹¹ WEINRIB, E. (1987, Vol. 63). Causation and wrongdoing. *Chicago-Kent Law Review*, p. 429.

A causal link is essential, because it is the act of harming that should be wrongful, not the damage.

'A' causal link is sufficient. It does not need to be 'the' causal link of the damage, there can be more causes.²⁹²

Although causation is a necessary condition for liability, it is not a sufficient condition. Additional requirements should be fulfilled. Firstly, there should be no justification for causing the harm. Secondly, the defendant should be at fault or negligent.²⁹³

Adding the last criterion further narrows the concept of corrective justice. Demanding fault or negligence, corrective justice, strictly speaking, excludes systems of strict liability. However, when the requirement of wrongfulness is not an element of corrective justice in itself, but rather 'an independent limit to the pursuit of corrective justice', then strict liability is an option. Such a view on wrongfulness is in line with the theory on responsibility for the outcome of conduct.²⁹⁴ Responsibility for the outcome of conduct means that he who caused the damage is responsible even without committing a wrongful act.²⁹⁵

Liability without proof of causation is a form of social insurance or of another compensation system based on the imposition of risk or the occurrence of harm. Causation singles out the plaintiff from the class of persons whom the defendant has endangered and it does this on the basis of the injury as the materialization of the general risk.²⁹⁶ Thereby it is implicitly said that liability based upon mere risk creation is inconsistent with the principles of corrective justice.²⁹⁷ Imagine that a victim X of an unidentified, drunk hit-and-run driver would be allowed to claim compensation from all drunk drivers on the road because they created a risk of collision for X. The court would hold these drivers liable even when they

²⁹² HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 80.

²⁹³ HONORE, T. (2001)). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, pp. 80-81.

²⁹⁴ HONORE, T. (2001)). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, pp. 80-81.

²⁹⁵ HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press, p. 81.

²⁹⁶ CULHANE, J. (2003, Vol. 55). Tort, compensation and two kinds of justice. *Rutgers Law Review*, p. 1073.

²⁹⁷ GIFFORD, D. (2005, Vol. 62). The challenge to the individual causation requirement in mass products torts. *Washington and Lee Law Review*, p. 890.

were not involved in the injury of victim X and there was no causal link between them and X. Such an approach is not compatible with corrective justice, not even when the drunk driving was replaced by emitting toxic substances. The latter may seem socially less acceptable than the former, but victims of exposures to toxic substances will not win their case. The theory of corrective justice does not accept the mere creation of risk as an actionable tort claim. Consequently some scholars drafted different compensation systems, like (obligatory) social insurance and other collective compensation systems.²⁹⁸ These systems are considered outside the tort system and rather part of public policy.

Others, like Wright, disagree with the conclusion that corrective justice leaves the victims of exposure without recourse. He does this by stating that the basis of holding a defendant liable can be the creation of the risk and not the damage,

“[I]f each defendant is held liable only for her share of the risk exposure, there is no conflict with the corrective-justice view. It still must be proven that each defendant caused the risk exposure that possibly led to the manifested injury, and liability is for such risk exposure, rather than the manifested injury.”²⁹⁹

This approach leads to an acceptance of market share liability and of liability when the exactness of causation cannot be proved. This ‘solution’ applied to a concrete situation in a particular case³⁰⁰ is (sometimes) seen as stretching the logic of corrective justice.³⁰¹

Anyhow, the general principle remains that the corrective justice doctrine does not accept that a victim recovers from a defendant solely on the basis of an exposure to a risk. Also when applying market share liability, strict liability or liability on the basis of probability, it is still required to prove damage. The substantive limit excludes transactions that are not causally connected to both

²⁹⁸ GIFFORD, D. (2005, Vol. 62). The challenge to the individual causation requirement in mass products torts. *Washington and Lee Law Review*, p. 890.

²⁹⁹ WRIGHT, R. (1988, July 73 IOWA L. REV. 1001). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1073.

³⁰⁰ *Sindell versus Abbott Laboratories*, 607 P.2d 924 (Supreme Court of California March 20, 1980).

³⁰¹ GIFFORD, D. (2005, Vol. 62). The challenge to the individual causation requirement in mass products torts. *Washington and Lee Law Review*, p. 889.

the defendant and the plaintiff.³⁰² Third parties cannot intervene, neither can the state. Also natural causes, societal causes, and the like are excluded.³⁰³ It should however be remembered that a causal link and a necessary condition are not equivalent.³⁰⁴ A necessary condition can exist and can be observed but not be the cause of the occurrence as causation is understood in corrective justice.

2.2.4 Specific aspects of causation in toxic tort

The relation between the parties in a tort case comes to existence when the defendant, alias tortfeasor, has acted inconsistently with the equality of the person(s) his act might affect.³⁰⁵ The relation is 'consummated' when the 'risk' materializes in damage to the victim/plaintiff. Then causation is the link between both, or as Weinrib writes:

“Causation represents the relationship's physical aspect, the direction of energy from the defendant to its impingement upon the plaintiff.”³⁰⁶

All of the above is put under strain in toxic tort cases. The principle 'do not harm others' is stressed by the often considerable time lag between the obligation to avoid (unknown) harmful consequences that become manifest only after many years. Such a situation is difficult to reconcile with the corrective justice principle that one should only be responsible for morally irresponsible decisions or choices.³⁰⁷ The qualification of one's acts is complicated by the lack of knowledge of the consequences. Besides that, the time lag between the source and the materialisation of the damage can be the reason that a causal link cannot be proved. Corrective justice requires such a causal connection. It is on the basis of causation that the tortfeasor is identified amongst the class of

³⁰² CALNAN, A. (2005, Vol. 1). In defence of the liberal justice theory of torts: a reply to professors Goldberg and Zipursky. *NYU Journal of Law & Liberty*, p. 1067.

³⁰³ CALNAN, A. (2005, Vol. 1). In defence of the liberal justice theory of torts: a reply to professors Goldberg and Zipursky. *NYU Journal of Law & Liberty*, pp. 1067-1068.

³⁰⁴ EPSTEIN, R. (1979, Vol. 8 issue 3). Causation and corrective justice: a reply to two critics. *The Journal of Legal Studies*, p. 478.

³⁰⁵ WEINRIB, E. (1989, Vol. 23). Understanding tort law. *Valparaiso University Law Review*, p. 430.

³⁰⁶ WEINRIB, E. (1987, Vol. 63). Causation and wrongdoing. *Chicago-Kent Law Review*, pp. 429-430

³⁰⁷ BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. *Columbia Law Review*, p. 2133; SCHROEDER, C. (1990, February). Corrective justice and liability for increasing risks. *UCLA Law Review*, p. 452.

persons who created the risks.³⁰⁸ Indeed, the objectives of corrective justice exclude broader concerns.

Attribution of liability in cases concerning a category or a class of parties (e.g. chemical industry) inclines towards distributive justice, namely stepping outside the interest of the specific parties involved in the specific case. The distinction between distributive and corrective justice becomes blurred. In order to justify the liability of defendants without proving causation the burden of proof has been shifted to the defendant. Then the defendant has to prove that he did not cause the plaintiff's damage. Such a shift is accepted by the doctrine of corrective justice. Market share liability, as elaborated in the *Sindell* case, is a concrete example of the former.³⁰⁹

Some scholars consider an expanded view of corrective justice useful. Distributive considerations are then acceptable if the distributive elements remain subordinate to the corrective justice principle, namely repairing private wrongs.³¹⁰

The principles of law and economics can then not be ignored when evaluating toxic tort. The complexity of proving causation leads to considerable costs. The discovery phase involves a host of complex factual, technical, and medical issues.³¹¹ The question asked is thus if a diluted standard of cause can achieve valuable outcomes in a cost-efficient manner. An economic evaluation is useful. Thereby the goal is to achieve an optimal level of prevention where any further unit of precaution would cost more than the corresponding reduction in the expected harm.³¹²

³⁰⁸ CULHANE, J. (2003, Vol. 55). Tort, compensation and two kinds of justice. *Rutgers Law Review*, p. 1073.

³⁰⁹ In market share liability, the defendants are held proportionally liable in line with their market share. *Sindell versus Abbott Laboratories*, 607 P.2d 924 (Supreme Court of California March 20, 1980).

³¹⁰ CULHANE, J. (2003, Vol. 55). Tort, compensation and two kinds of justice. *Rutgers Law Review*, p. 1077.

³¹¹ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 586.

³¹² MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 601.

However the socially desirable level of precaution may differ from the economically optimal level.³¹³ To solve this the Pareto efficiency concept can be used: social welfare increases when at least one person's welfare improved without reducing the welfare of any other person.³¹⁴

Still the fact remains that toxic tort is about externalities. When neither the person who acted wrongfully (amongst multiple potential tortfeasors), nor the damage can be identified, it is not possible to take economic efficient decisions in toxic tort.³¹⁵ In other words, toxic tort must fail in any attempt to create efficient incentives when an eroded causation standard is used.³¹⁶

After discussing the role of causation in the theories of tort, the next paragraphs will focus on specific categories of tort that are particularly important in tort and in toxic tort, namely negligence and strict liability.

2.3 Liability on the basis of negligence

Negligence in the legal sense differs from its meaning in ordinary language. Legally it refers strictly to a characteristic of conduct, not to the actor's state of mind. In daily life there is a connotation of moral appreciation of the individual act.³¹⁷ Negligence law disregards moral excuses.³¹⁸ But that does not mean that there is no moral influence at all. Tort is concerned with justice as a societal concept, namely you should not harm another.

In the past an actor was held liable simply because he acted.³¹⁹ This was customary in both Continental and Common law systems.³²⁰ Nowadays

³¹³ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 602.

³¹⁴ See supra paragraph 1.1.1.1.

³¹⁵ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 604.

³¹⁶ WRIGHT, R. (1987). The Efficiency Theory of causation and responsibility: unscientific formalism and false semantics. *Chicago-Kent Law Review*, pp. 576-577.

³¹⁷ POSTEMA, G. (2007). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press, p. 3.

³¹⁸ POSTEMA, G. (2007). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press.

³¹⁹ PECK. (1971, Vol. 46, Is. 2). Negligence and liability without fault in tort law. *Washington Law Review*, p. 225.

negligence is a specific part of liability, and has become the majority of the liability cases.³²¹ Negligence as a course of action in tort holds everybody to the general standard of what the ordinary man would do. But who is that ordinary man? How does he behave? But first of all what exactly is negligence?

The following paragraph explains the concept of negligence through a description of negligent behaviour. Thereafter the principle of the duty of care and its characteristics is analysed.

2.3.1 Are you negligent?

Acting negligently means that a person behaved clumsy. What is considered clumsy or negligent depends on the culture and the social norms of the location where the person acted. An exact description is not possible. The concept is substantively philosophical. In the judicial sense, negligence is linked to the duty of care (see paragraph 2.3.3) and appreciated according to the circumstances of the case.

Thus negligence includes conduct, but apart from that it is a rather vague and open concept. Courts and lawyers use several different formulas and varying terminology, but all are centred on the concept of a defendant's unreasonable acts.³²² Reference to acts and conduct are useful for the understanding of the concept of negligence. In other words, the question when is an act negligent needs to be answered and not the question what is negligence.

2.3.2 Negligence and the duty of care³²³

The world changes continuously. One aspect is however invariable: the perpetual increase of stress on the world we live in. Sustainable use of materials is, for example, an element we recently started to consider in our behaviour and

³²⁰ PECK. (1971, Vol. 46, Is. 2). Negligence and liability without fault in tort law. *Washington Law Review*, p. 226.

³²¹ CHAMALLAS, M., & WRIGGINS, J. (2010). *The measure of injury*. New York/London: New York University Press, p. 15; CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 91. Exact figures could not be retrieved, but the sources referred to are reliable enough to quote their opinion as valid.

³²² SHAPO, M. (2010). *Principles of Tort Law*. St. Paul: West (Thomas Reuters).pp. 96, 101-102.

³²³ This analysis of duty has been limited to rather basic understanding of the duty of care. Although several theories were studied, they proved to be of minor relevance vis-à-vis the issues of causation.

During the study of the duty of care several theories have been considered.

our duty towards each other. And what about climate change? Do car manufacturers have a duty of care towards the world and its environmental and human health? Or is their duty not so vast? The same questions can be raised concerning chemicals (nano's, toxics, etc.). Producers and users of chemical substances can be at the basis of damage to others. What about the duty of care these companies and individuals owe the world and others?

Liability results from the assessment of the situation where upon the claim is based. This claim should be legitimate. Legitimate means that the plaintiff has an entitlement or a right in respect of the tortfeasor causing the damage. A correlative duty exists on the part of that tortfeasor to satisfy the claim.³²⁴ In negligence such a legitimate claim is based on a breach of the duty of care a tortfeasor has towards another person.

Negligence is thus the failure to meet a required standard defined by the reasonable care.³²⁵ In itself negligence is neither moral nor immoral.³²⁶ The question remains however how and when such a breach of the duty of care can be established. In the following paragraphs the duty of care is examined in more detail. Thereafter, in paragraph 3.2.2 and 3.2.3 the connection is made with the two main factors related to the duty of care, namely foreseeability and proximity.

2.3.2.1 The duty by itself

Neither negligence nor damage is sufficient to be held liable, a duty of care should exist between the actor and the victim. *In concreto* the duty of care can be described as the obligation a person has to refrain from an activity when it is reasonably likely that harm to another person will result. The acting person is compared with a standard, namely the reasonable man, or the '*bonus pater familias*'. It is a hypothetical who is a typical member of a specific community, behaving in situations that might pose a threat of harm (through action or inaction) as everyone in that community is entitled to expect, id est with

³²⁴ WRIGHT, R. (2001). Right, justice and tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 159-182). Oxford: Oxford University Press, p. 176.

³²⁵ ABRAHAM, K. (2011-2012, Vol. 61). Strict liability in negligence. *DePaul Law Review*, p. 274.

³²⁶ RANDALL, S. (1993). Corrective justice and the tort process. *Indiana Law Review*, p. 8.

prudence, care and self-control. It is in fact a standard of conduct towards others. A standard that the law recognizes and protects.³²⁷

The standard of the duty of care³²⁸ is mostly determined by the circumstances or conditions of the concrete case. Courts assess the existence of a duty on its reasonableness, fairness, and justice in the actual societal context³²⁹ or/and on its economic efficiency.³³⁰ A compensation or deterrence approach focuses on economic effects rather than on moral elements like justice and fairness and can thus lead to a different appreciation of the duty of care.³³¹

An economic approach is especially considered relevant when dealing with new dangers like exposure to toxic chemicals, environmental pollution and dangerous activities.³³² Generally both justice and economic elements are present, but the focus can be on one of both.

a) Reasonableness as the standard

It might seem that we are turning in circles: negligence is based on the breach of a duty of care and a duty of care is assessed when there is negligence... A better understanding can be achieved by defining what the concept of reasonable care involves.

Across the legal systems in this study the required standard of conduct is the reasonable behaviour of a reasonable person in a similar situation. Many scholars and academics claim that the criterion of reasonableness is objective,

³²⁷ CARDI, J. W. (2005, April 58 Vand. L. Rev. 739). Purging foreseeability: The New Vision of Duty and Judicial Power in the Proposed Restatement (Third) of Torts. *Vanderbilt Law Review*, p 752.

³²⁸ This research does not go into the discussion whether the duty of care is an essential, a meaningless, redundant, or other concept. The inclusion of the paragraph is based on the widespread use of the concept in litigation.

³²⁹ *Volpe versus Gallagher*, 821 A.2d 699 (R.I. 2003). Supreme Court of Rhode Island March 12, 2003); *Bozied versus City of Brookings*, 638 N.W.2d 264 (Supreme Court of South Dakota December 26, 2001); ROGERS, W. (2010). *Winfield and Jolwicz on tort*. London: Sweet & Maxwell, p. 153.

³³⁰ See the Learned Hand formula in paragraph 1.1.1.1.

³³¹ RUSTAD, M. (2011, Vol. 38). Torts as public wrongs. *Pepperdine Law Review*, p. 452.

³³² RUSTAD, M. (2011, Vol. 38). Torts as public wrongs. *Pepperdine Law Review*, pp. 433-551; LANDES, W., & POSNER, R. (1983, January). Causation in tort law: an economic approach. *Journal of Legal Studies*, pp. 109-134; LANDES, W., & POSNER, R. (1987). *The economic structure of tort law*. Cambridge, Massachusetts and London: Harvard University Press; CALABRESI, G. (1965, Vol. 78, issue 4). The Decision for Accidents: An Approach to No-fault Allocation of Costs. *Harvard Law Review*, pp. 713-745.

precisely because the standard is the ordinary man or like the French and the Dutch describe it so clearly: “*le bon père de famille*” or “*de goede huisvader*”. The standard of the reasonable person focuses on the act and actor, not on the consequences.³³³ Neither does the standard take into account any individual particularities or characteristics of the defendant.³³⁴ A person may be considered negligent although he did his best to avoid negative consequences. He just happened to be clumsier than the average person. The basic principle is that everybody should be judged by the same standard.³³⁵

On the other hand the obligation for objectivity is also interpreted flexibly. That flexibility is grounded in the vagueness of the concept of the reasonable person. Flexibility implies that the imposition of a duty cannot (always) be demanded if that duty goes beyond the abilities of the alleged tortfeasor.³³⁶ An evaluation is necessary to make duty concrete.³³⁷ This is called the moral element of tort.³³⁸ For example, apparent physical disabilities are taken into account.³³⁹

Taking into account the influence of norms and values and the standard of the reasonable man, duty can be defined as a set of obligations of care that citizens³⁴⁰ believe they owe to each other.³⁴¹ This duty can be general (i.e. to a category of people, the country, the world) or specific, (i.e. to one person in a

³³³ RANDALL, S. (1993). Corrective justice and the tort process. *Indiana Law Review*, p. 29.

³³⁴ GOLDBERG, J., & ZIPURKSY, B. (2007, Vol. 92). Tort law and moral luck. *Cornell Law Review*, pp 1123-1125; ABRAHAM, K. (2011-2012, Vol. 61). Strict liability in negligence. *DePaul Law Review*, p. 283.

³³⁵ CONTE, P. (2013). *Répertoire de droit civil - Responsabilité du fait personnel*. Editions Dalloz, § 38.

³³⁶ CONTE, P. (2013). *Répertoire de droit civil - Responsabilité du fait personnel*. Editions Dalloz, § 38.

³³⁷ KORTHALS ALTES, E., & GROEN, H. (2005). Cassatie in burgerlijke zaken. In ASSER, *Procesrecht* (pp. 99-102). Kluwer.

³³⁸ See for this discussion: WALDRON, J. (2001). Moments of Carelessness and Massive Loss. In D. OWEN, *Philosophical foundation of tort law* (pp. 387-408). Oxford: Oxford University Press, pp.387, 387-88; SCHROEDER, C. (2001). Causation, Compensation, and Moral Responsibility. In D. OWEN, *Philosophical Foundations of Tort Law* (pp. 347-362). Oxford: Oxford University Press; POSNER, R. (1972, Vol. 1). A Theory of Negligence. *Journal of Legal Studies*, pp. 29-96.

³³⁹ *Roberts versus State*, Through Louisiana Health and Human Resources Administration, 396 So.2d 566 (Court of Appeal of Louisiana, Third Circuit May 6, 1981); *Otterbeck versus Lamb*, 456 P.2d 855 (Supreme Court of Nevada July 14, 1969).

³⁴⁰ The term citizens should be understood as including legal and natural persons.

³⁴¹ GOLANSKI, A. (2011-2012, Vol. 75). A new look at duty in tort law: rehabilitating foreseeability and related themes. *Albany Law Review*, p. 239.

'relation' to another person). A balancing approach between general and specific is preferred. Thereby one seeks to balance the degree of likelihood of harm against the burden of the duty to be imposed.³⁴²

Reasonableness is thus not linked to the average person. It is referring to a typical member of a certain category in a certain situation. This means that the description can vary depending on the class or community the alleged tortfeasor is belonging to.³⁴³ The criterion used is the behaviour of a person with a similar profile in a similar situation.

As a concept reasonableness remains a workable objectifying standard that is broadly recognized throughout the four countries studied.³⁴⁴ The duty is an obligation to behave reasonably and is linked to foreseeability. The standard of reasonable is linked to the concept of the 'ordinary' man and is measurement of the duty. In concreto, the duty is (for example) to remain up to date on the knowledge concerning the risks of a chemical and reasonable is behaving as one should as a reasonable person in that situation. As such reasonableness is part of the assessment of a duty of care.

There is however also the question to whom the duty is owed and what that duty entails. These elements are discussed in the following paragraph.

b) A principle without boundaries

The duty of care is a set of obligations of care persons believe to owe to other persons³⁴⁵ or to people within the particular plaintiff's class.³⁴⁶ It is also the embodiment of moral principles.³⁴⁷ Although duty is frequently discussed and opinions differ on its value, it is widely used in litigation. The assessment of the

³⁴² Volpe versus Gallagher, 821 A.2d 699 (R.I. 2003). (Supreme Court of Rhode Island March 12, 2003).

³⁴³ VLOEMANS, N. (2010). Events are in the saddle... the terrible ifs accumulate - Over onzekere risico's en voorzorg in het aansprakelijkheidsrecht. *Aansprakelijkheid, verzekering & schade*, p. 2.

³⁴⁴ Some differences do however exist, like the US is more focused on scientific reason and France, at the other end of the spectrum, is mainly focused on the plaintiff and his rights. Reservation should also be made for other cultures than the western culture to which all four belong.

³⁴⁵ GOLANSKI, A. (2011-2012, Vol. 75). A new look at duty in tort law: rehabilitating foreseeability and related themes. *Albany Law Review*, p. 239.

³⁴⁶ GOLDBERG, J. C., & ZIPURSKY, B. C. (2001, April). The Restatement (Third) and the place of duty in negligence law. *Vanderbilt Law Review*, pp. 705-707.

³⁴⁷ GOLDBERG, J., & ZIPURSKY, B. (1998, August). The moral of MacPherson. *University of Pennsylvania Law Review*, p. 1743.

existence of a duty of care typically relies on the answer to two questions.³⁴⁸ The first and primary one is 'to whom the duty is owed'.³⁴⁹ Only thereafter the second question concerning what the duty entails can be answered.³⁵⁰

Indeed, even when a defendant was negligent, he will not be held liable if he has no duty of care towards the plaintiff. The rule 'without duty, no liability' can be found in all four countries. Duty is thereby ordinarily limited to the risks and consequences created by the actor's conduct.³⁵¹

Is the duty of care individual or universal?

The basic principle of tort, namely you should not harm another, seems to suggest that a duty of care exists towards everybody. There is always a duty because a generic standard of reasonable care is owed by and imposed on all to all.³⁵² If a person causes harm or damage to any other person then that breach of the duty is actionable negligence.³⁵³

But phrasing duty in such a broad way is quite unrealistic and not manageable. Therefore the primary question 'to whom is a duty owed' is also defined as a specific relational concept.³⁵⁴ Although the objective of deterrence goes beyond the relation between the parties in a tort claim, it would go too far to extend the duty of care to a universal and general obligation.³⁵⁵ The breach must be a breach situated in the relation between the tortfeasor and the plaintiff.

³⁴⁸ See for example Holmes-Prosser model of negligence rejecting the notion that a question exists as to whether a given defendant owes a given plaintiff a duty of care.

³⁴⁹ It should be noted that there exist quite some different opinion and doctrines on the duty of care. It is impossible to consider all of these here. Consequently I took the liberty to make a selection on what I believe is the most relevant to serve as a basis for the main topic of this dissertation: causation in relation to non-contractual liability for damage to people caused by chemicals.

³⁵⁰ Within this research the focus is on the first question.

³⁵¹ Restatement (Third) of Torts: liability for physical and emotional harm, Chapter 3. The Negligence Doctrine and Negligence Liability, § 7 Duty (2013)

³⁵² GOLDBERG, J., & ZIPURSKY, B. (1998, August). The moral of MacPherson. *University of Pennsylvania Law Review*, p. 1769.

³⁵³ Palsgraf versus Long Island Railroad Co., 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928); GOLDBERG, J. C., & ZIPURSKY, B. C. (2001, April). The Restatement (Third) and the place of duty in negligence law. *Vanderbilt Law Review*, p. 699; Restatement (Third) of Torts: liability for physical and emotional harm, § 7; POSNER, R. (1972, Vol. 1). A Theory of Negligence. *Journal of Legal Studies*, p. 38.

³⁵⁴ GOLDBERG, J. C., & ZIPURSKY, B. C. (2001, April). The Restatement (Third) and the place of duty in negligence law. *Vanderbilt Law Review*, p. 707.

³⁵⁵ Caparo Industries Plc. versus Dickman and Others, [1990] E.C.C. 313 (House of Lords February 8, 1990).

Seeking a balance between both approaches, the option is to interpret the principle of 'duty of care' in such a way that decisions are maximally universally applicable.

However, Golanski concludes that courts determine duty often in a too case-specific and fact-bound manner.³⁵⁶ Judges fail to recognize that they take normative aspects into account and/or to appreciate the social (dis)advantages of their decisions.³⁵⁷ Although Golanski refers to the US situation, the duty of care is in the other countries also decided on an individual basis, with nuances in line with the needs of the case or the authority of the court. Some examples: the Netherlands have the concept of attribution allowing a judge to decide for liability on reasonable appreciations and inferences; in UK cases up to the highest level reference is made to the ordinary or common man in the street, French judges have much freedom to decide.

Anyhow, a plaintiff has to demonstrate that a defendant's act fell below the duty of care. He needs to individuate the breach. The breach at issue should be precisely specified in relation to the alleged tortfeasor and his act, thereby the focus is on the role of the individual, alleged tortfeasor.³⁵⁸

It is clear that liability cases have a strong individual aspect, and that, at the same time these cases are embedded in the generally accepted moral and normative values of a society and/or are driven by economic considerations. For example, in line with the economic theory, if there is a 'plethora' of potential defendants and only one is chosen out them, this defendant should be dismissed for the lack of duty, because the other potential defendant(s) could have been in a better position to foresee their liability and thus could have prevented the damage in a more efficient manner.³⁵⁹

³⁵⁶ GOLANSKI, A. (2011-2012, Vol. 75). A new look at duty in tort law: rehabilitating foreseeability and related themes. *Albany Law Review*, p. 277.

³⁵⁷ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, § 12-1; URSIN, E. (2012, Spring). Clarifying the normative dimension of legal realism: the example of Holmes's the path of the law. *San Diego Law Review*, p. 494; ROGERS, W. (2010). Winfield and Jolwicz on tort. London: Sweet & Maxwell, p. 153; LEITER, B. (1997, December). Rethinking legal realism: toward a naturalized jurisprudence. *Texas Law Review*, p. 238.

³⁵⁸ STAPLETON, J. (2012). Causation in Law. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 744 - 771). Oxford: University Press, pp. 751-752.

³⁵⁹ *Edwards versus Honeywell, Inc.*, 50 F.3d 484 (United States Court of Appeals, seventh circuit April 11, 1995): Firefighter's widow brought action against alarm service, alleging

Some values and norms enter liability cases through the duty of care and its concepts of foreseeability and proximity. These two concepts are not only linked to the duty of care, but also to each other. The following paragraphs will explain both foreseeability and proximity separately and in connection.

2.3.2.2 Foreseeability and proximity: close encounters

*"For those responsible for understanding tort doctrine, the concept of foreseeability is a scourge, and its role in negligence cases is a vexing, crisscrossed morass."*³⁶⁰

Foreseeability is frequently the most salient policy issue in duty determination. However, another concept, next to foreseeability, is also important.³⁶¹ This is the principle that 'you should not hurt your neighbour' meaning that the duty extends to people in your proximity. A person is proximate if he is so closely and directly affected by the acts of the tortfeasor that it is considered reasonable that the consequences should have been taken into account by the tortfeasor.

US courts apply in the majority of their cases the criteria of (1) foreseeability of the harm, the (2) proximity between the conduct of the alleged tortfeasor and the damage, and the certainty that the plaintiff suffered (3) damage.³⁶²

The same elements are found in court decisions on tortious liability in the UK and the Netherlands.³⁶³

The French situation is different and less transparent. Without excluding the use of foreseeability and proximity in liability judgments completely, the formal

that firefighter died because of service's negligence in failing to call fire department promptly upon receiving signal from alarm in burning house. The judge decided that the alarm service did not owe duty of care to firefighters engaged in fighting fire on its customer's premises, and could thus not be held liable for death of firefighter who fell through floor of the burning house allegedly because service's delay in alerting correct fire department caused floor of house to be severely weakened by time firefighter entered. The defendant may not be in the best position to prevent a particular class of damage. All things considered, however, the creation of a duty of care running from the alarm service to Edwards is likely to make at best a marginal contribution to fire safety and one outweighed by the cost of administering such a duty. The defendant was entitled to dismissal of the suit because it had no duty of care to firefighters engaged in fighting a fire on its customer's premise

³⁶⁰ CARDI, J. W. (2005, April). Purging foreseeability: The New Vision of Duty and Judicial Power in the Proposed Restatement (Third) of Torts. *Vanderbilt Law Review*, p. 740.

³⁶¹ *Carvalho versus Toll Bros. and Developers*, 675 A.2d 209 (Supreme Court of New Jersey May 6, 1996), p. 572.

³⁶² CARDI, W. J. (2011, Vol. 91). Hidden legacy of Palsgraf. *Boston University Law Review*, pp. 1878-1885.

³⁶³ Exact data on the frequency of applying these concept are not available for the other countries.

adherence to the theory of equivalence³⁶⁴ impedes the application of the concepts.

The foreseeability of harm is a significant consideration to be made in determining the existence of a duty. This aspect will be discussed in paragraph 3.2.2.1. But, as mentioned before, the ability to foresee damage is not sufficient by itself to establish such a duty. There should also be a proximate relation between the alleged tortfeasor and the plaintiff. Proximity and its connection to foreseeability are the subject of paragraph 3.2.2.2.

a) The impact of foreseeability on duty

However the dangerousness of a substance is not sufficient to base liability on, not even when the substance 'is out of the control' of the owner or possessor. It should be foreseeably that the chemical would likely cause damage.³⁶⁵ This was the verdict in the case of Wood against Esso Petroleum Co. The plaintiff claimed that he sustained serious injury when working at the premises of the refinery. He, allegedly, had inhaled a noxious dangerous substance and consequently suffered a respiratory injury.³⁶⁶ Since it is for the claimant to prove his claim, he had to prove on the balance of probabilities that there was an escape of a hazardous substance in quantities above the threshold limit.³⁶⁷ The fact that a chemical is toxic and thus can cause harm is not sufficient. Foreseeability is linked to different elements of the tort procedure: the establishment of a duty of care, the factual analysis of the circumstances and the allegedly resulting damage. The overall meaning of the concept of foreseeability is the topic of this paragraph.

i) *The concept of foreseeability*

Foreseeability is not an objectively measurable criterion.³⁶⁸ It is a principle of interpersonal fairness and justice.³⁶⁹ What is deemed to be foreseeable always

³⁶⁴ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, § 1715.

³⁶⁵ Wood versus Esso Petroleum Co Ltd, 2011 WL 2747840 (Queen's Bench Division February 9, 2011).

³⁶⁶ Wood versus Esso Petroleum Co Ltd, 2011 WL 2747840 (Queen's Bench Division February 9, 2011), § 1 and §§ 13-15.

³⁶⁷ Wood versus Esso Petroleum Co Ltd, 2011 WL 2747840 (Queen's Bench Division February 9, 2011), § 18.

³⁶⁸ GOLANSKI, A. (2011-2012, Vol. 75). A new look at duty in tort law: rehabilitating foreseeability and related themes. *Albany Law Review*, p. 253.

requires a judgment call and thus automatically is influenced by societal values, norms and legal policy. Straightforward and simple cases do not pose any problems on this topic, but when foreseeability needs to be assessed in more complex cases, the situation is different. Long latency periods, mysterious or uncertain causing factors and the amount of knowledge necessary to foresee the damage, lead to disagreements on the assessment of the existence of foreseeability. How do courts and/or laws handle such situations?

As part of the legal phase³⁷⁰, foreseeability depends on the normative and policy context used in a particular society.³⁷¹

In the Netherlands, for example, everybody should be aware of dangers that are commonly known.³⁷² Thereby foreseeability is case and claim specific and stands in relation to the damage.³⁷³ Hence it is not necessary that the manner in which the damage emerged was foreseeable, as is shown in the Natronloog case. One day a garbage collector got hurt when he putted garbage into the turning mechanism of the garbage truck. The garbage bag contained a bucket with caustic soda (natronloog) and when the container was flatted, the alkali sprayed on the face of the collector. The eyes of the man were seriously injured. Consequently a liability claim was filed. Did the person, who placed the caustic soda in the garbage bag, behaved negligently? The court considered that it was foreseeable that something could happen with the bucket since garbage was generally manipulated frequently during its removal. The way in which the damage occurred was much less or even not foreseeable.³⁷⁴ It is however sufficient that the result is foreseeable to hold a defendant liable. The likelihood of an occurrence of a damage rather than the likelihood of the occurrence of a precise chain of events leading to the harm constitutes foreseeability.³⁷⁵ The

³⁶⁹ ROBERTSON, A. (2013, Vol. 33 issue 1). On the function of the law of negligence. *Oxford Journal of Legal Studies*, p. 33.

³⁷⁰ The legal phase, as opposite to the factual phase is explained in paragraph 3.1.2.

³⁷¹ CARDI, J. W. (2005, April). Purging foreseeability: The New Vision of Duty and Judicial Power in the Proposed Restatement (Third) of Torts. *Vanderbilt Law Review*, p 743.

³⁷² Hoge Raad 5 November 1965, LJN AB7079, *Nederlandse Jurisprudentie* 1966/136. (Kelderluikarrest)

³⁷³ GOLANSKI, A. (2011-2012, Vol. 75). A new look at duty in tort law: rehabilitating foreseeability and related themes. *Albany Law Review*, p. 232.

³⁷⁴ Hoge Raad 8 January 1982, LJN AG4306, *Nederlandse Jurisprudentie* 1982/614, note of C.J.H. Brunner. (Natronloogarrest).

³⁷⁵ *Suchomajcz versus Hummel Chemical Co.*, Newark, New Jersey, 524 F.2d 19 (United States Court of Appeals, Third Circuit September 24, 1975).

Supreme Court of the Netherlands added to the former that it is commonly expected in society to handle an unknown substance prudently. Precautions, as part of a normal duty of care, should be taken to avoid that others could be hurt by an unknown substance. Clearly the defendant in the Natronloog case did not behave in line with the normal standards. He should have foreseen that something could happen.³⁷⁶

* *Foreseeability of the damage*

Based on the former reasoning, it becomes possible that damage caused in very exceptional circumstances results in liability, because the damage in itself was foreseeable. The case of Suchomajcz versus Hummel Chemical Co. demonstrates how an (at first sight) unlikely chain of events led to foreseeable damage and thus liability. A manufacturer, Hummel, sold harmless chemicals to the professional assembler. The latter mixed these chemicals with others substances and sold the resulting firework kits illegally to a minor. The child poured some of the now dangerous mixture into a bottle, which he thereafter dropped in a park. Later on some other children found the bottle, played with it and then the bottle exploded. Children were injured and killed. This course of events was outside what could normally be expected. The court however found that the damage was foreseeable. On the basis of the information the original manufacturer of the harmless substances had about his customer, namely that the customer selling the firework kits illegally to minors, he could and should have foreseen the damage. The properties of the sold substance were overruled by the concrete substances of the case.

Mutatis mutandis unforeseeability indeed leads to non-liability, as is demonstrated by the following chain of events in Palsgraf versus Long Island Railroad Co. This case is still cited as the benchmark concerning the impact of foreseeability on duty.³⁷⁷

What happened to Helen Palsgraf, waiting unsuspectingly at the station?

A man carrying a small package was late for his train. He tried to jump aboard a wagon whilst the train was already moving. It, however, looked as if he would fall. A guard on the train reached out to help him and another guard on the

³⁷⁶ Hoge Raad 8 January 1982, LJN AG4306, *Nederlandse Jurisprudentie* 1982/614, note of C.J.H. Brunner. (Natronloogarrest).

³⁷⁷ Although, recently some discussions on the correct interpretations of the case exist.

platform pushed the man from behind. Because of all that pushing and pulling the package of the stumbling man fell on the rails and ... exploded.

Many feet away the explosion threw down some balance scales situated on the platform. These heavy scales fell upon Helen Palsgraf standing nearby, causing her injuries.³⁷⁸

The case was argued by Judge Cardozo in an appeal after the judgement of the Appellate Division of the Supreme Court.³⁷⁹ That judgement dealt with the question if the guard, who was helping the passenger with the package, was liable for the harm caused to Palsgraf, who was standing on the other side of the platform. Was she a foreseeable victim?³⁸⁰ No. Judge Cardozo found that there was no duty of care owed by the railroad employee to the plaintiff, as an unforeseeable victim, although the causal link between the negligence and her injuries was clear.

“Nothing in the situation gave notice that the falling package had in it the potency of peril to persons thus removed... If no hazard was apparent to the eye of ordinary vigilance, an act innocent and harmless, at least outward seeming, [...] did not take to itself the quality of a tort.”³⁸¹

* *Foreseeability of the victim*

However there is still another requirement in relation to foreseeability. To establish a duty of care it is necessary that not only the damage is foreseeable, but also the victim. The notion ‘victim’ is thereby to be understood rather as a ‘category’ of victims than as a specific individual. The standard of assessment is again the reasonable person. A duty of care exists only when the tortfeasor is a person who is appropriately informed, capable, aware of the law, and fair-minded.³⁸² Breaching that duty leads to liability.³⁸³

³⁷⁸ Palsgraf versus Long Island Railroad Co., 225 N.Y.S. 412 (Supreme Court of New York, Appellate Division, Second Department December 9, 1927).

³⁷⁹ Palsgraf versus Long Island Railroad Co., 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928), p. 340.

³⁸⁰ CARDI, W. J. (2011, Vol. 91). Hidden legacy of Palsgraf. *Boston University Law Review*, p. 1890.

³⁸¹ Palsgraf versus Long Island Railroad Co., 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928).

³⁸² Romero versus Superior Court, 89 Cal.App.4th 1068 (Court of Appeal, Fourth District, Division 1, California June 8, 2001);

The case of *Suchomajcz versus Hummel Chemical Co.*, already mentioned, demonstrates besides the necessity of establishing foreseeability of the damage, the requirement of foreseeability of the victim before convicting a defendant. The chemical supplied by the defendant Hummel was not dangerous by itself, but Hummel knew that the harmless chemical would be used for a potentially explosive firecracker assembly kit. He also knew that his customer was not respecting the law and would most probably sell the kits to minors.³⁸⁴ On the basis of that information available to the defendant, the court was convinced that it was not unforeseeable to Hummel that his chemical would be sold to minors and would be used in such a way that it could cause injuries to third parties.³⁸⁵ Harm was indeed inflicted. The explosion of the bottle with chemicals killed two playing children and injured another four.³⁸⁶ They were foreseeable victims.

The concept of 'foreseeability' was in the case defined as the:

"likelihood of the occurrence of a general type rather than the occurrence of a precise chain of events leading to the injury".³⁸⁷

The reasoning followed by the US court is similar to the one used in the Dutch *Natronloog* case *supra*. The fact that the defendant did not have a direct contact with the minor or the injured children was irrelevant. The intervening negligent act of a third party:

"does not constitute a superseding cause shielding a tortfeasor from liability unless the intervening act was unforeseeable, highly extraordinary, or extraordinarily negligent".³⁸⁸

³⁸³ *Donnelly Const. Co. versus Oberg/Hunt/Gilleland*, 677 P.2d 1292 (Supreme Court of Arizona, In Banc February 8, 1984), p. 187.

³⁸⁴ *Suchomajcz versus Hummel Chemical Co.*, 385 F.Supp. 1387, (United States District Court, E.D. Pennsylvania October 10, 1974), p. 24.

³⁸⁵ *Suchomajcz versus Hummel Chemical Co.*, Newark, New Jersey, 524 F.2d 19 (United States Court of Appeals, Third Circuit September 24, 1975), p. 26.

³⁸⁶ *Suchomajcz versus Hummel Chemical Co.*, 385 F.Supp. 1387, (United States District Court, E.D. Pennsylvania October 10, 1974); *Suchomajcz versus Hummel Chemical Co.*, Newark, New Jersey, 524 F.2d 19 (United States Court of Appeals, Third Circuit September 24, 1975).

³⁸⁷ *Suchomajcz versus Hummel Chemical Co.*, Newark, New Jersey, 524 F.2d 19 (United States Court of Appeals, Third Circuit September 24, 1975), p. 29.

³⁸⁸ *Suchomajcz versus Hummel Chemical Co.*, Newark, New Jersey, 524 F.2d 19 (United States Court of Appeals, Third Circuit September 24, 1975), p.28. See also: *Indian Brand Farms, Inc. versus Novartis Crop Protection Inc.*, 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010); *Flickinger's Estate versus Ritsky*, 305 A.2d 40 (Supreme Court of Pennsylvania May 23, 1973); *Hall versus E. I. Du Pont De Nemours & Co., Inc.*, 345 F.Supp. 353 (United States District Court, E. D. New York May 18, 1972).

The majority of courts in the USA³⁸⁹ concur that once foreseeability is evaluated, the most important factor whether duty exists is considered.³⁹⁰ Thereby the 'reasonable person of ordinary intelligence' sets the standard in the appreciation of the situation.³⁹¹ Would he have anticipated the occurrences? A reasonable person would avoid foreseeable damage, as well as he would have no reason to avoid unforeseeable dangers, precisely because these are unforeseeable.

The same observations are valid for the assessment of foreseeability in the UK³⁹² and the Netherlands³⁹³.

ii) Standards of foreseeability

Two features linked to foreseeability are particularly important in relation to chemical liability: reasonableness and knowledge. There exist mutually reinforcing effects of the two on predictability of toxic damage. The question is if one could or could not (1) reasonably expect somebody to have (2) knowledge on the consequences of the conduct. Or, formulated differently, if somebody has the necessary knowledge then one could reasonably expect him to use that knowledge. In the following text the role of reasonable foreseeability in relation to knowledge is analysed. The first paragraph focuses on reasonability of the foreseeability and the second paragraph describes the role knowledge has in that liability. Thereafter the last paragraph brings the concepts of reasonableness and knowledge together.

³⁸⁹ 65 % according to CARDI, W. J. (2011, Vol. 91). Hidden legacy of Palsgraf. *Boston University Law Review*.

³⁹⁰ *Giggers versus Memphis Housing Authority*, 277 S.W.3d 359 (Supreme Court of Tennessee, at Jackson February 3, 2009); *Hornback versus Archdiocese of Milwaukee*, 752 N.W.2d 862 (752 N.W.2d 862 July 16, 2008); *Smoot ex rel. Smoot versus American Elec. Power*, 671 S.E.2d 740 (Supreme Court of Appeals of West Virginia October 28, 2008); *Olivo versus Owens-Illinois, Inc.*, 895 A.2d 1143 (Supreme Court of New Jersey April 14, 2006); *Zimko versus American Cyanamid*, 905 So.2d 465 (Court of Appeal of Louisiana, Fourth Circuit July 15, 2005); *Savage versus Utah Youth Village*, 104 P.3d 1242 (Supreme Court of Utah December 3, 2004); *Indian Brand Farms, Inc. versus Novartis Crop Protection Inc.*, 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010). See also: CARDI, W. J. (2011, Vol. 91). Hidden legacy of Palsgraf. *Boston University Law Review*, pp. 1874-1914.

³⁹¹ CARDI, J. W. (2005, September 46 B.C. L. Rev. 921). Reconstructing foreseeability. *Boston College Law Review*, pp. 925-926.

³⁹² GOLANSKI, A. (2011-2012, Vol. 75). A new look at duty in tort law: rehabilitating foreseeability and related themes. *Albany Law Review*, p. 270.

³⁹³ HARTKAMP, A., & SIEBURGH, C. (2012). Asser 6-II *De verbintenis in het algemeen: Voorzienbaarheid schade als factor voor redelijke toerekening*. Kluwer; GROENE SERIE. (2009). Voorzienbaarheid van de schade bij Burgerlijk Wetboek 6. In GROENE SERIE, *Onrechtmatige daad* (p. 17.10.3). Kluwer.

* *Reasonable foreseeability*

Objective foreseeability is defined as reasonable foreseeability.

“The standard does not affix responsibility for future events that are only theoretically, remotely, or just possibly foreseeable, or even simply subjectively foreseen [...]”³⁹⁴

“[I]t applies to those future occurrences that, in light of the general experience within the industry when the product was manufactured, objectively and reasonably could have been anticipated.”³⁹⁵

As with the standard of the reasonable man, the ‘standard of reasonably foreseeable’ is aimed at guaranteeing objectivity.³⁹⁶

Also in product liability not all damages caused by a product are an acceptable basis for a claim. When a product is used for something other than its specifically intended purpose, liability will be attributed on condition that the (mis)use was reasonably foreseeable.³⁹⁷

An example will clarify above.

When damage was caused by end users mixing fungicides with an insecticide they bought from the defendant, the court conclude that it was reasonably foreseeable for the manufacturer of the product that his customers would act as they did. Several reasons were given for this conclusion. First of all, farmers combined chemicals whenever possible, since it meant that they had at least one round less to go through their fields. This practice clearly had an economic advantage. Secondly, the mixing of substances was already practiced for many years and was a well-known and common habit amongst the end-users of such products. In fact it could be considered an industry practice. Thirdly, the manufacturer’s own representatives attested that they knew about the mixing of

³⁹⁴ Port Authority of New York and New Jersey versus Arcadian Corp., 189 F.3d 305 (United States Court of Appeals, Third Circuit August 18, 1999).

³⁹⁵ Port Authority of New York and New Jersey versus Arcadian Corp., 189 F.3d 305 (United States Court of Appeals, Third Circuit August 18, 1999); *Brown v. U.S. Stove Co.*, 98 N.J. 155 (Supreme Court of New Jersey December 21, 1984).

³⁹⁶ *Indian Brand Farms, Inc. versus Novartis Crop Protection Inc.*, 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010).

³⁹⁷ *Indian Brand Farms, Inc. versus Novartis Crop Protection Inc.*, 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010), p. 227; *Port Authority of New York and New Jersey versus Arcadian Corp.*, 189 F.3d 305 (United States Court of Appeals, Third Circuit August 18, 1999).

the insecticide and fungicides.³⁹⁸ If, on the contrary, the mixing would have been only theoretical, remote, or just possibly foreseeable; the defendant would not be held liable.³⁹⁹

Next to fairness and justice, economic motives play a role in the assessment of foreseeability, as made explicit in product liability.⁴⁰⁰ Risk-utility analysis is used to determine whether a particular product creates a risk of harm that outweighs its usefulness.⁴⁰¹ Sometimes this leads to disagreements, as in the case of Indian Brand Farms.⁴⁰²

Judge Hardiman, dissenting, argued that, although the evidence suggested an awareness of the practice of mixing, the acceptance of the existence of such awareness is a subjective appreciation and does not prove that the mixing was objectively and reasonably foreseeable.⁴⁰³ Although the judge refers to fairness, his argument is clearly economic:

“Evidence suggests that the burden such testing would impose on Novartis would be substantial to say the least. [...] This yields over 850,000 tank-mix/plant combinations that Novartis would be required to test for compatibility before marketing AG600. [...] In my view, the considerable burden that the Majority's holding will impose on manufacturers is unsound public policy. Requiring Novartis to test [...] would stifle the development of agricultural pesticides and increase substantially their cost of production. This would, in turn, drive up the cost of food [...]”⁴⁰⁴

³⁹⁸ Indian Brand Farms, Inc. versus Novartis Crop Protection Inc., 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010), p. 230.

³⁹⁹ Port Authority of New York and New Jersey versus Arcadian Corp., 189 F.3d 305 (United States Court of Appeals, Third Circuit August 18, 1999), p. 314.

⁴⁰⁰ Indian Brand Farms, Inc. versus Novartis Crop Protection Inc., 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010); Port Authority of New York and New Jersey versus Arcadian Corp., 189 F.3d 305 (United States Court of Appeals, Third Circuit August 18, 1999); Brown v. U.S. Stove Co., 98 N.J. 155 (Supreme Court of New Jersey December 21, 1984).

⁴⁰¹ Indian Brand Farms, Inc. versus Novartis Crop Protection Inc., 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010), p. 227.

⁴⁰² Indian Brand Farms, Inc. versus Novartis Crop Protection Inc., 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010), p. 230.

⁴⁰³ Indian Brand Farms, Inc. versus Novartis Crop Protection Inc., 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010), p. 230.

⁴⁰⁴ Indian Brand Farms, Inc. versus Novartis Crop Protection Inc., 617 F.3d 207 (United States Court of Appeals, Third Circuit August 10, 2010), pp. 229-233.

Judge Hardiman concluded that the mixing was not objectively foreseeable to the defendant.

In the UK foreseeability is equally important when determining liability. A UK defendant is liable for any type of damage which is reasonably foreseeable to happen even in the most unusual cases, unless the risk is 'so small that a reasonable man would in the whole circumstances feel justified in neglecting it.'⁴⁰⁵

The Netherlands also explicitly use the notion of reasonableness. When basing decisions on attribution as stipulated in article 6:98 of the Dutch Code Civil, reasonableness is an important element despite the omission of the term in the article. Foreseeability is eventually part of the decision process whether liability should be attributed to a defendant. The logic that duty requires foreseeability is in practice regularly used in court decisions.⁴⁰⁶

Overall the outcomes of court cases are quite similar across the systems studied. One finds cultural and societal differences mainly in the arguments and not in the results of litigation. This brings us to another question that still needs to be answered: what if the harm is judged to be reasonably foreseeable, but the defendant claims he did not know he created a risk that would result in damage?⁴⁰⁷

* *The knowledge one has and the knowledge one should have*

Knowing about a risk makes the potential damage foreseeable. Ignorance blocks in principle foreseeability, but can ignorance be used as an argument against attribution of liability? Foreseeability is assessed by the standard of knowledge a

⁴⁰⁵ Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009); Koufos versus C. Czarnikow Ltd., [1969] 1 A.C. 350 (House of Lords October 17, 1967), § 48.

⁴⁰⁶ Hoge Raad 29 April 2011, LJN BP0567, Nederlandse Jurisprudentie 2011/406, note of T.F.E. Tjong Tjin Tai. (Melchemie); Hoge Raad 25 April 2008, LJN BC5603, Nederlandse Jurisprudentie 2008/262; Hoge Raad 31 March 2006, LJN AU6092, Nederlandse Jurisprudentie 2011/250, note of T.F.E. Tjong Tjin Tai; Hoge Raad 22 April 1992, LJN ZC1347, Nederlandse Jurisprudentie 1994/624, note of C.J.H. Brunner. (Taxisstruikarrest); Hoge Raad 25 March 1983, LJN AG4558, Nederlandse Jurisprudentie 1984/629, note of C.J.H. Brunner.

⁴⁰⁷ In this context the risk has materialized into damage and the question if risk in itself can be subject of a liability claim is not at hand in this paragraph.

defendant in a specific situation reasonably should have.⁴⁰⁸ If there exists, for example, a general and recognised practice in the relevant industry sector which has been followed in similar circumstances for a substantial period of time and without negative consequences, then the defendant/alleged tortfeasor is entitled to behave in the same way without being held liable.⁴⁰⁹ However he should continuously keep up to date on relevant developments in knowledge and technology in the sector. Changes in relevant social awareness are explicitly included in the knowledge a potential defendant should follow up and take into account during his activities.⁴¹⁰

On the other hand, when a defendant has a greater than average knowledge of risks, he is obliged to take more than average precautions.⁴¹¹

After applying above principles to the concrete situation in Abraham versus Ireson, Judge Swift argued that at the time of occurrence the danger of asbestos was solely linked to substantial exposure. It was thus unlikely that an employer would have been worried by the infrequent use of asbestos string and/or asbestos scorch pads by the plaintiff.⁴¹² There was no reason to expect that the defendant had any knowledge on asbestos above and beside the generally available information.⁴¹³ Consequently the injury to Abraham was considered not foreseeable.

In general the same approach is used in the Netherlands. But following example shows how interpretations of situations and events can differ. A judgement of

⁴⁰⁸ Williams versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011), § 55; Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009), §§ 52-53.

⁴⁰⁹ Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009). See also: Thompson versus Smiths Shiprepairers (North Shields) Ltd., [1984] Q.B. 405 (Queen's Bench Division November 14, 1983); Stokes versus Guest Keen & Nettlefold (Bolt & Nuts) Ltd, [1968] 1 W.L.R. 1776 (Birmingham Assizes October 4, 1968); Morris versus West Hartlepool Steam Navigation Co Ltd, [1956] A.C. 552 (House of Lords January 31, 1956).

⁴¹⁰ Thompson versus Smiths Shiprepairers (North Shields) Ltd., [1984] Q.B. 405 (Queen's Bench Division November 14, 1983), pp. 415-416; Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009), § 53.

⁴¹¹ Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009), § 52; Asmussen versus Filtrona United Kingdom Ltd, 2011 WL 2649361 (Queen's Bench Division District Registry (Newcastle) July 6, 2011); Asmussen versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011).

⁴¹² Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009), § 87.

⁴¹³ Abraham versus Ireson & Son Ltd., 2009 WL 22220 3 (High Court of Justice Queen's Bench Division July 31, 2009), §§ 83-85.

the Supreme Court of the Netherlands says that if you do not know that yew bushes are very toxic for horses, you cannot be held liable for the death of two horses eating from the bush you dropped nearby their meadow.⁴¹⁴ The court was especially forgiving in this case, since the defendants were living in a rural area. They would normally be held liable if the reasonable standard of knowledge in a rural area is followed.⁴¹⁵ In rural communities it is well known that yew is extremely poisonous for horses, and the defendants thus should have realized that.

* *Bringing together reasonableness and knowledge*

After above examples, it is clear that reasonableness concerning foreseeability is linked to knowledge.

Reasonable foreseeability not only includes the standard of the reasonable man, who based on 'general' experience should know that his act or activity could cause damage. It also means that foreseeability should be assessed against the knowledge that the reasonable man should have regarding the relation between his conduct and the outcomes thereof. Reasonableness is a standard, but is in foreseeability also an obligation (keeping aware of new developments, being knowledgeable as is normal for a person in a similar situation).

Reasonable foreseeability is thus a flexible and evolving concept that is to be understood in the specific circumstances and conditions of a case. An assessment of the relevant knowledge the defendant supposingly should have or has should be performed. Thereby the concept is influenced by torts' objectives like fairness, justice, public policy and economy.

Reasonable foreseeability measures the fragment of objective probability that a reasonable person could have or should have foreseen under the circumstances.⁴¹⁶

Precisely because foreseeability is highly influenced by the evolution of scientific knowledge and by the changes in public policy and societal values, the danger is that courts judge along the actual knowledge and norms, whilst the defendant

⁴¹⁴ Hoge Raad 22 April 1994, LJN ZC1347, Nederlandse Jurisprudentie 1994/624, note of C.J.H. Brunner. (Taxisstruikarrest).

⁴¹⁵ Hoge Raad 22 April 1994, LJN ZC1347, Nederlandse Jurisprudentie 1994/624, note of C.J.H. Brunner. (Taxisstruikarrest), § 2.

⁴¹⁶ PERRY, S. (2001). Responsibility for Outcomes, Risk, and the Law of Torts. In G. J. POSTEMA, *Philosophy and the Law of Torts* (pp. 72-130). Cambridge: Cambridge University Press, p. 97.

should only be held liable for what was considered 'wrong' when he acted. This is called judging by hindsight and is the subject of the following paragraph.

iii) The pitfall of hindsight

It is not exceptional that damage caused by chemical substances emerges only years or decades after the facts. Consequently the danger of judging by hindsight is lurking. Such time laps always cause difficulties and influence the applicable standard of knowledge that should be considered when deciding in such tort cases.

When dealing with a liability claim, the fact-finder should only take into account the knowledge of the danger or of the potential damage that the tortfeasor could or should have had at the time of his negligent act.⁴¹⁷ Sometimes it is very tempting to judge what happened in the past by knowledge and laws of the present. For courts it is difficult and requires discipline plus scrutiny to stick to the information and knowledge available at the time the damaging facts took place.

This is shown in the benchmark case of Cambridge Water versus Eastern Counties Leather.⁴¹⁸

The case was based on three (alternative) grounds: negligence, nuisance⁴¹⁹ and the rule in Rylands versus Fletcher.⁴²⁰ In negligence foreseeability plays a dominant role. In nuisance this is not always the case, although the evolution of the law of negligence in the past 60 years points strongly towards a requirement

⁴¹⁷ Hoge Raad 25 November 2005, LJN AT8782, Rechtspraak van de Week 2005/130, Nederlandse Jurisprudentie 2009/103, note of Giesen. (Eternit/H).

⁴¹⁸ Cambridge Water Co Ltd versus Eastern Counties Leather Plc, [1993] Env. L.R. 116 (Queen's Bench Divisional Court July 31, 1991); Cambridge Water Co Ltd versus Eastern Counties Leather Plc, [1993] Env. L.R. 287 (Court of Appeal (Civil Division) November 19, 1992); Cambridge Water Co. versus Eastern Counties Leather Plc., [1994] 2 A.C. 264 (House of Lords December 9, 1993).

⁴¹⁹ Nuisance protects the right to use and enjoy one's property. "*The essence of private nuisance is the protection of a property owner's or occupier's reasonable comfort in occupation of the land in question*", in Adkins versus Thomas Solvent Co., 440 Mich 293 (Supreme Court of Michigan July 28, 1992); Bamford versus Turnley, 122 E.R. 25 (Court of King's Bench November 5, 1860).

⁴²⁰ Rylands versus Fletcher, (1868) L.R. 3 H.L. 330 (House of Lords July 17, 1868). The Fletcher rule: "*the person who for his own purpose brings on his lands and collects and keeps there anything likely to do mischief, if it escapes, must keep it in at his peril, and if he does not do so, is prima facie answerable for all the damage which is the natural consequence of its escape.*" This rule is still holding thought refined with the introduction of natural and non-natural use of land.

that foreseeability should be a prerequisite of liability for nuisance, as it is of liability in negligence.⁴²¹

What happened? The company Eastern Counties Leather was a leather manufacturer. For a considerable period of time up to 1976, the company used a chlorinated solvent, namely perchloroethene, for degreasing the pelts.⁴²² The solvent was transported through a pipeline from the storage tanks to the machinery. During this process no evidence of spilling was found. Later on, but still before 1976, the pipeline was decommissioned. From that moment on drums containing the solvent were transported with a forklift to the factory hall and poured into the machines. The quantity of solvent needed increased significantly. There must have been frequent spillages.⁴²³ It was accepted in court that the minimum amount of spillage was some 3.200 litres.⁴²⁴ A maximum could not be guessed.⁴²⁵ The spilled perchloroethene apparently seeped into the groundwater. The solvent collected in the underground pools at or towards the base of the chalk aquifers beneath the tannery and then escaped into the chalk aquifers under the adjoining land in the direction of the borehole of Cambridge Water Corporation. This must have begun at some unspecified date well before 1976 and was still continuing in 1991.⁴²⁶

When testing the water obtained from the borehole of the Cambridge Water Corporation, organochlorines were found. Consequently the water was classified as unfit for human consumption.⁴²⁷

⁴²¹ Cambridge Water Co. versus Eastern Counties Leather Plc., [1994] 2 A.C. 264 (House of Lords December 9, 1993), p. 121; Overseas Tankship (UK) Ltd versus Miller Steamship Co Pty Ltd (The Wagon Mound) , [1967] 1 A.C. 617 (Privy Council May 25, 1966).

⁴²² Perchloroethene is part of the organochlorines. The latter are chemicals that contain carbon and chlorine. Several organochlorines are listed as persistent organic pollutants (POPs), and this list includes dioxin, polychlorinated biphenyls (PCBs), pentachlorophenol (PCP), dieldrin and DDT. <http://emedicine.medscape.com/article/815051-overview>.

⁴²³ The amount consumed varied between 50,000 and 100,000 litres per year.

⁴²⁴ Cambridge Water Co Ltd versus Eastern Counties Leather Plc, [1993] Env. L.R. 116 (Queen's Bench Divisional Court July 31, 1991), p 117 – 118.

⁴²⁵ Cambridge Water Co. versus Eastern Counties Leather Plc., [1994] 2 A.C. 264 (House of Lords December 9, 1993), p.292.

⁴²⁶ Cambridge Water Co. versus Eastern Counties Leather Plc., [1994] 2 A.C. 264 (House of Lords December 9, 1993), pp. 291-294.

⁴²⁷ When it was discovered that organochlorines are persistent and remain in an aquifer for a long period and without evaporation even forever, national rules limited the presence of these substances in water. Simultaneously international rules were also implemented, starting with in 1982 with Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption as amended by Council Directives 81/858/EEC and 91/692/EEC (further amended by Council Regulation 1882/2003/EC).

In 1991 a claim was submitted by Cambridge Water Company. Trial judge Ian Kennedy dismissed the action in nuisance.⁴²⁸ Neither were the defendants found liable in negligence, since they could not reasonably have foreseen that any environmental hazard would come from the small, but frequent spillages of the solvent.⁴²⁹

Finally the dossier was studied by the House of Lords.⁴³⁰ Their Lordships decided that foreseeability is a prerequisite of the recovery of damages in private and public nuisance. The logic that was followed is interesting. First, it was clear that at the time the defendant used the solvent nobody could have reasonably foreseen the damage it caused many years later.⁴³¹ But, at the time of the trial there was still solvent coming from the pools into the well of the Cambridge Water company. Was defendant to be held liable because he could have foreseen the damage on the basis of the continuing contamination? No, for two reasons: firstly the defendant could not have foreseen that the contamination would happen and continue and secondly, long before the knowledge on the toxicity of the solvent and the subsequent relevant legislation on the 'maximum admissible concentration' of perchloroethene, the substance had escaped the control of the defendant and was irretrievably lost. Their Lordships concluded that the tannery was not liable.⁴³²

Imagine that the court would have judged the case by the knowledge of today. Then it would have been clear that spilling the chlorinated solvents would cause

⁴²⁸ The use of the land was not proved to be non-natural. On the contrary, the storage of organochlorines for use in the tanning industry constituted a natural use of land in an industrial village, whereby the benefits to the community outweighed the risks created for adjacent occupiers. "*Where the owner of land, without willfulness or negligence, uses his land in the ordinary manner of its use, though mischief should thereby be occasioned to his neighbor, he will not be liable in damages.*" This rule was set in *Rylands versus Fletcher*, (1868) L.R. 3 H.L. 330 (House of Lords July 17, 1868), and is still holding thought refined with the introduction of natural and non-natural use of land.

⁴²⁹ *Cambridge Water Co. Ltd versus Eastern Counties Leather Plc*, [1993] Env. L.R. 116 (Queen's Bench Divisional Court July 31, 1991), pp. 106-107.

⁴³⁰ In appeal *Cambridge Water Co.* won their case in nuisance. *Cambridge Water Co.* appealed on the rule of *Rylands versus Fletcher*, i.e. the natural use of the land. The Court of Appeal held *Eastern Countries Leather* liable. The basis for the liability was that the defendant had no right to contaminate what the plaintiff was entitled to. A landowner had a natural right to uncontaminated groundwater beneath his land. It was considered sufficient that the defendant caused the pollution.

⁴³¹ *Cambridge Water Co. versus Eastern Counties Leather Plc.*, [1994] Env. L.R. 105 (House of Lords December 9, 1993), p. 127.

⁴³² *Cambridge Water Co. versus Eastern Counties Leather Plc.*, [1994] Env. L.R. 105 (House of Lords December 9, 1993).

damage to the environment and potentially to human health. Experts would have been aware of the persistence of the perchloroethene in the soil and in aquifers. Data about underground water streams and connections between reservoirs could have been used to predict the flow of the toxic chemical into the borehole of Cambridge Water Company. No doubt that Eastern Counties Leather would then be held liable.

By judging as they did, their Lordship correctly placed themselves at the time of the occurrence of the spillage and did not judge by hindsight.

But what if there exists knowledge on a particular risk, and that knowledge is not or only limited available. This is frequently the case in chemical liability, with its specialized science leading to different degrees in knowledge and access to information.

At the age of 54 Michael Williams died of mesothelioma.⁴³³ At that time he had already filed a liability claim in negligence on the basis that he allegedly had contracted his disease during his studies as an undergraduate in physics at the University of Birmingham.⁴³⁴ During his last year, Michael undertook speed of light experiments in a service tunnel beneath the university buildings. Because of the old and poor state of the isolation, dust was lying on the ground. When, after the claim was filed, the dust was analysed, all forms of asbestos: in particular, crocidolite (blue asbestos), amosite (brown asbestos) and chrysotile (white asbestos) were found.⁴³⁵ Whilst the university admitted the facts, they pleaded that these were not foreseeable.⁴³⁶

Foreseeability has to be assessed in relation to the position of the defendant at the time of exposure. In concreto, the question should be asked if it was in 1974

⁴³³ Williams versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011).

⁴³⁴ The action was also an action based on breach of common duty of care under the Occupiers' Liability Act 1957. At the trial was however agreed that the judge would only have to deal with the breach of common duty, since there was "*nothing [...] to be gained by investigating*" the Occupiers' Liability Act 1957 as an alternative. Williams versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011), § 5.

⁴³⁵ After his studies Michael worked from 1976 up to 1983 with Brown & Root UK Ltd as an airline pilot at Heathrow Airport. He worked frequently inside a hanger which was in a poor condition and was said to contain significant amounts of asbestos. Originally this company was also present in the proceeding, but after their denial that Michael had been exposed to asbestos, the claim concerning Brown & Root was withdrawn.

⁴³⁶ Williams versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011) §§ 51, 1-2.

justified to expect that the university should have foreseen the injury, namely a disease caused by asbestos.⁴³⁷

This case confirms that foreseeability involves the state of knowledge about the risks at the time of the facts using the standard not of the overall average reasonable person, but the reasonable person belonging to the same category as the defendant.

A defendant is thus judged against the knowledge of a reasonable man, but should that reasonable man take into account a reasonably foreseeable victim? Or does reasonable means that a person should take into account certain characteristics, beyond average, of potential victims before acting? What if the vulnerability of the potential victim is not observable?

Can the actor, *a contrario*, take into account that the potential victim is stronger than average? The following paragraph describes different approaches to non-average victims.

iv) Victims beneath and above average: challenges for the principle of foreseeability

A negligent defendant is liable to a foreseeable victim for foreseeable damage. The notion of foreseeable harm is based on the assumption that there is such a thing as a normal or an average degree of vulnerability on the part of potential victims.

** You should take your victim as you find him*

Normally a defendant should not be held liable for unforeseeable damage, but societal norms and values allow for some exceptions to that rule. One exception is the 'eggshell skull' rule. This principle is the concrete application of the extension of duty beyond what is normally expected.⁴³⁸ Once one has a duty of care vis-à-vis a person, a plaintiff is on the basis of that principle entitled to recover damages for all harm he has suffered, even if, because of his extreme susceptibility, the extent of it is considerably greater than might reasonably be

⁴³⁷ Williams versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011), pp. 54-55.

⁴³⁸ ABRAHAM, K. (2011-2012, Vol. 61). Strict liability in negligence. *DePaul Law Review*, p. 292; Page versus Smith, [1996] 2 W.L.R. 644 (House of Lords May 11, 1995).

foreseen.⁴³⁹ The 'eggshell skull' principle is based on public policy.⁴⁴⁰ 'The victim should be taken as he is found'.⁴⁴¹

In some cases the 'eggshell skull' exception is not accepted. Then recourse is made to the first principle that only foreseeable damage creates liability. Such an exception to the exception is strict liability in the US. In strict liability cases the general principle of being liable only for foreseeable damage is followed.⁴⁴²

An example is the case concerning petroleum gas.⁴⁴³ On September 14, 1990, a large amount of aviation fuel, diesel fuel, and gasoline from Star Enterprise had leaked into the soil and groundwater of the neighbourhood. Another significant spill occurred on December 9, 1991. A valve was left open and thirty-four thousand gallons of aviation fuel were released. The spill, contained by the dike, remained on the company's grounds for two weeks. Living nearby the spill, Mrs. Cavallo was exposed to fuel vapours and was treated by several doctors for several injuries. She claimed specifically that she was 'highly susceptible' to petroleum vapours. Subsequently the court decided that the liability of the defendant was to be assessed according to the standard of a 'normal person'. Mrs. Cavallo was not such a person, thus her claim was denied.

The other common law system, the UK, also follows the 'eggshell skull' principle. In 1961 the benchmark case of *Smith versus Leech Brain* marked the establishment of the principle that an individual is held responsible for the full consequences of his negligence, regardless of extra, or special damage resulting from the tortious act.⁴⁴⁴ Nowadays the principle still stands.⁴⁴⁵ A defendant would be held liable for all damages resulting from their wrongful conduct, even

⁴³⁹ Page versus Smith, [1996] 2 W.L.R. 644 (House of Lords May 11, 1995).

⁴⁴⁰ CARDI, J. W. (2005, April). Purging foreseeability: The New Vision of Duty and Judicial Power in the Proposed Restatement (Third) of Torts. *Vanderbilt Law Review*, p. 762; *Martinez versus Woodmar IV Condominiums Homeowners Ass'n, Inc.*, 941 P.2d 218 (Supreme Court of Arizona, In Banc June 24, 1997).

⁴⁴¹ *Bourhill versus Young*, [1943] A.C. 92 (House of Lords August 5, 1942), p. 591.

⁴⁴² *Bingham versus Terminix international company*, 896 F.Supp. 642 (US District Court, S.D. Mississippi June 15, 1995).

⁴⁴³ *Cavallo versus Star Enterprise*, 100 F.3d 1150 (United States Court of Appeals, Fourth Circuit November 20, 1996).

⁴⁴⁴ *Smith versus Leech Brain & Co*, 1961 WL 21023 (Queen's Bench Division November 17, 1961).

⁴⁴⁵ Page versus Smith, [1996] 2 W.L.R. 644 (House of Lords May 11, 1995).

beyond what would be described as normal damage. Contrary to the US the eggshell skull rule is also applied in strict liability.⁴⁴⁶

When there is a causal link between the tortious act and the damage that actually materialized courts impose liability also for the 'excess' injuries.⁴⁴⁷ However, when calculating compensation the probability of future damage caused by the predisposition tortious can be taken into account.⁴⁴⁸

In Continental law the full loss in 'eggshell' or 'thin skull' cases will be attributed to the liable person.⁴⁴⁹ The basis therefore is the same as in the Common Law systems: you take the victim as you find him.

Anno 1985 the Dutch Supreme Court declared that in principle all the consequences of a tortious act, including those caused by the predisposition of a victim, should be attributed to the tortfeasor.⁴⁵⁰

However, on the basis of 'reasonable attribution' the predisposition of a victim, i.e. his 'thin skull', is a factor that can be taken into account when deciding on the compensation.⁴⁵¹ The probability that by the predisposition future damage will occur can also be taken into account when deciding on the compensation.⁴⁵²

In France the rehabilitation of the plaintiff is for all the damage caused. The argument is that the victim should be compensated regardless of his particular condition.⁴⁵³ Again the rule 'you take the victim as you find him' is applicable. However the courts have freedom of decision, they can take into account the

⁴⁴⁶ CAMPBELL FITZPATRICK. The Thin or 'Eggshell' Skull. <http://www.cfs-law.com/eggshell.html> (accessed on 19 August 2013)

⁴⁴⁷ BAILEY, S., & NOLAN, D. (2010). The Page v Smith saga: a tale of inauspicious origins and unintended consequences. *Cambridge Law Journal*, p. 509.

⁴⁴⁸ BAILEY, S., & NOLAN, D. (2010). The Page v Smith saga: a tale of inauspicious origins and unintended consequences. *Cambridge Law Journal*, p. 509.

⁴⁴⁹ EUROPEAN GROUP ON TORT LAW. (2005). Principles of European Tort Law. Springer. p. 61.

⁴⁵⁰ Hoge Raad, 8 February 1985, *Nederlandse Jurisprudentie*, 1986/136, note of C.J.H. Brunner. (Renteneurose).

⁴⁵¹ Hoge Raad, 8 July 2011, LJV BQ3514, *Nederlandse Jurisprudentie* 2011/311; Hoge Raad 13 January 1995, LJV ZC1611, *Nederlandse Jurisprudentie* 1997/175, note of C.J.H. Brunner.

⁴⁵² Hoge Raad, 8 February 1985, *Nederlandse Jurisprudentie*, 1986/136, note of C.J.H. Brunner. (Renteneurose)

⁴⁵³ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz., nr. 1788.

predisposition of the victim and the probability of future abnormal damage when deciding on the compensation.⁴⁵⁴

* *The impact of new science on the general principle and the eggshell skull rule*
With science increasingly able to detect predispositions in humans, the influence of genetic susceptibility on liability opens novel possibilities for liability claims. Do defendants, in line with the thin skull rule, have a duty of care including idiosyncratic responses to chemicals based on the genetic susceptibility of the plaintiff? Or can genetic susceptibility be used to escape liability? Can plaintiffs use their particular genetic condition to solve issues on causation? All challenges that courts will face in the near future, especially when dealing with chemical and medical liability.

Actually, some examples of court decisions already exist.

A first example is a case whereby defendants claim they do not owe a duty of care for excessive damages based on more than average vulnerability caused by a genetic predisposition. In a Dutch asbestos case reference was made to a publication stating that next to asbestos a genetic predisposition could cause the mesothelioma. However the Dutch Supreme Court considered the publication was not sufficient to prove with enough certainty that the predisposition was more than a secondary factor. Consequently the defendant was held liable on the basis that it was common knowledge that mesothelioma is most likely caused by asbestos.⁴⁵⁵ The court did consider the possibility of a genetic predisposition, but waived its importance and relevance.

Based on actual knowledge the judgment is well-motivated. Future increased insights in genetics could however change the reasoning of courts. Then the outcome of such a court case might be different. After all, only a minority of people exposed to asbestos develop mesothelioma. It may well be that genetic aspects prove to be more important than is thought now.

⁴⁵⁴ Cassation Civile (1re chambre), 22 November 2007, *Bulletin Civile* 2007. I.366; Cassation Civile (1re chambre), 7 December 1999, *Bulletin Civile* 1999.I.337.

⁴⁵⁵ Hof 's-Gravenhage, 18 December 2012, LJV BY6205, *Nederlandse Jurisprudentie* 2013/372, § 5.1.5

PART II – The essence of tort

A second example relates to the question if genetic predisposition can be used by plaintiffs to support their case. Indeed, plaintiffs have already used genetic susceptibility when trying to circumvent causation issues.⁴⁵⁶

For example: thyroid cancer victims living near the Hanford nuclear facility argued that their background risk doubled from the exposure to radioactive wastes when their alleged genetic susceptibility to ionizing radiation was taken into account. In general such claims failed up to now. One failure in the Hanford case was the fact that the plaintiffs only submitted evidence of a genetic susceptibility in the general population and did not prove that they themselves carried the relevant susceptibility-conferring gene.⁴⁵⁷

Genetic information could on the other hand help with proving causation. In a Benlate case a specific genetic trait was identified that could have caused the plaintiffs injury. Judicial permission to genetically test the plaintiff for that specific trait was granted and a causal link was discovered. However, the court decided on the basis of the results of the test that the birth defect was caused by a specific inherited genetic mutation rather than by the exposure to the chemical substances in Benlate, although the substance was likely to be teratogenic.⁴⁵⁸

The evolution in science, as outlined above, has an impact on the foreseeability of harm caused by chemical exposures, especially when exposure and harm are separated by a considerable time lapses or distance. This brings us to the topic of the next paragraph: the condition of proximity.

b) Proximity and foreseeability

Additionally to the foreseeability of damage, it is necessary for the establishment of a duty of care that there is proximity between the party owing the duty and the party to whom that duty is owed.⁴⁵⁹ Liability for negligence should be kept within the bounds of common sense⁴⁶⁰ and practicality. But what is proximity?

⁴⁵⁶ MARCHANT, G. (2006, Vol. 14 Is. 7). Genetic data in toxic tort litigation. *Journal of Law and Policy*, p. 10.

⁴⁵⁷ In re Hanford Nuclear Reservation Litigation, 1998 WL 775340 (United States District Court, E.D. Washington August 21, 1998), p. 70.

⁴⁵⁸ Bowen versus E.I. Du Pont De Nemours and Co., Inc., 2005 WL 1952859 (Superior Court of Delaware June 23, 2005).

⁴⁵⁹ SUGARMAN, S. D. (2002, December). Rethinking Tort Doctrine: visions of a Restatement (Fourth) of Torts. *UCLA Law Review*, pp. 586-618; CARDI, J. W. (2005, April). Purging foreseeability: The New Vision of Duty and Judicial Power in the Proposed Restatement (Third) of Torts. *Vanderbilt Law Review*, pp. 739-808; Dean William C. Powers, Jr. of the

i) The principle of proximity

First it is necessary to clarify the meaning of 'proximate cause' as the concept is understood in the US versus in the Continental law system and the UK. In the latter, proximate cause refers to the 'remoteness' between an actor and a victim involved in a liability claim. This remoteness does not exclusively refer to physical distance, but also to the closeness and/or directness in relations and responsibilities.

In the US 'proximate cause' is used in two senses. One is similar to the meaning in the other legal systems: the remoteness between actor and victim. The other refers to the legal phase of causation. In that sense proximate cause includes foreseeability, proximity, and policy.⁴⁶¹ In the strict sense proximity is in the US a factual question, whilst in the second sense it is used as a "matter of policy considerations".⁴⁶² Thus, proximate cause as "legal cause" is not a question of causation; it is simply a policy determination of whether or not the defendant should be held responsible.⁴⁶³

Confusion is obvious. The new Restatement (Third) of Torts tries to correct the situation with replacing the term 'proximate cause' in its meaning of 'legal phase' by 'scope of liability'.⁴⁶⁴ Because this suggestion is quite recent, caution is still necessary when the term 'proximate cause' is used. The context should provide clarity on its actual meaning. In this study 'proximate' cause is used in its closeness/directness sense.

University of Texas School of Law and Wake Forest School of Law's, and Professor Michael D. Green in *Restatement (Third) of Torts: Liability for Physical Harm (Basic Principles)* (Tentative Draft No. 2, 2002), §§ 26-34.

⁴⁶⁰ STAUCH, M. (2001, March). Risk and remoteness of damage in negligence. *The Modern Law Review*, p. 198.

⁴⁶¹ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 131.

⁴⁶² *CSX Transp., Inc. versus McBride*, 131 S. Ct. 2630 (Supreme Court of the United States June 23, 2011), 2642; *Williamson versus Waldman*, 696 A.2d 14 (Supreme Court of New Jersey July 21, 1997), p. 20; *Derdiarian versus Felix Contr. Corp.*, 51 N.Y.2d 308 (Court of Appeals of New York November 20, 1980), p. 314; *Palsgraf versus Long Island Railroad Co.*, 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928), p. 104.

⁴⁶³ MacAYEAL, J. (2000-2001, Vol. 18). The comprehensive environmental response, compensation and liability act. *UCLA Journal of Environmental Law & Policy*, p. 238; CARDI, J. W. (2005, September 46). Reconstructing foreseeability. *Boston College Law Review*, p. 748.

⁴⁶⁴ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 6. Scope of Liability, § 33 Scope of Liability for intentional and reckless tortfeasors (2013).

* *Proximity in itself*

Proximity is more than a factual question, it is a standard for assessing if a defendant should have considered the plaintiff's interest when he thought about his acts or omissions.⁴⁶⁵ The proximity principle helps to evaluate situations that are dubious as to the existence of a duty, especially when the occurrence of the harm is unclear, i.e. indirect or difficult to estimate.⁴⁶⁶

The principle provides also answers to problems in ascribing damage to a negligent act⁴⁶⁷:

"The damage must be so connected with the negligence that the latter may be said to be a proximate cause of the former".⁴⁶⁸

Even when the damage was judged foreseeable, there is no duty of care when the nexus between a defendant's act and the particular consequences to the plaintiff is too attenuated.⁴⁶⁹

The assessment of proximity is thereby based as well on facts as on legal policy.⁴⁷⁰ A factual assessment of proximity should take place before policy questions should be considered.⁴⁷¹

The requirement of proximity was in 1932 for the first time formally used. A UK court introduced the concept in the case of *Donoghue versus Stevenson*:⁴⁷²

"persons who are so closely and directly affected by my act that I ought reasonably to have them in contemplation as being so affected when I am directing my mind to the acts or omissions that are called in question ."

⁴⁶⁵ ROBERTSON, A. (2013, Vol. 33 issue 1). On the function of the law of negligence. *Oxford Journal of Legal Studies*, p. 33.

⁴⁶⁶ SHAPO, M. (2010). *Principles of Tort Law*. St. Paul: West (Thomas Reuters), pp. 354.

⁴⁶⁷ STAUCH, M. (2001, March). Risk and remoteness of damage in negligence. *The Modern Law Review*, pp. 191 &.

⁴⁶⁸ Judge Andrews in *Palsgraf versus Long Island Railroad Co.*, 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928).

⁴⁶⁹ *Baptiste versus Better Val-U Supermarket, Inc.*, 811 A.2d 687 (Supreme Court of Connecticut December 10, 2002).

⁴⁷⁰ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press.

⁴⁷¹ See tripartite test to assess proximity, which was developed in *Caparo versus Dickman*.

When following questions are answered affirmative, proximity exists: (1) was the harm reasonably foreseeable, (2) was there a requisite degree of proximity between the claimant and the defendant, (3) is it fair, just and reasonable to impose a duty of care and not against public policy concerns. *Caparo Industries Plc. versus Dickman and Others*, [1990] E.C.C. 313 (House of Lords February 8, 1990); ROBERTSON, A. (2013, Vol. 33 issue 1). On the function of the law of negligence. *Oxford Journal of Legal Studies*, p. 35.

⁴⁷² *Donoghue versus Stevenson*, [1932] A.C. 562 (House of Lords May 26, 1932).

Until 1961 remoteness was evaluated on the basis of the existence of a direct link between the act and the consequence. A direct link was lacking if the consequence would not have occurred when a subsequent intervention of an abnormal occurrence or the voluntary act of another person intervened (*novus actus interveniens*).⁴⁷³

The standpoint in the UK is clear: for a duty to exist the consequences of an act should not only be foreseeable, but also proximate.⁴⁷⁴ Proximity is also in the UK not necessarily linked to geographical closeness. A proximate cause refers to *inter alia* the closeness of the relationship, the continuity of the relation.⁴⁷⁵

“What emerges is that, in addition to the foreseeability of damage, necessary ingredients in any situation giving rise to a duty of care are that there should exist between the party owing the duty and the party to whom it is owed a relationship characterised by the law as one of ‘proximity’ or ‘neighbourhood’ and that the situation should be one in which the court considers it fair, just and reasonable that the law should impose a duty of a given scope on the one party for the benefit of the other.”⁴⁷⁶

Deciding on the proximity in tort is not always easy. Problems do occur in cases as to how widely proximity extends. A good example is the case of Pinder versus Cape Plc.⁴⁷⁷ As a child Pinder used to play in the evenings after school and at weekends on a tip. He remembered that he got really dirty playing; dust was all over his clothes. That dust proved to be asbestos coming from Cape Plc. Pinder was clearly not an employee of the company, and neither was he in any other way related to Cape. The court had thus to investigate if Pinder was in a proximate relation to the defendant. The question was phrased as follows:

⁴⁷³ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press, pp. 136-138.

⁴⁷⁴ Home Office versus Dorset Yacht Co. Ltd., [1970] A.C. 1004 (House of Lords May 6, 1970), p. 1030.

⁴⁷⁵ Heaven versus Pender (t/a West India Graving Dock Co), 11 Q.B.D. 503 (Court of Appeal July 30, 1883), pp. 507-508; Home Office versus Dorset Yacht Co. Ltd., [1970] A.C. 1004 (House of Lords May 6, 1970), p. 1014.

⁴⁷⁶ Lord Bridge in Caparo Industries Plc. versus Dickman and Others, [1990] E.C.C. 313 (House of Lords February 8, 1990).

⁴⁷⁷ This case is not only a good example for the principles of proximity and foreseeability, but also an example of correct assessment of a situation decades ago. Pinder versus Cape Plc., 2006 WL 4402685 (High Court of Justice, Queen's Bench Division December 20, 2006).

“whether Cape could reasonably foresee that these acts or omissions would be likely to injure Mr. Pinder as a person who was so closely and directly affected by those acts or omissions that Cape ought reasonably to have had him in contemplation as being so affected when directing their mind to those acts or omissions.”⁴⁷⁸

The playground of Pinder was in fact a landfill located in a populated area with a school nearby. Across the grounds a public footpath ran. The tip was therefore attractive to children.⁴⁷⁹

Consequently Judge Ramsey declared that if it was reasonably foreseeable that a person outside the factory might be exposed to levels of dust similar to those which would have given rise to a breach of a duty of care in the workplace, then that person would have a cause of action.⁴⁸⁰ But, he added that from a common sense point of view those persons that could be affected would include those who handled and transported such dangerous wastes to the waste tips, those persons who were likely to be exposed to airborne asbestos dusts/fibres as a result of lorry loads being driven along public roads and those who were concerned with the ultimate disposal of such wastes at the landfill. Lacking the evidence that Cape knew or ought to have known that children were playing in the waste at that tip, Cape could not reasonably have foreseen that Pinder would be injured. The relation with the children playing on the tip was not proximate enough.⁴⁸¹ Consequently the court ruled that at the time of the exposure (1950s) Cape did not owe Pinder a duty of care.⁴⁸²

* *The Netherlands*

The Netherlands apply a more normative method instead of focussing on foreseeability and proximity. They use the concept of attribution, whereby reference is made to different aspects of the case. The concept of proximate

⁴⁷⁸ Pinder versus Cape Plc., 2006 WL 4402685 (High Court of Justice, Queen's Bench Division December 20, 2006), § 53.

⁴⁷⁹ See also the case of Margerson and Hancock versus J.W. Roberts Limited, [1996] Env. L.R. 304 (Court of Appeal April 2, 1996).

⁴⁸⁰ Pinder versus Cape Plc., 2006 WL 4402685 (High Court of Justice, Queen's Bench Division December 20, 2006), § 94.

⁴⁸¹ Pinder versus Cape Plc., 2006 WL 4402685 (High Court of Justice, Queen's Bench Division December 20, 2006), § 94.

⁴⁸² Pinder versus Cape Plc., 2006 WL 4402685 (High Court of Justice, Queen's Bench Division December 20, 2006), § 98.

cause never had much success in the Netherlands.⁴⁸³ According to Boonekamp the concept was developed in insurance law and refers to the last element in the causal link. In fact, proximity thus refers to '*causa proxima*' and means physical closeness.⁴⁸⁴ Besides that, the Supreme Court does not accept the concept.⁴⁸⁵

* *France*

Concerning France it must again be stressed that there are very few indications on the factors judges take into account when assessing liability.⁴⁸⁶ Although, it is clear that French judges reject the concept of proximity, which they understand as closeness in time to the damage. This definition of proximity is the reason for the rejection, since the most proximate (as they understand the concept) cause is often not the most determining element in the causation.⁴⁸⁷ Consequently the concept is considered too unfair and too rough to use.⁴⁸⁸

On the other hand, the French law uses factors like immediate, direct, which are not completely unlike the concept of proximate cause.⁴⁸⁹

ii) Proximity as part of foreseeability or the other way around

Proximate cause should be separated in a factual question of causation and a normative concept with an impact on the scope of liability as it relates to duty.⁴⁹⁰ As a normative element, proximity requires a judgement call and belongs as such to the legal cause. In practice proximity refers explicitly or implicitly to foreseeability.⁴⁹¹ Both concepts are used together:

⁴⁸³ BOONEKAMP, R. (2013). *Causa proxima*. In GROENE SERIE, *Schadevergoeding*. Amsterdam: Kluwer, § 54.

⁴⁸⁴ Hoge Raad 25 November 2005, LJN AT8782, Rechtspraak van de Week 2005/130, Nederlandse Jurisprudentie 2009/103, note of Giesen. (Eternit/H); Hoge Raad 25 September 1992, LJN ZC0691, Nederlandse Jurisprudentie 1992/751.

⁴⁸⁵ HARTKAMP, A., & SIEBURGH, C. (2013). Aannemen oorzakelijk verband in twee stappen: c.s.q.n en toerekening naar redelijkheid. In ASSER, HARTKAMP, & SIEBURGH, *Asser 6-II De verbintenis in het algemeen, tweede gedeelte* (pp. 50-55). Kluwer, § 54.

⁴⁸⁶ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 54.

⁴⁸⁷ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, § 1714.

⁴⁸⁸ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 55.

⁴⁸⁹ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 132

⁴⁹⁰ STAPLETON, J. (2001, April). Legal cause: cause-in-fact and the scope of liability for consequences. *Vanderbilt Law Review*, pp. 954-969.

⁴⁹¹ CARDI, J. W. (2005, September 46 B.C. L. Rev. 921). Reconstructing foreseeability. *Boston College Law Review*, pp. 748-749.

“The duty to take care is the duty to avoid doing or omitting to do anything the doing or omitting to do which may have as its reasonable and probable consequence injury to others, and the duty is owed to those to whom injury may reasonably and probably be anticipated if the duty is not observed.”⁴⁹²

Jane Stapleton explains, whilst denominating proximity by the term directness, that:

“The directness rule extends to all outcomes, even if not foreseeable, so long as they are the “direct” result of the tortious conduct. The more popular modern rule is that of foreseeability: freakish, “unforeseeable” outcomes are outside the scope of liability. Though it is widely acknowledged that in practice both approaches produce, or can be made to produce, the same results.”⁴⁹³

But even when the result was foreseeable and the tortfeasor’s conduct was close and direct, responsibility will not be retained if no duty of care exists. This can happen when a duty would be inconsistent with the relation between the parties, a duty would be unreasonable or would conflict with a duty owed by defendant to another person or to himself.⁴⁹⁴

Indeed a specific challenge in toxic tort cases is the harm done to a person not directly caused by the tortfeasor. Examples are the cases where people further away of the original source of exposure (like family or persons living in the neighbourhood) get harmed through an indirect contact, namely through the person who was actually exposed, but who might even not be harmed.

2.3.2.3 A duty of care to third parties

‘Secondary exposure’ or exposure of third parties takes place when the exposed person not directly comes into contact with the source of the danger, but is exposed only through an auxiliary source.⁴⁹⁵ The cause of damage and the alleged negligence is still with the tortfeasor, but runs through another person in

⁴⁹² *Bourhill versus Young*, [1943] A.C. 92 (House of Lords August 5, 1942).

⁴⁹³ STAPLETON, J. (2012). Causation in Law. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 744 - 771). Oxford: University Press, p. 996.

⁴⁹⁴ ROBERTSON, A. (2013, Vol. 33 issue 1). On the function of the law of negligence. *Oxford Journal of Legal Studies*, pp. 34-35.

⁴⁹⁵ *Gunn versus Wallsend Slipway and Engineering Co*, 1989 WL 649978 (November 7, 1988).

the proximity of the tortfeasor to a third person remote from the tortfeasor. This third person suffers damage, independently of the fact that the person standing in direct relation with the defendant has suffered damage or not.

The many cases of secondary damage through indirect exposure to asbestos suggest that similar situations might occur following exposure to other dangerous chemicals. It is therefore important to analyse this topic further. The core question is then if the defendant in such a tort case owed a duty of care towards the harmed third person. The answers differ in time, but also depend on the legal system.

In the US, the aspect of foreseeability is a decisive factor in attributing liability for secondary exposure. For example in *Zimko versus American Cyanamid*, the plaintiff was as a child who had been exposed to asbestos brought home by his father working for the defendant. It was held that the employer should have foreseen the possible damage to family members of his employees originating from taking asbestos dust home on work clothes. Consequently the employer had breached his duty of care.⁴⁹⁶

The case of *Holdampf* is somewhat different.⁴⁹⁷ *Holdampf* worked with several asbestos-containing products during his 36 years with the Port Authority. When, in 2001, his wife was diagnosed with mesothelioma, the *Holdampfs* claimed that the cause for the illness was the washing of the soiled uniforms. His employer, however, had issued *Holdampf* with five uniforms, and offered laundry services. However *Holdampf* preferred to take his dirty uniforms home for cleaning. He claimed that this was more 'convenient' and that he was unaware of the risk of secondary exposure. Conversely, his employer, the Port Authority, was aware of the potential risk caused by secondary exposure to asbestos. Should the Port Authority have warned *John Holdampf* or even have prevented him from going home with asbestos contaminated uniforms? The court held that foreseeability alone did not define the duty of care: there is no relationship between the employer and the spouse. Indeed, the condition of proximity was not. Furthermore, the defendant depended fully on the willingness of its employee to

⁴⁹⁶ *Zimko versus American Cyanamid*, 905 So.2d 465 (Court of Appeal of Louisiana, Fourth Circuit July 15, 2005). See also: *Exxon Mobil Corp. versus Altimore*, 256 S.W.3d 415 (Court of Appeals of Texas, Houston (14th Dist.) April 3, 2008); *Gunn versus Wallsend Slipway and Engineering Co*, 1989 WL 649978 (November 7, 1988).

⁴⁹⁷ *Holdampf versus Port Authority of New York and New Jersey*, 840 N.3.2d 115 (Court of Appeals of New York October 27, 2005).

change his work clothes and subsequently reduce the risk for his family.⁴⁹⁸ Both elements together lead to the decision that no duty of care existed between the employer and the spouse of his employee.⁴⁹⁹

Depending on the jurisdiction a claim for secondary exposure can be denied or accepted in the US. Concerning the litigation in the US, one could say that courts that use foreseeability as an element of causation bar secondary exposure, whilst courts considering foreseeability as part of duty recognize and accept claims for secondary exposure.^{500 501}

Imposing a duty of care involves, besides foreseeability and proximity, considerations of fairness and policy.⁵⁰²

“Once the foreseeability of an injured party is established, [...] considerations of fairness and policy govern whether the imposition of a duty is warranted.”⁵⁰³

This principle is applied in cases concerning secondary exposure. Other elements are also considered, like the relation between the involved parties, the nature of

⁴⁹⁸ *Holdampf versus Port Authority of New York and New Jersey*, 840 N.3.2d 115 (Court of Appeals of New York October 27, 2005), pp. 493-496.

⁴⁹⁹ *Holdampf versus Port Authority of New York and New Jersey*, 840 N.3.2d 115 (Court of Appeals of New York October 27, 2005), p. 493; *Hamilton versus Beretta U.S.A. Corp.*, 727 N.Y.S.2d 7 (Court of Appeals of New York April 26, 2001); *Pulka versus Edelman*, 390 N.Y.S.2d 393 (Court of Appeals of New York December 2, 1976).

⁵⁰⁰ KENDALL, M. (2006-2007, Vol. 1). *Settling the dust: Trends in bystander asbestos exposure litigation. Charleston Law. Review.* p. 208.

⁵⁰¹ Since the discussion of foreseeability in causation or in duty is mainly driven by the different tasks of a judge and a jury, the subject is mainly relevant for the US system. Anyhow, going into this rather complex issue does not add to this study. For those who want to learn more about it, reference is made to two articles: KENDALL, M. (2006-2007, Vol. 1). *Settling the dust: Trends in bystander asbestos exposure litigation. Charleston Law. Review*, pp. 207-218 and CARDI, J. W. (2005, September 46 B.C. L. Rev. 921). *Reconstructing foreseeability. Boston College Law Review*, pp. 921-1014.

⁵⁰² *Olivo versus Owens-Illinois, Inc.*, 895 A.2d 1143 (Supreme Court of New Jersey April 14, 2006), p. 401; *Overseas Tankship (U.K.) Ltd. versus Morts Dock & Engineering Co. Ltd. (the Wagon Mound)*, [1961] A.C. 388 (Judicial Committee - On Appeal from the Supreme Court January 18, 1961).

⁵⁰³ *Olivo versus Owens-Illinois, Inc.*, 895 A.2d 1143 (Supreme Court of New Jersey April 14, 2006); *Zimko versus American Cyanamid*, 905 So.2d 465 (Court of Appeal of Louisiana, Fourth Circuit July 15, 2005); *Widera v Ettco Wire & Cable Corp.*, 204 A.D.2d 306 (Supreme Court, Appellate Division, Second Department, New York May 2, 1994); *Carter Lincoln-Mercury, Inc., Leasing Div. versus EMAR Group, Inc.*, 638 A.2d 1288 (Supreme Court of New Jersey April 12, 1994), p. 195; *Goldberg versus Housing Authority of City of Newark*, 186 A.2d at 293 (Supreme Court of New Jersey December 3, 1962).

the risk, the opportunity and ability to exercise proper care, and the public interest.⁵⁰⁴

The UK courts also accept liability for exposure to third persons, i.e. people that had no direct relation with the tortfeasor. In *Margerson versus Roberts* a claim was filled in negligence directly to the alleged source of the damage and not on the basis of an action for pollution of the environment or something similar.

In that case⁵⁰⁵ the court had to deal with environmental exposure to asbestos dust resulting in mesothelioma. The plaintiffs lived in proximity to a factory in which asbestos was very extensively used. Asbestos could not be kept within the walls of the factory and thus the judge decided that protection/safety measures could also not be restricted to the inner circle of the walls. Textual it was said that

“no doubt that in the immediate vicinity of the premises factory conditions in terms of dust emission were at various points effectively replicated so as to give rise to like foresight of potential injury to those exposed for prolonged periods.”⁵⁰⁶

On the continent, the Dutch system is likewise confronted with liability cases concerning damage to third parties.

The concept of secondary exposure is recognized in relation to asbestos.⁵⁰⁷ But, there is no reason why the same approach would not be used similar cases concerning other chemicals, pending adequate proof of causation. Article 6:162 Civil Code offers ample possibilities to attribute liability in such cases:

“(1) [...]

(2) Als onrechtmatige daad worden aangemerkt een inbreuk op een recht en een doen of nalaten in strijd met een wettelijke plicht of met hetgeen volgens ongeschreven recht in het maatschappelijk verkeer

⁵⁰⁴ *Olivo versus Owens-Illinois, Inc.*, 895 A.2d 1143 (Supreme Court of New Jersey April 14, 2006), p. 401 and *Carvalho versus Toll Bros. and Developers*, 675 A.2d 209 (Supreme Court of New Jersey May 6, 1996), p 1149.

⁵⁰⁵ *Margerson/Hancock versus J.W. Roberts Limited*, *Environmental Law Review*. 304 (Court of Appeal April 2, 1996).

⁵⁰⁶ *Margerson/Hancock versus J.W. Roberts Limited*, *Environmental Law Review* (Court of Appeal April 2, 1996), p. 140.

⁵⁰⁷ Rechtbank Rotterdam 12 October 2011, LJN BT8484, *Nederlandse Jurisprudentie Feitenrechtspraak* 2011/473; Rechtbank Rotterdam 8 July 2009, LJN BL1548, www.rechtspraak.nl; Rechtbank Almelo 27 January 1999, LJN AJ6587, *Verkeersrecht* 2000/24.

betaamt, een en ander behoudens de aanwezigheid van een rechtvaardigingsgrond.⁵⁰⁸

(3) Een onrechtmatige daad kan aan de dader worden toegerekend, indien zij te wijten is aan zijn schuld of aan een oorzaak welke krachtens de wet of de in het verkeer geldende opvattingen voor zijn rekening komt.”⁵⁰⁹

Is secondary exposure related to the issue of intervening acts as a potential breach of the chain of causation? In principle causation needs to be direct if liability is to be attributed.⁵¹⁰ If the period between the tortious act and the damage is long, the chance that a breach of the chain of causation occurs increases. Then the attribution of liability to the first actor is no longer reasonable. This has however nothing to do with secondary exposure, but only with the concept of ‘intervening act’. Intervening acts are known in all four countries.⁵¹¹

The conclusion is that secondary exposure does have a role in the attribution of chemical liability. Concerning causation there is, however, not a different standard, but an enlarged interpretation of proximity.

⁵⁰⁸ Free translation: “A tortious act is an infringement of a right and an act or omission violating a legal obligation or an unwritten societal norm, except when a formal justification exists for that act.”

⁵⁰⁹ Free translation: “A tortious act can be attributed to an actor if he committed a fault or when the attribution can be based in the law or in the act contrary to the applicable norms.”

⁵¹⁰ France: LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, § 1777; Netherlands: Hoge Raad 7 June 2013, LJV BZ1721, *Rechtspraak van de Week* 2013/762; Rechtbank Rotterdam 12 October 2011, LJV BT8484, *Nederlandse Jurisprudentie Feitenrechtspraak* 2011/473; Hoge Raad 31 March 2006, LJV AU6092, *Nederlandse Jurisprudentie* 2011/250, note of T.F.E. Tjong Tjin Tai.

⁵¹¹ US: Stone versus Secretary of Health and Human Services, 676 F.3d 1373 (United States Court of Appeals, Federal Circuit April 26, 2012); Pittway Corp. versus Collins, 973 A.2d 771 (Court of Appeals of Maryland June 12, 2009); Herrera versus Quality Pontiac, 73 P.3d 181 (Supreme Court of New Mexico May 16, 2003); UK: Environment Agency versus Ellis, [2009] P.I.Q.R. P5 (Court of Appeal (Civil Division) October 17, 2008); Corr versus IBC Vehicles Ltd, [2008] 1 A.C. 884 (House of Lords February 27, 2008); Knightley versus Johns and Others, [1982] 1 W.L.R. 349 (Court of Appeal March 27, 1981); Netherlands: Unfortunately I could not find any civil case explicitly mentioning this reasoning. There is however, in my opinion, no reason why a similar reasoning concerning causation could not be applied in civil litigation, especially since the principle of reasonable attribution is also used in criminal judgments. Hoge Raad 25 June 1996, LJV ZD0496, *Nederlandse Jurisprudentie* 1997/563, note of A.C. 't Hart. (Niet-behandelde longinfectie, strafkamer); Hoge Raad 12 September 1978, LJV AC2616, *Nederlandse Jurisprudentie* 1979/60 (strafzaak); France: LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, § 1777.

2.3.3 Acts and omissions

Before liability can be attributed an act or an omission is necessary. In the following paragraphs the essential elements of both are detailed.

2.3.3.1 The damage is (allegedly) related to an act of the defendant

If anyone of ordinary sense would in a specific situation at once recognise that, if he did not use ordinary care in his action, danger would emerge and that person still acts despite the danger, he will be liable for the damage to the other.

“Actionable negligence consists in the neglect of the use of ordinary care or skill towards a person to whom the defendant owes the duty of observing ordinary care and skill, by which neglect the plaintiff, [...], has suffered injury to his person or property.”⁵¹²

This statement is said to be the first explicit mention of the ‘ordinary man’ as the standard for evaluating the negligence of conduct or activity.

The concept of the ‘ordinary or reasonable man’ is across legal systems a basic principle of negligence: a person acts negligently if he departs from the conduct expected of a reasonably prudent person.

The concrete implementation of the concept takes into account the circumstances of the case plus the knowledge the ordinary person should normally have in the situations concerned. A layperson handling a toxic chemical (like dimethylformamide, a solvent used in the pharmaceutical industry) is judged differently than the professional chemist.

When defining negligence and the reasonable person the US Restatement (Third) of Torts relies on fact-sensitive risk-utility standards of reasonableness.⁵¹³

“A person acts negligently if the person does not exercise reasonable care under all the circumstances. Primary factors to consider in ascertaining whether the person's conduct lacks reasonable care are the foreseeable likelihood that the person's conduct will result in harm, the

⁵¹² Heaven versus Pender (t/a West India Graving Dock Co), 11 Q.B.D. 503 (Court of Appeal July 30, 1883), pp. 508-509.

⁵¹³ HENDERSON, J. (2002-2003, Vol. 50). Why negligence dominates tort. *UCLA Law Review*, pp. 402-403.

foreseeable severity of any harm that may ensue, and the burden of precautions to eliminate or reduce the risk of harm.”⁵¹⁴

The moral content of the negligence principle combined with the standard of the reasonable person and with the conduct of individual actors enables courts to reach rational and consistent judgments.⁵¹⁵ However, refining the standard of negligence to each actual and individual situation is not feasible. Such an approach would result in legal uncertainty and in excessive additional economic and litigation costs. Consequently a more general application of the standard of a ‘reasonable person’ is chosen as the benchmark.⁵¹⁶ A tortfeasor is always compared to that standard. As a consequence a person can act wrongfully even though he does not have the ability to act otherwise.⁵¹⁷ The fact that not everybody is (always) able to act as the reasonable person, does not prevent liability despite the particular and individual circumstances preventing behaviour like a reasonable person.

Such situation can be appreciated as being unfair. Moral values indeed reject this common standard in certain situations. For example, most tort systems do not hold small children to the standard of the reasonable person. In line with the objective of justice it is difficult to sustain the principle beyond all particularities of specific situations. Tort can neither dissociate from all moral standards, nor relinquish all intuitive or common sense influences and impacts.⁵¹⁸

France is a concrete example thereof. The French legal system uses the standard of the ordinary man (*le bon père de famille*), but legal scholars are conscious that the interpretation of the standard is often, if not always, based on less objective elements. As Conte describes it:

⁵¹⁴ Restatement (Third) of Torts, Liability for Physical and Emotional Harm, Chapter 1. Intent, Recklessness, and Negligence: Definitions, § 3 Negligence (2013)

⁵¹⁵ HENDERSON, J. (2002-2003, Vol. 50). Why negligence dominates tort. *UCLA Law Review*, p. 403.

⁵¹⁶ In the UK often referred to as the “ordinary man”, in the Netherlands known as (e.g.) the “goede huisvader” and in France called “*le bon père de famille*”.

⁵¹⁷ GOLDBERG, J., & ZIPURKSY, B. (2007, Vol. 92). Tort law and moral luck. *Cornell Law Review*, p. 1161.

⁵¹⁸ See the chapter 2.1 on ‘The objectives of Tort’.

“En réalité, il est probable que le juge, sans égard excessif pour les débats doctrinaux, s'interroge tout simplement sur ce qu'aurait été sa propre conduite dans les mêmes circonstances...”⁵¹⁹

The French Court of Cassation supports the pragmatic approach of the trials judges in this matter. Its decisions in this matter have been stable since long.⁵²⁰ Indeed the French judges in civil liability have an extensive freedom to decide as they like. According to Le Tourneau, the reason therefore can be found in the acceptance of the brief motivations of court decisions, the incompleteness of the Civil Code and the absence of a comprehensive review of the legalisation.⁵²¹ Indeed the French Civil Code is brief on its requirements relating to motivation of judgements. It is difficult to understand that no regulation on proof is included in the French Civil Code.⁵²² A reform of the Code is desired by French scholars.⁵²³

The former makes it likewise difficult to analyse and pinpoint the methodology and reasoning behind liability judgments. Additionally the lack of motivation and the lack of a transparent thinking process is present as well in the higher courts, like the Court of Cassation, as in the lower trial courts.

The Dutch approach is comparable to the French in accepting 'subjective' arguments. The difference is though that decisions are explicitly motivated. The influence of moral values on and personal interpretation of the concept of the reasonable man is made concrete in law, e.g. in article 6:162 of the Civil Code introducing the concept of attribution. Next to that principle of reasonable attribution, the Dutch Supreme Court declared that alleged negligence should be assessed against the societal standard of negligence. The application of the standard can be found in the Eternit case. The court used for its judgment the

⁵¹⁹ CONTE, P. (2013). *Répertoire de droit civil - Responsabilité du fait personnel*. Editions Dalloz, § 11: “In fact, it is likely that the judge, without excessive consideration of doctrine, assesses the situation in line with what he himself would have done in that situation.” (Free translation)

⁵²⁰ Cour de Cassation (2^e chambre) 24 November 1955, *Dalloz* 1956/163.

⁵²¹ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, § 12-1.

⁵²² VERGES, E. (2014). *La réforme du droit de la preuve civile : enjeux et écueils d'une occasion à ne pas manquer*. Dalloz, p. 617.

⁵²³ VERGES, E. (2014). *La réforme du droit de la preuve civile : enjeux et écueils d'une occasion à ne pas manquer*. Dalloz, p. 617 ; LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz,

societal opinion at the time of the alleged tortious acts.⁵²⁴ That approach is fully in line with article 6:162, point 2 of the Civil Code:

“Als onrechtmatige daad worden aangemerkt een inbreuk op een recht en een doen of nalaten in strijd met een wettelijke plicht of met hetgeen volgens ongeschreven recht in het maatschappelijk verkeer betaamt, een en ander behoudens de aanwezigheid van een rechtvaardigingsgrond.”

Based on above analysis, it is clear that the criteria for holding a defendant negligent are quite similar across the four countries: negligent is a person who could foresee the consequences of his act, but omits to do the necessary to prevent damage to others.⁵²⁵ The basic standard for evaluation of conduct is thereby the ordinary man in similar circumstances.

Besides the similarities some differences between the legal systems exist. These differences are mainly situated in (the clearness of) the motivation of a decision and the transparency of the methodology and considerations leading to the decision. Sometimes moral and societal values are clearly referred to (Netherlands), sometimes these are hidden in the concept of the reasonable man as an objective standard (Anglo-American) and sometimes these are engrossed in the authority of the judge and the court (France). A description suiting all could be the following:

“The required standard of conduct is that of the reasonable person in the circumstances, and depends, in particular, on the nature and value of the protected interest involved, the dangerousness of the activity, the expertise to be expected of a person carrying it on, the foreseeability of the damage, the relationship of proximity or special reliance between those involved, as well as the availability and the costs of precautionary or alternative methods.”⁵²⁶

⁵²⁴ Hoge Raad 25 November 2005, LJN AT8782, *Rechtspraak van de Week* 2005/130, *Nederlandse Jurisprudentie* 2009/103, note of Giesen, par. 3.3. (Eternit/H).

⁵²⁵ VAN MAANEN, G. (2008). De Nederlandse Kelderluikarresten. Al meer dan honderd jaar -rechtseconomisch(!) - op de goede weg in Europa. *Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 5-16.

⁵²⁶ Article 4/102 (1) of PETL, in EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer.

The former paragraphs dealt with affirmative acts, behaviour that brings about a harm. But the failure to act can also cause damage. Can the creation of harm by omission also lead to liability?

2.3.3.2 Omissions or the defendant remained passive and damage (allegedly) resulted

In general omissions, or the failure to act, do not create a duty of care. However they can lead to a breach of the duty of care. In fact an omission is just a special type of conduct. It is the act of not doing that creates the damage. Good examples thereof are the failures to follow safety instructions, the failures to observe users guidances or simply the failure not to close the cupboard with toxic chemicals in the presence of children.

It is fully in line with the objective and the doctrine of negligence that such 'omitted acts' create liability through a breach of duty if damage was to occur.⁵²⁷

But can we on the basis of the former paragraphs conclude that being negligent is sufficient to be held liable? After all everybody regularly acts negligently. Frequently negligence goes unnoticed. Thus, first of all, damage should be caused if liability claims are to be granted. Besides that, another important element is to be considered. Liability in negligence for harm is linked to the duty of care. The existence of a duty of care between the tortfeasor and the plaintiff is core. The principle of the duty of care is analysed in the following paragraph.

2.3.4 Intentional or not: is the difference important?

Intent on behalf of the alleged tortfeasor is in some situations relevant, but what is the exact impact of having an intention or having no intention?

Tortious liability can indeed exist for both intentional and non-intentional acts.⁵²⁸

An intentional act is to be understood with a broader meaning than in ordinary language.

Intention refers not only to acting with a conscious purpose, it also includes acting whilst knowing that the consequence is substantially certain or

⁵²⁷ Per Lord Goff in *Maloco versus Littlewoods Organization Ltd.*, [1987] A.C. 241 (House of Lords February 5, 1987): "*the common law does not impose liability for what are called pure omissions*".

⁵²⁸ Fault liability covers both categories. In the US negligence is grounded in fault. See for example: RANDALL, S. (1993). Corrective justice and the tort process. *Indiana Law Review*, p. 8.

foreseeable to result in damage.⁵²⁹ It is not necessary that one has a specific damage in mind in order to classify an act as intentional.⁵³⁰ A general awareness of potential damage or injury is sufficient.

Acts with the intention (purpose) to cause damage are frequently criminal acts. But for a behaviour to be considered criminal, the willingness to cause harm should be present. In an intentional tortious behaviour the harm is not the objective. Such behaviour gives rise to a presumption of liability.⁵³¹ Evidence that there is knowledge that harm is substantially certain to result is sufficient to show that the harm is intentional, even if the actor did not desire to bring about the harm.⁵³²

Following is an example of a situation where the harm was foreseeable, but the target was not.

Due to a transformer failure, a toxic amount of polychlorinated biphenyl's (PCBs) was released on the floor of the Crown Zellerbach factory. Employees were ordered to clean up the spill. They had to scrub the floor while on hands and knees without protective clothing and this during five days. The company (defendant) was warned by the authorities that the concentration of PCBs highly exceeded the authorized levels. Previously the company always contracted specialists when in need for a clean-up of PCBs. This time however, the task was assigned to temporary workers unfamiliar with the circumstances and the substances. Based on this conduct by the company, it was held that a conscious

⁵²⁹ Restatement (third) of Torts: Liability for Physical and Emotional Harm, Chapter 2. Liability for Physical Harm, Liability for Intentional Physical Harm, § 5 Liability for Intentional Physical Harm (2013); Restatement (Third) of Torts, General Principles, Chapter 1. Intent and Recklessness: definitions, § 1 Intent (2013).

⁵³⁰ Without going further into this topic, it must be said that not in all areas of personal injury litigation knowledge is sufficient to base intentional tort on. One example of such area is the workers'-compensation programs provide only compensation for occupational injury. Restatement (Third) of Torts, General Principles, Chapter 1. Intent and Recklessness: definitions, § 1 Intent (2013).comment (a).

⁵³¹ Restatement (Third) of Torts, General Principles, Chapter 1. Intent and Recklessness: definitions, § 1 Intent (2013)

⁵³² Although the interpretation of the standards 'certain' and 'reasonably certain' differs amongst jurisdictions. See for example: Kielwein versus Gulf Nuclear, Inc., 783 S.W.2d 746 (Court of Appeals of Texas, Houston January 4, 1990); Gulden versus Crown Zellerbach Corp., 890 F.2d 195 (United States Court of Appeal, Ninth Circuit November 24, 1989); Beauchamp versus Dow Chemical Co., 427 Mich. 21 (Supreme Court of Michigan December 23, 1986).

choice was made to have the temporary employee clean up the released substance, whilst knowing that injury would occur. Intent was inferred.⁵³³

A substantial certainty that damage will follow from an act is the basic criterion for intentional tort. A substantial likelihood is not sufficient to make the tortious behaviour intentional.

The difference between intentional and non-intentional is mainly important in the Anglo-American system because of their specific categories in tort, making a distinction between battery, assault, negligence.⁵³⁴ Although these categories no longer have specific procedural restrictions, plaintiffs still have to choose one or more causes of action when filing a liability claim.⁵³⁵ In the US intentional tortious acts can, for example, lead to a claim in tort above and beyond the rights established in strict liability.⁵³⁶ When opting for intentional tort the plaintiff has to prove the intention.⁵³⁷ It thus adds an element to the requirements of proof.⁵³⁸

In the Continental Law system intentional and non-intentional tort does exist, but the distinction between both is not really relevant for the court's appreciation of liability. In the Netherlands intention is, for example, used as one of the elements that can influence the size of the compensation.⁵³⁹

In France intention is rarely required in liability. Negligence in general suffice or liability is strict.⁵⁴⁰

⁵³³ *Gulden versus Crown Zellerbach Corp.*, 890 F.2d 195 (United States Court of Appeal, Ninth Circuit November 24, 1989)

⁵³⁴ VAN GERVEN, W. (2000). *National, Supranational and International Tort Law*. Oxford: Hart Publishing, p. 44.

⁵³⁵ Restatement (third) of Torts: Liability for Physical and Emotional Harm, Chapter 2. Liability for Physical Harm, Liability for Intentional Physical Harm § 5 Liability for Intentional Physical Harm (2013); Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 6. Scope of Liability, § 33 Scope of Liability for intentional and reckless tortfeasors (2013).

⁵³⁶ Restatement (Third) of Torts, General Principles, Chapter 1. Intent and Recklessness: definitions, § 1 Intent (2013).

⁵³⁷ Restatement (Third) of Torts, General Principles, Chapter 1. Intent and Recklessness: definitions, § 1 Intent (2013); EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, p. 69.

⁵³⁸ This is an aspect of liability is not studied in this project and will thus not be discussed in detail. For more information the article by Nancy Moore is a good start. MOORE, N. (2011-2012, Vol. 61). Intent and consent in the tort of battery: confusion and controversy. *American University Law Review*, p. 1589

⁵³⁹ Hoge Raad 18 March 2005, LJN AR5213, *Nederlandse Jurisprudentie* 2006/606.

⁵⁴⁰ VAN DAM, C. (2006). *European Tort Law*. Oxford: Oxford University Press, p. 185, nr. 802-1.

Transposing the situation of the Crown Zellerbach factory⁵⁴¹ to the Continental system, the company would have breached the duty of care.⁵⁴² The required standard of conduct was not observed when having laypersons clean-up the PCBs without safety equipment and without warning. Both intent and negligence are on the same level, leading to liability in tort.

Claims based on negligence or non-intentional tortious acts are the most common in tort. Negligence is thereby linked to an assessment of a number of conditions surrounding the conduct and acts of the alleged tortfeasor. In some cases, negligence was considered not the appropriate tool. Strict liability was consequently implemented. The next chapter analysis the characteristics of strict liability.

2.4 Strict liability

2.4.1 Justification for strict liability

Under strict liability one can be held liable without proof of fault or negligence.⁵⁴³ It is an exception to the standard tort system and, as such, limited to specific situations.⁵⁴⁴ Indeed, the lack of the wrongfulness requirement (namely avoidable and undesirable conduct) leaves strict liability without the moral and economic justifications of tort.⁵⁴⁵ *De facto* strict liability favours some categories of victims, by assuming that the defendant acted wrongfully.⁵⁴⁶ Justifications used for strict liability are often the fact that an activity creates (increased) risk

⁵⁴¹ Gulden versus Crown Zellerbach Corp., 890 F.2d 195 (United States Court of Appeal, Ninth Circuit November 24, 1989).

⁵⁴² Abstraction is made of the role of employers' liability in this example.

⁵⁴³ Cane distinguishes conduct-based strict liability, relationship-based strict liability or vicarious liability and outcome strict liability. For more information, see CANE, P. (1997). *The anatomy of tort law*. Oxford: Hart Publishing.

⁵⁴⁴ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 5.

⁵⁴⁵ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 119.

⁵⁴⁶ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 119.

and risk-spreading.⁵⁴⁷ Generally a notion of dangerousness is present.⁵⁴⁸ Furthermore, strict liability is frequently imposed on persons who have a superior knowledge about risks and safety and thus are in a better position to take precautionary measures in order to avoid damages or to reduce risk.⁵⁴⁹ However, strict liability does not equal absolute liability.⁵⁵⁰ It is a solution benefiting the plaintiff, but the latter still has to prove a causal link.⁵⁵¹

In negligence a defendant is not held liable unless the duty of care was not respected, nor would one be held liable for damage when the cost of preventing the creation of the risk is higher than the losses that might occur (see the theory of law and economics⁵⁵²). Strict liability deviates from those principles. It puts (for example) liability on the creator of the dangerous situation who benefits from the activity. Strict liability tends to encourage effective and extensive reduction of risks, whilst distributing the costs more fairly when the risks materializes.⁵⁵³ In concreto, strict products liability encourages defendants to produce and develop safe products, promotes risk-spreading amongst the manufacturers and reliefs the plaintiff from the duty to prove the negligence of the manufacturer.⁵⁵⁴

⁵⁴⁷ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p.5.

⁵⁴⁸ KOCH, B., & KOZIOL, H. (n.d.). Comparative conclusions. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability*. European Centre of Tort and Insurance Law, p. 406

⁵⁴⁹ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, pp. 91-93; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p 120.

⁵⁵⁰ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 4. Strict liability, (2013)

⁵⁵¹ ASTRACHAN, D. (1992, July). *Anderson v. Owens-Corning Fiberglass Corp.: asbestos manufacturers and strict liability: just how strict is it?* *Pacific Law Journal*, pp. 1815-1820.

⁵⁵² FAURE, M. (2005). Economic analysis of fault. In P. WIDMER, *Unification of tort law: fault* (pp. 311-330). The Hague, London, New York: Kluwer Law International, p. 314; EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, p 79.

⁵⁵³ POSTEMA, G. (2007). Introduction: Search for an explanatory theory of torts. In G. J. POSTEMA, *Philosophy and the law of torts* (pp. 1-21). Cambridge: Cambridge University Press, p. 6.

⁵⁵⁴ ASTRACHAN, D. (1992, July). *Anderson v. Owens-Corning Fiberglass Corp.: asbestos manufacturers and strict liability: just how strict is it?* *Pacific Law Journal*, p. 1821.

In the Continental Law System strict liability is mostly limited to specific dangers listed by statute.⁵⁵⁵ In this legislation specific objectives and activities are incorporated on the basis of their dangerousness.⁵⁵⁶

Despite the attempt to frame the scope of strict liability, strict and standard tort liability are more frequent seen as a continuum than as two separate categories.⁵⁵⁷ The four countries do not perceive a need for special rules for strict liability beyond the superfluity of fault or negligence.⁵⁵⁸ The allocation of the burden of proof does not formally differ from general rules.⁵⁵⁹ The same is true for causation. There is no presumption of causal links.⁵⁶⁰ The plaintiff has to find the responsible tortfeasor and then he should prove causation.⁵⁶¹ For example, a plaintiff will still have to prove his exposure to a toxic substance before the defendant can be held strictly liable for the harm. There is, but in a few cases, no need for special rules on causation in strict liability.⁵⁶²

2.4.2 Dangerous objects and dangerous activities

Strict liability for creating danger can be based on the act of creating a risk or on the object that is created. Dutch law focuses on the control of dangerous things, whilst France relies on the dangerousness of an activity.⁵⁶³

2.4.2.1 The Netherlands

In the Netherlands article 6:173 of the Civil Code applies to objects that do not meet reasonable safety standards.⁵⁶⁴ In practice this means that the plaintiff

⁵⁵⁵ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 610.

⁵⁵⁶ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, pp. 103-104.

⁵⁵⁷ ROGERS, H. (2002). England. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 101-126). The Hague, London, New York: Kluwer Law International, nr. 1.

⁵⁵⁸ KOCH, B., & KOZIOL, H. (n.d.). Comparative conclusions. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability*. European Centre of Tort and Insurance Law, p. 425

⁵⁵⁹ ROGERS, H. (2002). England. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 101-126). The Hague, London, New York: Kluwer Law International, nr. 4

⁵⁶⁰ ROGERS, H. (2002). England. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 101-126). The Hague, London, New York: Kluwer Law International, nr. 53

⁵⁶¹ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 465.

⁵⁶² KOCH, B., & KOZIOL, H. (2002). Comparative conclusions. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 395-436). The Hague, London, New York: Kluwer Law International, p. 425.

⁵⁶³ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 623.

must prove that the object was defective.⁵⁶⁵ If objects do not present a serious danger resulting from their defect, then these are not subject to strict liability unless they explicitly fall within the scope of rules in the Civil Code.⁵⁶⁶ For example the professional user or professional owner of a dangerous substance is liable for the harm that the substance might cause.

2.4.2.2 France

The French situation is different. France particularly favours strict liability. The keeper of an object is liable just because he is the custodian.⁵⁶⁷ The Court of Cassation has confirmed the strict custodial liability for many different

⁵⁶⁴ Art.173 of the Dutch Civil Code:

- (1) De bezitter van een roerende zaak waarvan bekend is dat zij, zo zij niet voldoet aan de eisen die men in de gegeven omstandigheden aan de zaak mag stellen, een bijzonder gevaar voor personen of zaken oplevert, is, wanneer dit gevaar zich verwezenlijkt, aansprakelijk, tenzij aansprakelijkheid op grond van de vorige afdeling zou hebben ontbroken indien hij dit gevaar op het tijdstip van ontstaan daarvan zou hebben gekend.
- (2) Indien de zaak niet aan de in het vorige lid bedoelde eisen voldoet wegens een gebrek als bedoeld in afdeling 3 van titel 3, bestaat geen aansprakelijkheid op grond van het vorige lid voor schade als in die afdeling bedoeld, tenzij (a) alle omstandigheden in aanmerking genomen, aannemelijk is dat het gebrek niet bestond op het tijdstip waarop het product in het verkeer is gebracht of dat het gebrek op een later tijdstip is ontstaan; of (b) het betreft zaakschade terzake waarvan krachtens afdeling 3 van titel 3 geen recht op vergoeding bestaat op grond van de in die afdeling geregelde franchise.
- (3) De vorige leden zijn niet van toepassing op dieren, schepen en luchtvaartuigen.

Translation:

- (1) The possessor of a movable thing, of which is known that it causes great danger for people and property when it does not meet the standards which in the circumstances may be set for such equipment, is liable if this potential danger is realized, unless he would not have been liable under the previous Section if he would have known of the danger at the time it occurred.
- (2). If the movable thing does not meet the standards referred to in the previous paragraph because it has a safety defect as meant in Section 6.3.3 of the Civil Code, no liability exists on the basis of the previous paragraph for damage as meant in Section 6.3.3 of the Civil Code, unless:
- a. it is plausible, taken all circumstances into account, that the defect did not exist at the time that the movable thing (product) was put into circulation on the market or that the defect has arisen after this moment, or;
- b. it concerns damage to any item of property other than the defective movable thing (product) itself, to the point of which under Section 6.3.3 6 of the Civil Code no right of compensation exists on the basis of the threshold as regulated in that Section.
- (3). The previous paragraphs do not apply to animals, ships and aircraft.

⁵⁶⁵ In practice the proof of the defect of an object is mitigated by the application of the *res ipsa loquitur* principle. Hoge Raad 18 March 2005, LJN AR5213, *Nederlandse Jurisprudentie* 2006/606.

⁵⁶⁶ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 626.

⁵⁶⁷ Art. 1384 of the French Civil Code: A person is liable not only for the damages he causes by his own act, but also for that which is caused by the acts of persons for whom he is responsible, or by things which are in his custody.

objects.⁵⁶⁸ It does not matter if the object is defective or not. The presumption of liability can only be removed if the defendant proves that the damage did not result from the object under custody and that the foreign cause cannot be attributed to the object.

Concerning dangerous objects the French focus on the activity rather than on the object. Article 1362 of the Civil Code states that one who undertakes an abnormally dangerous activity is obliged to compensate any harm caused by that activity, even when the act was lawful. Except for the annihilation of the requirement to prove the negligence/fault of the defendant, the plaintiff still has to prove the damage, the defect and the causal relationship between defect and damage, as would be the case in 'standard' tort.⁵⁶⁹

2.4.2.3 The Common Law

The US also have a specific liability for physical harm caused by dangerous activities.⁵⁷⁰

"An activity is abnormally dangerous if: (1) the activity creates a foreseeable and highly significant risk of physical harm even when reasonable care is exercised by all actors; and (2) the activity is not one of common usage."

The liability is for creating a significant risk of physical harm, whereby the former relates as well to the likelihood of the damage as to the severity of the harm.⁵⁷¹ When the defendant has taken all reasonable precautions in relation to his dangerous activity, then the strict liability remains relevant and applicable. Indeed the actor is still liable although he respected the duty of care, because the risk still exists even when reasonable care is practiced.⁵⁷² The Supreme Court held that someone who, for his own purposes, keeps abnormally dangerous things is strictly liable to others for harm caused by these things.⁵⁷³

⁵⁶⁸ Cour de Cassation Civile (2e Chambre) 24 February 2005, nr. 03-17.190.

⁵⁶⁹ Art. 1386-1389 of the French Civil Code.

⁵⁷⁰ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 4. Strict liability, § 20 Abnormally Dangerous activities, (2013).

⁵⁷¹ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 4. Strict liability, § 20 Abnormally Dangerous activities, (2013), comment (b).

⁵⁷² Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 4. Strict liability, § 20 Abnormally Dangerous activities, (2013), comment (b).

⁵⁷³ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 637.

An example is the Department of Environmental Protection versus Ventron.⁵⁷⁴ The disposal of waste containing mercury and other toxic substances was considered an abnormally dangerous activity because it was scientifically recognized that these substances could cause environmental harms. The fact that the disposal of waste was not listed as an abnormally dangerous activity was not decisive.

Dangerous objects in a situation or activity that is not classified as dangerous can still fall under strict liability.⁵⁷⁵

Despite the fact that the US regards the UK case of Rylands versus Fletcher as their basis for strict liability⁵⁷⁶, the concept of strict liability is not considered a formal liability in the UK. After the application of the Rylands versus Fletcher rule in different cases, the concept was stopped by Read versus Lyons:

“a man is not, in the absence of negligence, liable in respect of things, whether they are called dangerous or not, which he has brought or collected or manufactured on his premises. The manufacture of high explosive shells does not impose on the manufacturer an absolute liability for any personal injuries which may be sustained in consequence of his operations.”⁵⁷⁷

The Pearson Commission, working on a statutory scheme for tort in the 1970s, suggested a strict liability scheme for any dangerous thing or activity that caused damage.⁵⁷⁸ This recommendation was ignored and it seems to be ‘no reason to suppose that Parliament will be any more receptive to the idea in future’.⁵⁷⁹

⁵⁷⁴ Dept. of Environmental Protection versus Ventron Corp., 468 A.2d 150 (Supreme Court of New Jersey July 21, 1983).

⁵⁷⁵ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 637.

⁵⁷⁶ In this case strict liability was imposed for dangerous substances which escaped from the defendant’s land and caused damage to other property. Rylands versus Fletcher, (1868) L.R. 3 H.L. 330 (House of Lords July 17, 1868).

⁵⁷⁷ Read versus Lyons & Co Ltd., [1947] A.C. 156 (House of Lords October 18, 1946).

⁵⁷⁸ The Royal Commission on Civil Liability and Compensation for Personal Injury, better known as the Pearson commission was a United Kingdom royal commission, established in 1973 under the chairmanship of Lord Pearson. See The Pearson commission recommendations at <http://hansard.millbanksystems.com/lords/1983/nov/29/the-pearson-commission-recommendations>.

⁵⁷⁹ NOLAN, D. (2005). The distinctiveness of Rylands v Fletcher. *Law Quarterly Review*, pp. 447-448.

Still the House of Lords, in *Transco versus Stockport Metropolitan Borough Council* leaves the possibility to use of the Rylands rule open. Lord Bingham stated:

“there is in my opinion a category of case, however small it may be, in which it seems just to impose liability even in the absence of fault.”⁵⁸⁰

It remains thus possible that in some cases strict liability will be applied.

2.4.3 Strict liability as a solution

What is then the added value of strict liability for toxic tort? Generally plaintiffs who pursue a claim concerning damage caused by exposure to chemicals in strict liability are entitled to recourse simply because they suffered damage from exposure to a specific risk.⁵⁸¹ Indeed, strict liability is, as said before, not liability for wrongful conduct, but for engaging in certain risk creating activity.⁵⁸² The plaintiff does not have to prove fault or negligence on behalf of the defendant.⁵⁸³ It is sufficient if he finds the tortfeasor and proves a causal link between the product and his injury. The defendant is held liable, even when he is blameless. The absence of fault on behalf of the actor has as a consequence that there is no longer a criterion for deciding on whom the liability should rest.⁵⁸⁴ This is the difference between strict liability and shifting the burden of proof from the plaintiff to the defendant. Shifting the burden of proof does not alter the basis of tort as strict liability does. The defendant still should have behaved incorrectly.⁵⁸⁵ The justification of shifting the burden of proof is that the defendant is in a much better position concerning knowledge and (material) possibilities to find out what exactly happened.⁵⁸⁶ The defendant has the

⁵⁸⁰ *Transco Plc versus Stockport Metropolitan Borough Council*, [2003] UKHL 61 (House of Lords November 19, 2003).

⁵⁸¹ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 614.

⁵⁸² HONORE, T. (2001 (reprint)). Necessary and sufficient conditions in tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 363-385). Oxford: Oxford University Press, p. 369

⁵⁸³ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, pp. 464-465.

⁵⁸⁴ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 92.

⁵⁸⁵ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 94.

⁵⁸⁶ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 94.

obligation to prove that he did not commit a tort if he wants to escape liability. Both systems have in common that they protect the interests of the plaintiff.

It is possible to cumulate strict and fault liability.⁵⁸⁷ Some exceptions exist. In the US an alleged victim's claim under product liability is exclusive.⁵⁸⁸

This is not the case for strict liability concerning dangerous activities. Industrial accidents frequently involve parallel claims in strict liability and for negligence.⁵⁸⁹

Strict liability is not based on any assessment of the wrongfulness of the defendant's behaviour. Cane describes strict liability as the liability for the consequences of conduct and not for the defendant's conduct in itself, as it is in fault liability.⁵⁹⁰ Consequently one can be held liable without having been involved in the tortious acts.⁵⁹¹ As Perry describes strict liability:

"A theory rooted in outcome-responsibility [...] does not necessarily have to point to any action-guiding norm that the defendant's harm-causing behaviour violated before it can treat her as outcome-responsible for the harm and therefore as potentially liable for it in tort."⁵⁹²

In strict liability causation is sufficient to hold a defendant liable. Examples of litigation whereby defendants who could be or were innocent were convicted, are the cases concerning pharmaceuticals (like Bendectin or DES) and exposures

⁵⁸⁷ ROGERS, H. (2002). England. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 101-126). The Hague, London, New York: Kluwer Law International, nr. 59; SCHWARTZ, G. (2002). United States. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 351-361). The Hague, London, New York: Kluwer Law International, nr. 42; GALAND-CARVAL, S. (2002). Strict liability under French Law. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 127-147). The Hague, London, New York: Kluwer Law International, nr. 32; DU PERRON, E., & VAN BOOM, W. (2002). Netherlands. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 227-256). The Hague, London, New York: Kluwer Law International, nr. 127.

⁵⁸⁸ SCHWARTZ, G. (2002). United States. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 351-361). The Hague, London, New York: Kluwer Law International, nr. 42.

⁵⁸⁹ ROGERS, H. (2002). England. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 101-126). The Hague, London, New York: Kluwer Law International, nr. 59.

⁵⁹⁰ CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 91.

⁵⁹¹ HONORE, T. (2001 (reprint)). Necessary and sufficient conditions in tort law. In D. OWEN, *Philosophical foundations of tort law* (pp. 363-385). Oxford: Oxford University Press, p. 373.

⁵⁹² PERRY, S. (2001). Responsibility for Outcomes, Risk, and the Law of Torts. In G. J. POSTEMA, *Philosophy and the Law of Torts* (pp. 72-130). Cambridge: Cambridge University Press, p. 81.

to asbestos or pesticides (like Agent Orange), in which it was impossible to identify the actual tortfeasor. Recently market share liability is, in some jurisdictions, used as a tool to soften the consequences of convictions in such cases.

France is a strong believer in the advantages of strict liability. In that country strict liability has almost superseded liability for negligence.⁵⁹³ One can find the system in public law as well as in private law.⁵⁹⁴ The latter is concretized in the principle of 'equality before public burdens'. It is considered only fair that a person suffering from a lawful act or decision which benefits society as a whole, should be compensated for his damage.⁵⁹⁵

Add to this the fact that the French courts are willing to apply these rules extensively, the popularity of strict liability is clear.⁵⁹⁶ Overall, a tendency to a broader interpretation of strict liability regimes is noticeable in different European systems.⁵⁹⁷

On the other hand, the US has a number of dangerous activities that remain covered by standard negligence liability.⁵⁹⁸ These activities are sufficiently covered by an adequate application of the negligence standard. The amount of care is in such situation assessed in relation to the dangerousness of the activity or act. Increased precautionary measures are required.⁵⁹⁹ Failing to meet that

⁵⁹³ GALAND-CARVAL, S. (2002). Strict liability under French Law. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 127-147). The Hague, London, New York: Kluwer Law International, nr. 1

⁵⁹⁴ GALAND-CARVAL, S. (2002). Strict liability under French Law. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 127-147). The Hague, London, New York: Kluwer Law International, nr. 3

⁵⁹⁵ GALAND-CARVAL, S. (2002). Strict liability under French Law. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 127-147). The Hague, London, New York: Kluwer Law International, nrs. 18-19

⁵⁹⁶ GALAND-CARVAL, S. (2002). Strict liability under French Law. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 127-147). The Hague, London, New York: Kluwer Law International, nrs. 10 & 37

⁵⁹⁷ BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 614.

⁵⁹⁸ SCHWARTZ, G. (2002). United States. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 351-361). The Hague, London, New York: Kluwer Law International, nr. 1.

⁵⁹⁹ SCHWARTZ, G. (2002). United States. In B. KOCH, & H. KOZIOL, *Unification of tort law: strict liability* (pp. 351-361). The Hague, London, New York: Kluwer Law International, nr. 1

requirement leads to liability. In fact, the degree of risk created by the tortfeasor is balanced against the requirement for care.

The core of strict liability is the fact that actors are held accountable for damage which originates in their acts or activities. As such strict liability is the concretisation of the principle that losses should be borne by the doer, *in casu* the enterprise, rather than distributed on the basis of fault/negligence.⁶⁰⁰ The system is fair when risks are not reciprocal. In other words, when there is no balance between the benefits, *id est* the freedom to act, of the potential injurers and the right of the potential victims not to be harmed.⁶⁰¹ Strict liability is implemented to restore this unbalance. Strict liability is frequently considered a solution to fairness and cost problems.

“Today, partly as a reaction to this doctrinal call for coherency, various statutory solutions as well as proposals have been suggested to widen the scope of strict liability clauses”⁶⁰²

Last but not least, some scholars doubt the usefulness of strict liability. This discussion is not held in this study. For more information on advantages and disadvantages of strict liability the cited works of Nolan, Honoré and Bergkamp are recommended.⁶⁰³

2.5 Some concluding remarks

Tort is the area of law that is the most influenced by its practical application. This is the case as well in the Continental Law systems as in Common Law. Essential for an action in tort is that damage is caused to another person. The loss incurred by the victim is shifted to the actor who caused it. This is an exception to the general rule that a loss lies where it falls.

⁶⁰⁰ KEATING, G. (2008, Vol. 37). The heroic enterprise of the asbestos cases. *South-western University Law Review*, p. 626.

⁶⁰¹ KEATING, G. (2008, Vol. 37). The heroic enterprise of the asbestos cases. *South-western University Law Review*, p. 628.

⁶⁰² BUYUKSAGIS, E., & VAN BOOM, W. (2013, Vol. 44). Strict liability in contemporary European codification: torn between objects, activities and their risks. *Georgetown Journal of International Law*, p. 610.

⁶⁰³ NOLAN, D. (2005). The distinctiveness of Rylands v Fletcher. *Law Quarterly Review*, pp. 421-450. HONORE, T. (2001). The morality of tort law: questions and answers. In D. OWEN, *Philosophical foundations of tort law* (pp. 73-95). Oxford: Oxford University Press; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International.

PART II – The essence of tort

Tort is also an area of law that leads to several discussions on its objectives. Since this is not the place for an extensive elaboration on tort doctrines, the choice was made to focus on the two most prominent and relevant theories, namely 'law and economics' and distributive/corrective 'justice'. Both are applied in standard tort, but, more importantly, also in toxic tort cases. Those cases frequently have a substantial economic impact. Consequently they benefit from maximizing efficiency, as well as deterring wrongful conduct involving chemicals. On the other hand, justice is also pertinent. The individual, exposed to a toxin suffers a loss, seeks recourse in tort and encounters several difficulties when proving his claim. The moral theories provide guidance on the basis of an interpretative rather than functionalistic approach. Normative grounds for compensation and deterrence are necessary, because the questions on what type of losses should be compensated and what type of behaviour should be deterred, are not answered by the economic theories. A normative theory is able to explain and justify the principle features of a system coherently.

Although the principle of tort remains that a victim should be compensated for damage wrongfully inflicted upon him, it is clear that the choice of theory will influence the outcome of litigation. The choice of doctrine is influenced by culture and is an expression of the values and the policies of a society.

Overall it can be said that the theory of law and economics is less prominent in Europe than in the US. However the economical approach is now used more frequently in Continental Law. One of the reasons therefore is the increasing internationalisation. The advantage of the economical language is that it is understood everywhere. In law and economics legal obligations aim at an optimum level of efficiency and deterrence. Achieving these objectives minimizes the social costs (precaution costs plus expected harm). Tools to assist court in the realisation of economic objectives have been developed. These tools have in common that their practical application is difficult and sometimes impossible, because courts lack sufficient information and often do not have the knowledge necessary. Algorithms like the Learned Hand, cost-benefit analysis, the Pareto efficiency and the Kaldor-Hicks efficiency have only a limited success.

Whilst the law and economic approach is useful and popular, many legal scholars admit that the law of tort should be limited and guided by some moral justifications. The moral theory of distributive and corrective justice

counterweights the approach of the economic theory. The justice theory is essentially relational.

Both variations of the justice doctrine aim at attaining the equal freedom of each person, but each approaches the equality from a different perspective. Corrective justice is based on an individual interaction, whereby both parties are equal regardless of their personal wealth, merit or need. Distributive justice is independent of individual interaction. Equality means that resources must be attributed amongst the members of a society following their (relative) ranking under some criterion of merit or need. The French culture of social contract is an example of distributive justice.

Because tort is essentially between private parties and is thus not directly concerned with societal issues, the corrective justice view is more appropriate for litigation. This does not mean that a tort system has no impact on society or completely disregards its social role, but it is not its primary objective.

Justice doctrines also have the advantage of being 'easy' to use in court. Indeed, taut economic formulas like the Learned Hand Formula, or the Pareto principle, although leading to more determinant results, are complicated and difficult to use because of the frequent lack of information to make a solid financial calculation of the damages and the profits.

The former brings us to the question concerning the role of causation in relation to tort's objectives. Opinions differ in line with the chosen doctrine.

Some legal economists believe that there is no added value in requiring proof of causal links. The objectives of tort can be achieved without it. The economic efficiency of a tort system increases by holding an act as the decisive factor for liability. Additionally they argue that if a risk creator is held liable for the simple reason that he acted, then he would always take enough care to minimize the costs.

In fact legal economists focus on risk creation. Thereby damage and risk have no longer a one-to-one relation. There exist several acts without which a certain result would not occur. The selection of the damaging act is possible using other standards than causation.

On the other hand, several academics adhering to the law and economics doctrine see a benefit in requiring proof of causation. Establishing causal links can reduce costs, because it prevents errors in judgments by delineating the

actual harm suffered and by holding the defendant liable for his act(s) and for compensating a specific victim. Lowering or abandoning the standards of causation leads to an imbalance between tortfeasors and plaintiffs.

Corrective justice agrees that proof of causation is necessary. Moreover, following this doctrine liability cannot be withheld without a causal link. Liability without causation is some kind of social insurance, based on the imposition of risk (by the defendant) and risk is not a basis for a claim in tort. Corrective justice requires physical/observable injury causally linked to a damaging event. A causal link is sufficient. There is no need to look for 'the' causal link.

Toxic tort is special. Causation is in such cases difficult to prove and to assess, mainly because of the long latency periods and the scientific difficulties to link damage to a chemical.

These difficulties exist especially when there is a lack of knowledge concerning the consequences at the time of exposure and the proof of the concrete facts are not retrievable.

When neither the person who acted wrongfully, nor the damage can be identified, it is not possible for toxic tort to take economic efficient decisions.⁶⁰⁴ In other words, toxic tort fails to meet his objectives when an eroded causation standard is used.⁶⁰⁵

The tort system is difficult to understand when limiting oneself to one approach. Both law and economics and justice have advantages and they are in practice not mutually exclusive. In many court cases both economic and moral arguments are considered. Limiting tort to one doctrine, whether that is economic or moral, distorts the tort system. Some scholars argue for mixed theories, whereby the core of tort law are the moral concerns and the economic approach the supporting fabric. However the discussion has not yet ended.

Besides the theories, there is the practice. Tort systems consist of standards and rules establishing the procedures and the elements to be considered and respected. There exists for example fault liability and negligence liability.

⁶⁰⁴ MOSHER, J. C. (2003, Vol. 11). A pound of cause for a penny of proof: the failed economy of an eroded causation standard in toxic tort cases. *New York University Environmental Law Journal*, p. 604.

⁶⁰⁵ WRIGHT, R. (1987). The Efficiency Theory of causation and responsibility: unscientific formalism and false semantics. *Chicago-Kent Law Review*, pp. 576-577.

Negligence takes the majority of the tort litigation in all four countries. Negligence as a concept is more complex than fault and has several aspects that need interpretation and judgment.

Negligence is based on the existence of a duty of care. This duty is combined with two other factors, namely foreseeability and proximity. All three concepts are interrelated and reciprocal.

The duty of care is the reasonable care one person owes to another person; it is a relational concept. The duty is determined by the circumstances of the case and exists between the alleged tortfeasor(s) and the plaintiff(s) in a specific situation. Although the assessment is individual, the courts aim at decisions that are in their essence similar across similar cases.

When a person is expected to act with care, he should act as a reasonable person would in a similar situation. Concerning liability the focus is thus on the act and not on the consequences.

But duty alone is not sufficient: the damage should have been foreseeable for the reasonable person in a similar situation. It is important to note that the result and the victim of the act should be foreseeable and not the chain of events leading to that result. This implies an assessment of the concrete situation. Standards differ according to the position of the alleged tortfeasor, relating for example to his knowledge. A housewife working with a rare toxic chemical and carelessly harming a bystander will be assessed differently on foreseeability than the professional who works daily with the chemical.

The third criterion is proximity. The tortfeasor and his victim should not be too far apart. This is not referring to a physical distance. A person is proximate if he is so closely and directly affected by the acts of the tortfeasor that it is considered reasonable that the consequences should have been taken into account by the tortfeasor. In France and the Netherlands the concept of proximity is not used. It is in these countries understood as exclusively referring to a factual distance.

Despite these rules, the overall conclusion remains that there exists no simple formula or definition providing an answer in every case if a duty of care exists. 'Foreseeability', 'proximity', 'just and reasonable', 'fair' are not precise definitions, rather they are elements that must be examined in each individual case before it can be determined if a duty of care exists. If then a duty exists

foreseeability and proximity determine the scope and extent of the duty and thus the liability.

When all of above standards are met, the defendant is held liable for the damage he caused, unless some regulation exonerates him.

With the increase of tort cases relating to chemicals, strict liability developed considerably. Although there is more than one reason to implement a strict liability system, generally a notion of dangerousness is present.

The difference between standard and strict liability is that in the first a person is not held liable if he was not negligent or did not make a fault. Strict liability deviates from that principle. It puts liability on the creator of the dangerous situation benefiting from the activity. Wrongful behaviour is not necessary. Strict liability encourages effective reduction of risks, whilst distributing the costs of resulting damage more widely.

Except of the annulations of the requirement to prove fault or negligence, the other standards of general tort remain applicable. The allocation of the burden of proof rests on the plaintiff. There is no presumption of causal links. The plaintiff has to find the responsible tortfeasor and then he should prove causation.

Dutch law focuses on the control of dangerous things. France particularly favours strict liability. Strict liability is thereby no homogeneous category and includes several different regimes. The French courts are willing to apply these rules extensively. Concerning strict liability for objects, the keeper of an object is liable just because he is the custodian. It does not matter if the object is defective or not. The French Court of Cassation confirmed the strict custodial liability for many different objects.

The US has a liability system for creating a significant risk of physical harm, whereby the former relates as well to the likelihood of the damage as to the severity of the harm. A number of dangerous activities however remain covered by standard negligence liability. These activities are considered sufficiently covered by an adequate application of the negligence standard.

In all four countries it is possible to cumulate strict and fault liability. In the US an exception on that rule is made for product liability. A victim's claim under that liability is exclusive.

PART II – The essence of tort

Part II has given an overview of the most relevant aspects of tort in relation to the topic of this study. The next part studies different approaches and theories on causation.

Causation is particularly important in toxic tort because of the many difficulties relating to proof. On top dealing with chemicals always requires scientific knowledge and insights, with as a consequence that toxic tort brings together the particularities of law and science.

Part III – Causation

Causation is in human life and experience, it is also omnipresent. As Hume phrased it:

*"All kinds of reasoning consist in nothing but a comparison, and a discovery of those relations, either constant or inconstant, which two or more objects bear to each other."*⁶⁰⁶

3.1 Causation: a condition for liability

Toxic tort or chemical liability is the term used for liability claims concerning damages arising from exposure to a harmful chemical or substance. Such cases follow the same rules as other liability cases, although over time nuances and exceptions have slipped into the litigation. Many of the differences between cases concerning chemical liability and 'standard' tort cases are related to causation and the proof thereof. The traditional *conditio sine qua non* test⁶⁰⁷ is, for example, difficult to apply due to the long latency periods of chemical injuries and the lack of traceability of the allegedly causing substance. But, the test is also arduous in cases with more than one possible source of damage or with multiple tortfeasors. Both frequently occur in situations where people are injured by chemicals.

Causation is important in human life, it is also omnipresent:

*"All kinds of reasoning consist in nothing but a comparison, and a discovery of those relations, either constant or inconstant, which two or more objects bear to each other."*⁶⁰⁸

Cause became also important in law when it was formally recognized that a person was allowed to protect his property by the use of physical force. The *conditio sine qua non* requirement was the first test for assessing the causal link between an alleged tortfeasor and the harmed plaintiff. This principle originated in the *actio legis Aquiliae*, as this statute developed during the reception of

⁶⁰⁶ David Hume (Edinburgh 26 April 1711 - Edinburgh 25 August 1776) in HUME, D. (2003). A treatise of human nature. New York: Dover Publications.

⁶⁰⁷ The Common Law usually uses the denomination '*but for*'. To secure a clear difference with ordinary language the term *conditio sine qua non* will be used.

⁶⁰⁸ David Hume (Edinburgh 26 April 1711 - Edinburgh 25 August 1776) in HUME, D. (2003). A treatise of human nature. New York: Dover Publications.

Roman law in Europe. Starting in the twelfth century the *conditio sine qua non* became a more comprehensive principle that allowed to find compensation for all losses that resulted from physical damage or personal injury. At that time, causation was looked at from a practical standpoint. The causal link between the fault and the result was not discussed explicitly.⁶⁰⁹ In modern times the *actio legis Aquiliae* developed into the rules governing non-contractual or tortious liability, thereby also influencing significantly the English common law and by proxy also the USA system.⁶¹⁰

In 2005 the European Group on Tort Law⁶¹¹ defined *conditio sine qua non* as an activity or conduct that 'is a cause of the victim's damage if, in the absence of the activity, the damage would not have occurred'. This general principle can be found in any legal system, although not always explicitly. It is presumably the basis of the similarity in judgments across legal regimes, despite the considerably distinct approaches in these individual legal systems, also within Europe.⁶¹² It are these differences that can be used to learn about chemical liability and consequently make the judicial process more transparent. Or formulated as a question: how do the different legal systems work with causation and what are the respective strengths and weaknesses? It is clear that, due to the complexity of tort cases involving damage allegedly caused by chemicals, the *conditio sine qua non* principle is no longer sufficient.

Chapter 1 will elaborate on the process of identifying and deciding on causation. The second chapter studies a selection of alternative causal doctrines chosen for their practical relevance in relation to the particularities of chemical liability in this matter: common sense (2.1), substantiality of the cause (2.2), causes considered as elements of a causal entirety (2.3) are analysed. The relevance of the different approaches is subsequently linked to chemical damage through a hypothetical example in chapter 3. Thereby a comparison is made between the different legal regimes in the US and UK as examples of Common law and in

⁶⁰⁹ BERMAN, H. (1983). *Law and revolution*. Cambridge, Massachusetts and London: Harvard University Press, p. 148.

⁶¹⁰ WINIGER, B., KOZIOL, H., KOCH, B., ZIMMERMANN, R. (2007). *Digest of European Tort Law, Volume 1: Essential Cases on Natural Causation*. Vienna: Springer, p 10.

⁶¹¹ EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, Art. 3:101.

⁶¹² JANSEN, N., ZIMMERMAN, R. (2010, Vol. 69). A European Civil Code in all but name: discussing the nature and purposes of the draft common frame of reference. *Cambridge Law Journal*, p 103.

France and the Netherlands as representatives of Continental law. Chapter 4 finally summarises some thoughts and gives some conclusions.

But first it should be clear what is to be understood by the concept of causation in tort litigation.

3.1.1 What is causation?

Liability occurs when damage is wrongfully caused to another person, on condition that a causal link between the conduct and the damage is proved and that there exists a legal basis for remedy of that damage.⁶¹³

Causation is thus primordial, but what is it? The quest for a definition of the concept of causation has over the years proved to be an unattainable task. Although the issue has been discussed by many philosophers, an agreement on a definition could not be found. Most lawyers are even reluctant to hold philosophical enquiries into causation.⁶¹⁴ They fail to see the benefit of it, but to say that causation is the causal relation between behaviour and result does not really help.⁶¹⁵

Hume, often considered as the most influential philosopher on logical empiricism, stated that in order to understand the nature of cause and effect we must first understand the nature of causal inference.⁶¹⁶ The nature of a relation depends highly on the nature of the inference.⁶¹⁷ Causal links should only be made after the experience of 'constant conjunction or regular sequence' of events and after we feel a necessity or 'a determination of the mind to pass from one object to its usual attendant'.⁶¹⁸ 'Objects' or facts that are constantly conjoined produce association, inference and an impression of determination or

⁶¹³ There are several reasons why somebody can be held liable for his conduct: (1) intentional, (2) negligence, (3) abnormally dangerous activities, (4) responsibility for the person causing the damage. One can find these elements in all tort systems studied: the Common Law, the Continental law systems, and the Principles of European Tort Law as elaborated by the European Group on tort law.

⁶¹⁴ STAPLETON, J. (2012). Causation in Law. In H. BEEBEE, C. HITCHCOCK, P. MENZIES, *The Oxford handbook of causation* (pp. 744 - 771). Oxford: University Press, p 749.

⁶¹⁵ STAPLETON, J. (2012). Causation in Law. In H. BEEBEE, C. HITCHCOCK, P. MENZIES, *The Oxford handbook of causation* (pp. 744 - 771). Oxford: University Press, p 745.

⁶¹⁶ HUME, D. (2003). *A treatise of human nature*. New York: Dover Publications, book 1, part 3, section 2.

⁶¹⁷ HUME, D. (2003). *A treatise of human nature*. New York: Dover Publications, book 1, part 3, section 14.

⁶¹⁸ HUME, D. (2003). *A treatise of human nature*. New York: Dover Publications, p 169.

necessary connection.⁶¹⁹ The relation between objects is discovered by the process of causal inference. Hume thus said that necessity originates in our minds⁶²⁰ and that the mental association is the basis of the concept of causation.⁶²¹ However, our experience is limited to a small part of what actually occurs. Inquiry into causal links requires experiments and rules for judging in order to minimize the limitations of human experience and observations.⁶²² Even then, constant conjunction is not necessarily proof of a causal link in law. After all causation in law and in court concerns the establishment that some particular occurrence was on a particular occasion leading to some particular outcome.⁶²³ Especially in complex liability cases traditional causal tests do not suffice.

Is the former also true for a factual test like the *conditio sine qua non*? Do causal links not exist when they cannot be observed? John Stuart Mill put forward that causes are sufficient and antecedent conditions for their effect.⁶²⁴ Jane Stapleton formulated causation in a way that (as she believes) it would best serve the 'wide projects of law'. Law is interested to identify the factor involved in the occurrence of a particular event.⁶²⁵ The description that a cause is a necessary element of complex conditions, which bring about a result, is in

⁶¹⁹ GARRETT, D. (2012). The history of causation: Hume. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 73-91). Oxford: Oxford University Press, p. 79.

⁶²⁰ The only mind-independent features of the world that the concept of causation can successfully refer to are contiguity, temporal priority and constant conjunction. In BEEBEE, H. (2012). The epistemology of causation: Causation and observation. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 471-497). Oxford: Oxford University Press, p. 474.

⁶²¹ Hume recognized that the truth in 'everything has a cause' is unprovable, but this can be ignored. Secondly he recognized that the notion of necessity between a cause and its result urges us to make causal statements only after experience of the regular sequence and after experiencing several instances in such a way that we feel determination of the mind to pass from one object to its 'usual attendant'. HUME, D. (2003). *A treatise of human nature*. New York: Dover Publications.

⁶²² GARRETT, D. (2012). The history of causation: Hume. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 73-91). Oxford: Oxford University Press, p. 81.

⁶²³ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press, pp. 9-10.

⁶²⁴ MILL, J. (1843). *A System of Logic*. Honolulu: University Press of the Pacific. (Kindle edition)

⁶²⁵ STAPLETON, J. (2012). Causation in Law. In H. BEEBEE, C. HITCHCOCK, & P. MENZIES, *The Oxford handbook of causation* (pp. 744 - 771). Oxford: University Press, p 744.

practice good enough for our analysis.⁶²⁶ Within the framework of chemical liability it is indeed generally sufficient to approach causation in a pragmatic manner.⁶²⁷ Through the observation of regularities it becomes possible to make causal generalizations and consequently infer causation. The legal discipline thus applies general knowledge on causation to the situation considered.⁶²⁸ Any reference to objective causation will refer to the factual observations as perceived by the parties in tort cases. It is the application of knowledge, not the finding thereof.

Besides the absence of a clear definition of causation and our refuge to the pragmatic description mentioned in the former paragraph, causal links and even sources of damage are in modern tort cases frequently arduous to establish. Medical and chemical claims for liability are notorious examples of all the difficulties a plaintiff can encounter. Several definitions and doctrines support the search, but courts have in liability still an important task of interpretation and motivation. Both elements are equally important in an analysis of this topic. Interestingly methodology differs depending on theory and on culture. For example in France the approach to causation is preponderantly empirical⁶²⁹, whilst in other Continental Law systems academic writing is more important.⁶³⁰ In the Common Law system of the UK courts are also not so much into theory. The House of Lords creates exceptions to the rule of causation to solve causation problems and find pragmatic solutions.⁶³¹ In the USA science has frequently a decisive role. It should however be noted that despite the differences between legal systems, the outcomes of many cases are often equivalent.⁶³² The question is thus if one system is more efficient and effective than the other system, and

⁶²⁶ HART, H., HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, pp 17-22; WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, pp. 1735-1826.

⁶²⁷ Some philosophical thoughts are however throughout the study used to clarify some analysis and opinions.

⁶²⁸ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press, p. 10.

⁶²⁹ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p 419.

⁶³⁰ For example: in Germany academic writings have an important influence on court reasoning and argumentation. VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 395.

⁶³¹ CARTWRIGHT, J. (2010). Causation in English private law: law, fact or just common sense. In R. VAN DER POEL, D. SCHEENJES, & T. VAN DER WAL, *Causaliteit* (pp. 105-122). Apeldoorn-Antwerpen: Maklu, p. 119.

⁶³² EUROPEAN GROUP ON TORT LAW. (2005). *Principles of European Tort Law*. Springer, p 13.

what can be learned from each other to become even better. The research on causation will look into the general principles as these are now applied in law and litigation, and then be followed by the so-called 'alternative' causal links relevant for chemical liability. But first two elements – cause-in-fact and legal cause – should be described in more detail.

3.1.2 A two-step process: the cause-in-fact and the legal cause

Objective causation is often equated with factual observations as perceived by the parties in a tort case. In reality, things are almost never that simple. Causation is more than a question of facts or an analysis of the unfolding of facts. In all legal systems the establishment of causal links is influenced by law, policy, and values. The duality of the causation process is formalized in a two stage assessment of what happened in the concrete situation: the cause-in-fact and the legal cause.

Cause in fact obviously deals with facts. Is the behaviour of the alleged tortfeasor a *conditio sine qua non* for the injury or damage suffered by the plaintiff? The *conditio sine qua non* principle is used to determine the link between the event and the damage.⁶³³ In other words it concerns an act giving rise to damage through a direct and uninterrupted sequence of events and without which the damage would not have occurred. It is a retrospective test: the facts are assessed after they happened. Consequently, it has the disadvantages distinctive for judging by hindsight and by retrospective observation. This is especially a pitfall for chemical liability. For example it is very tempting to evaluate exposure with the knowledge available at the time of the litigation instead of with the knowledge of decades ago.⁶³⁴

Then in the second stage an answer to the question whether the alleged tortfeasor ought to be held liable for the injury or damage of the plaintiff is sought.⁶³⁵ This is referred to as the legal cause; although in other legal systems

⁶³³ WINIGER, B., KOZIOL, H., KOCH, B., & ZIMMERMANN, R. (2007). *Digest of European Tort Law, Volume 1: Essential Cases on Natural Causation*. Vienna: Springer, p 28.

⁶³⁴ *Abrams versus Ciba Specialty Chemicals Corp.*, 2010. (US District Court, S.D. Alabama, Southern Division March 22, 2010); *Cambridge Water Co. versus Eastern Counties Leather Plc.*, [1994] Env. L.R. 105 (House of Lords December 9, 1993); *Williams versus University of Birmingham*, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011); *Cour d'Appel de Douai*, 29 September 2006, 2006 N 327/06 RG 04/01108 SM/AB; *Rechtbank van Rotterdam* 29 April 2009, , LJN: BI8604; *Hoge Raad* 25 November 2005, LJN: AT8782.

⁶³⁵ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p 408.

other denominations are used, like proximate cause, or legal cause as the denomination of both cause-in-fact and proximate cause. In this text legal cause is used as the overall denomination of non-factual appreciations of causal links. In that stage normative questions are addressed, e.g. up to what level is a defendant liable for the consequences of his behaviour? A legal cause is assessed *ex ante*, before the damage happened, and thus necessarily incorporates proximity⁶³⁶ and foreseeability.⁶³⁷ Neither proximity, nor foreseeability refers to a temporal or physical distance.⁶³⁸

3.1.2.1 The practical value of the two concepts

People try to find reasons why things happen the way they do. This is not different when decisions have to be taken in court. The bifurcation of causal questions is a solution to make the quest for causation transparent and manageable.⁶³⁹ A single question, like was the cancer of Y caused by the emission of benzene by factory X, easily leads to a multiplicity of causes and a mixture of complex arguments and assertions referring both to fact and to opinion or alleged applicable legal policies. Splitting up the question in two parts brings clarity: would Y have developed cancer if X had not emitted the substance and is there any legal principle that would preclude the cancer of Y from the emission by X.

The two step approach is recognized in Common Law and in Continental Law, although not generally accepted.⁶⁴⁰ Several court cases demonstrate the usefulness of the two phase distinction between facts and policy. An example: the UK case of the Yorkshire Dale Steamship Company versus the Minister of War Transport.⁶⁴¹ A merchant ship requisitioned by the Minister of War Transport was stranded. Compensation by the insurance would only be granted if the damage to the ship was linked to the war. If the accident was caused by

⁶³⁶ 'Proximity' is generally used in the USA, whilst in the UK it is called 'remoteness'. Both concepts refer to the same: the distance between the tortfeasor and the plaintiff.

⁶³⁷ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p 297.

⁶³⁸ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p 408

⁶³⁹ HART, H., HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, p 110.

⁶⁴⁰ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p 408

⁶⁴¹ Yorkshire Dale Steamship Company versus Minister of War Transport (Court of Appeal August 5, 1941); Yorkshire Dale Steamship Company versus Minister of War Transport (House of Lords May 19, 1942).

the exceptional tide on the route where the ship sailed, no compensation would be paid. Both causes were equivalent. The House of Lords first established the factual causes and then made a choice amongst the equivalent causes on the basis of proximity and common sense. The final conclusion was that the stranding was due to an act of war. This judgment was thus not solely based on a factual analysis, but also on a normative choice. Indeed, their Lordships could as well have decided that the tidal set carried the ship on to the rocks and not take into account the nature of the cargo and/or the destination. Viscount Simon argues that in most situations a combination of causes can be detected. It is the task of a court to find the substantial cause amongst the different explanations. Trying to determine the proximate cause in factual, neutral terms is not possible, since the concept of proximity implicitly refers to legal policy, in this case the application of common sense.⁶⁴²

Although the distinction between cause-in-fact and legal cause may seem arbitrary, since nothing is ever completely free of interpretation, the separate approach has proved its usefulness in the judgment process.⁶⁴³ Cause in fact is established if the injury has occurred were it not for the actor's act. In negligence cases the decision how far the causal continuum goes in relation to liability is part of the legal cause.⁶⁴⁴ Legal cause establishes a reasonable connection between an act of a tortfeasor and the harm suffered by a plaintiff.⁶⁴⁵ It seeks thereby a balance between philosophic, pragmatic and moral approaches to causation and makes court conclusions more acceptable for society.⁶⁴⁶

Examples can be found in all four legal systems. Although the two step approach is not formally recognized in the UK, courts in practice make a distinction.

⁶⁴² HART, H., HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, p 97.

⁶⁴³ In the USA there are differences in the denomination of the two steps in causation: sometimes legal cause refers to both cause-in-fact and proximate cause, in other cases proximate cause is both legal cause and cause-in-fact, or scope of liability and cause-in-fact. In the other legal systems, legal cause is together with cause-in-fact part of causation. To avoid confusion the concept of legal cause is used to refer to policy, value and/or cultural decisions in tort cases, regardless of the system discussed.

⁶⁴⁴ *Medcalf versus Wash. Heights Condo. Ass'n, Inc.*, 747 A.2d 532 (Appellate Court of Connecticut March 21, 2000).

⁶⁴⁵ PROSSER, W., KEETON, R., DOBBS, D., & OWEN, D. (1984). *Prosser and Keeton on the law of torts*. St. Paul: West Publishing CO., p. 263.

⁶⁴⁶ *Doe versus Manheimer*, 563 A.2d 699 (Supreme Court of Connecticut August 22, 1989), p. 757.

PART III – Causation

Beside the *conditio sine qua non* test, they also refer to fairness and justice as a basis to hold defendants liable.⁶⁴⁷ In the USA the two step approach is officially recognized and used. Courts do face the challenge when applying legal cause not to exaggerate and *de facto* make policy and thus mingle with politics.⁶⁴⁸

The Netherlands have the concept of reasonable attribution, clearly a principle that allows bringing in concepts like societal values, fairness and pragmatism.⁶⁴⁹

All French courts officially apply the doctrine of equivalence and a legal phase as such is not formally recognised.⁶⁵⁰ The theory of equivalence is based on the assumption that each factor in which absence the damage would not have occurred is a cause of that damage.⁶⁵¹ This cause is thus a *conditio sine qua non*. In practice, the theory of adequate causation is also widely used.⁶⁵² A cause is adequate if following experience and the normal sequence of events, normally would lead to the result that actually occurred. Thereby a hierarchy of causes has to be established in line with their individual probability of occurrence.⁶⁵³

A third French theory is the 'causa proxima'. This theory is not discussed further since it refers only to a chronological order (the most recent cause is retained) and is no longer used.⁶⁵⁴

Based on the former, the question arises if the sole use of cause-in-fact, referred to as the *conditio sine qua non* test, is sufficient to establish liability?⁶⁵⁵

⁶⁴⁷ Fairchild v. Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002).

⁶⁴⁸ This discussion on the borders between policy/politics and judicial decisions will not be held here. For some more information see: BLASIE, M. (2011). A separation of powers defence of federal rulemaking powers. In New York University, *New York University Annual Survey of American Law* (pp. 593-642). New York; YEAZELL, S. (1998, Summer). Judging Rules, Ruling Judges. *Law and Contemporary Problems*, pp. 229-240. And for the UK: see the reactions on the decision in Barker versus Corus and the reaction of the Parliament: JONES, M. (2006, Vol. 22 Issue 4). Proving causation - beyond the "but for" test. *Professional negligence*, pp. 251-269.

⁶⁴⁹ Hoge Raad 8 July 2011, LJN: BQ3514, *Nederlandse Jurisprudentie* 2011, 311.

⁶⁵⁰ See for example Cour de Cassation ((2^e Chambre) 27 March 2003, *Bulletin Civile* II, nr. 76 containing an explicit reference to the theory of equivalence.

⁶⁵¹ LE TOURNEAU, P. (20098 (update October 2013)). *Répertoire de droit civil, Responsabilité (en général) - § 3. Théories de la causalité*. www.dalloz.fr: Dalloz, nr. 31.

⁶⁵² LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, par. 1701-1718.

⁶⁵³ LE TOURNEAU, P. (20098 (update October 2013)). *Répertoire de droit civil, Responsabilité (en général) - § 3. Théories de la causalité*. www.dalloz.fr: Dalloz, nr. 50.

⁶⁵⁴ CONTE, P. (2002 (updated June 2013)). *Théories en matière de causalité*. In P. CONTE, *Répertoire de droit civil*. www.dalloz.fr: Dalloz, nr. 127.

⁶⁵⁵ STEELE, J. (2010). *Tort Law: text, cases and materials*. Oxford: University Press; see also *Cork versus Kirby Maclean Ltd*, 1952 WL 12362 (Court of Appeal (UK) June 30, 1952),

The test is simple: would the damage have occurred but for the fact that is tested. In 'normal' liability cases, the causal link is quite easy to determine and the *conditio sine qua non* works quite well.⁶⁵⁶ Experience or science learns that if A happens B follows, if not in all cases, at least in the majority of cases. The damage should not occur absent the defendant's negligent behaviour.

The question is now if the two step approach is useful in complex causation cases, when the *conditio sine qua non* test does not provide an answer.

3.1.2.2 Adding reasons for liability⁶⁵⁷

There is still a lot to solve once the facts are identified, before a defendant can be held liable. The establishment of a causal link is not the same as attributing liability. The latter is related to interpretation, legal and cultural norms. Choices have to be made between the possible causal elements, laws and other rules are to be considered, and policy objectives must be fulfilled. After all, the issue of causation cannot be separated from policy issues.⁶⁵⁸ Cases are decided on the basis of 'justice' and 'fairness', as well towards the individual as to society.⁶⁵⁹

Hart and Honoré described it even as an inevitable fact:

"Once the *conditio sine qua non* is satisfied, everything else is "purely a question of policy" or the legal cause."⁶⁶⁰

The traditional *conditio sine qua non* is indeed inadequate to solve some issues of proof.⁶⁶¹ An example illustrating the inadequacy is the Californian (USA) case

p 407; *Hotson versus East Berkshire Health Authority*, [1987] A.C. 750 (House of Lords July 2, 1987), p. 788.

⁶⁵⁶ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 177.

⁶⁵⁷ In this paragraph the concept of legal cause is explained without going into detail on the specific aspects of proximity and foreseeability. Both concepts are elaborated in one of the following chapters.

⁶⁵⁸ Lord Hope of Craighead in *Chester versus Afshar*, WL 2289136 (House of Lords October 14, 2004), § 85.

⁶⁵⁹ See for example: *Yorkshire Dale Steamship Company versus Minister of War Transport* (Court of Appeal August 5, 1941); *Alphacell Ltd. versus Woodward*, [1972] 2 W.L.R. 1320 (House of Lords May 3, 1972); *Reeves versus Commissioner of the Police of the Metropolis*, [2000] 1 A.C. 360 (House of Lords July 15, 1999); *Fairchild versus Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002); *Barker versus Corus (UK) plc*, [2006] UKHL 20 - appeal from [2004] EWCA Civ 545 (House of Lords May 3, 2006).

⁶⁶⁰ HART, H., HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, pp 3-4.

⁶⁶¹ *Smith New Court Securities Ltd versus Scrimgeour Vickers Ltd*, [1996] C.L.C. 1958 (House of Lords November 1996, 1996); HART, H., HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, p 113.

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of Summers versus Tice.⁶⁶² Two hunters, Tice and Simonson, erroneously struck a member of the hunting party whilst shooting at a quail. The issues were that one bullet had entered the victim's eye and that this injury was the major factor in assessing damage. Clearly this one bullet could not have come from both hunters. There was however not sufficient evidence to show which defendant was guilty of the negligent shot. The impossibility to identify the actual tortfeasor would normally, on the basis of the *conditio sine qua non* test, lead to exoneration of both hunters from liability, despite their negligence.⁶⁶³ Earlier cases indeed held that when two or more tortfeasors act independently they are not joint tortfeasors. Consequently plaintiffs must establish the portion of damage caused by each. When this is impossible to prove, liability cannot be attributed.⁶⁶⁴ In the Summers versus Tice case the solution was found in policy and justice as the basis for shifting the burden of proof to the hunters.

"[T]he innocent wronged party should not be deprived of his right to redress."⁶⁶⁵

Each tortfeasor is liable for the whole damage whether they acted in concert or independently.

More than forty years later, an additional argument for putting the burden of proof on the tortfeasors in cases of indivisible and not assignable damage, is given in Hymowitz versus Eli Lilly (USA). There the fact that the defendants had better access to information than did the plaintiff, was a policy, i.e. fairness, motive to hold the defendant liable. The condition for shifting the burden of proof towards the tortfeasors was however that all possible tortfeasors were before the court.⁶⁶⁶ This DES⁶⁶⁷ case confirms what was already suspected: the rule of Summers versus Tice will be important for chemical liability. The additional requirement of 'better access to information' will be nearly always

⁶⁶² Summers versus Tice e.a., 33 Cal.2d 80, 199 P.2d 1 (Supreme Court of California, in Bank December 16, 1948)

⁶⁶³ See also: Oliver versus Miles, 110 So. 666 (Supreme Court of Mississippi, Division B November 22, 1926).

⁶⁶⁴ See for example: Slater versus. Pacific American Oil Co., 212 Cal. 648 (Supreme Court of California May 28, 1931), p. 31; Wade versus Thorsen, 5 Cal.App.2d 706, 43 P.2d 592;

⁶⁶⁵ Summers versus Tice e.a., 33 Cal.2d 80, 199 P.2d 1 (Supreme Court of California, in Bank December 16, 1948), Wade versus Thorsen, 5 Cal.App.2d (District Court of Appeal, First District, Division 2, California April 2, 1935), p 88.

⁶⁶⁶ Hymowitz versus Eli Lilly & Co, 73 N.Y.2d 487 (Court of Appeals of New York April 4, 1989). p 505.

⁶⁶⁷ Diethylstilbestrol.

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easy to meet by the plaintiff(s). But, it must be said, the long latency period and the impossibility of identification of (all) tortfeasors posed in this concrete case significant problems of proof and procedure.⁶⁶⁸ And this is just a situation similar to the ones in a lot of chemical liability cases. When a disease could be caused by more than one chemical, for example by a mixture of chemicals, or by more than one source of chemical(s), it is often impossible to prove on a purely factual basis who or what is (are) the alleged tortfeasor(s) or the harmful substance(s). Such situations are far from hypothetical. A relevant example is the Dutch case of the plaintiff who worked in the company of his father, during which period he was exposed to asbestos. When he develops mesothelioma, he sues Eternit for delivering asbestos cement to his father's company. However the plaintiff could not prove that the asbestos dust coming from the Eternit cement was the cause of his disease. Neither could he prove that the mesothelioma was not caused by asbestos strings freed during him stripping cables. This action consequently failed.⁶⁶⁹

One formalised application of a judgment call in legal cause is the requirement for proximity of the cause. Proximity is to be understood in a pragmatic way: convenience, public policy, a sense of justice all form part of it.⁶⁷⁰ Any person, who is so close that the defendant ought to reasonably have him in contemplation when he is acting, is considered to be proximate⁶⁷¹ and the act causing the damage to that person is the proximate cause.

It should be noted that there can be more than one proximate cause for damage.⁶⁷² The Supreme Court had in the case of *Brisboy versus Fibreboard Corporation*⁶⁷³ to decide if there was sufficient evidence to establish a causal link between Charles Rand's exposure to an asbestos product manufactured by the

⁶⁶⁸ VANDALL, F., WERTHEIMER, E., RAHDERT, M. (2003). *Torts: cases and problems*. Newark: LexisNexis, p 278.

⁶⁶⁹ Gerechtshof Leeuwarden 13 January 2009, LJN BH2762.

⁶⁷⁰ *Palsgraf versus Long Island Railroad Co.*, 248 N.Y. 339 (United States Court of Appeal New York May 29, 1928).

⁶⁷¹ *Donoghue versus Stevenson*, [1932] A.C. 562 (House of Lords May 26, 1932), p 580.

⁶⁷² *O'Neal versus St. John Hosp. & Medical Center*, 791 N.W.2d 853 (Supreme Court of Michigan July 31, 2010); *Kirby versus Larson*, 256 N.W.2d 400 (Supreme Court of Michigan July 18, 1977).

⁶⁷³ *Brisboy versus Fibreboard Corp.*, 418 N.W.2d 650 (Supreme Court of Michigan January 25, 1988)

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defendant and the cancer he developed and died off.⁶⁷⁴ The work generated large quantities of visible dust, which implied an extreme exposure to asbestos and a high number of asbestos fibres were found in his lungs after his death. The exposure was considered a sufficient cause for the fatal disease.

However, an additional question was raised concerning the influence and the impact of Charles Rand's heavy smoking habit of two packs of cigarettes a day.⁶⁷⁵ The Supreme Court of Connecticut concluded that the smoking was part of the cause and that there was a rational basis for apportionment of liability. Other courts have judged in a similar manner.⁶⁷⁶

A slightly similar situation was dealt with in *Norfolk versus Ayers*. The railroad company argued that employment with another company also was a cause of the same injury. The Supreme Court of the United States rejected this argument on the basis that a company cannot escape liability for negligent exposure leading to an injury by asserting that there is also another outside source of exposure.⁶⁷⁷ In this case the court found that although smoking contributes to lung cancer; it does not bear on the risk of mesothelioma. ⁶⁷⁸ Consequently apportionment of damages was not allowed and the railroad was liable in full.⁶⁷⁹

A difference is thus made on the basis of the origin of the concurrent cause. If the plaintiff himself partially caused his damage, then the liability is proportional. If a negligent act of a third party contributed, then the situation is

⁶⁷⁴ Originally nine asbestos manufacturers were sued, but eight of them settled before or during trial. During Charles Rand work with the remaining defendant, Fibreboard Corp., he was exposed to asbestos for six to nine months, a rather limited period over a career of working with asbestos for twenty-six years.

⁶⁷⁵ The liability claim was originally filed by Mrs. Rand, widow of Charles Rand. She however died during the course of her action and subsequently Daniel Brisboy was named as the personal representative of the estate of Charles Rand.

⁶⁷⁶ *Champagne versus Raybestos-Manhattan, Inc.*, 562 A.2d 1100 (Supreme Court of Connecticut August 8, 1989); *Dafler versus Raymark Industries Inc.*, 622 A.2d 1305 (Supreme Court of New Jersey April 15, 1993); *Hao versus Owens-Illinois, Inc.*, 738 P.2d 416 (Supreme Court of Hawai'i June 10, 1987).

⁶⁷⁷ *Norfolk & Western Ry. Co. versus Ayers*, 538 U.S. 135 (Supreme Court of the United States March 10, 2003).

⁶⁷⁸ *Norfolk & Western Ry. Co. versus Ayers*, 538 U.S. 135 (Supreme Court of the United States March 10, 2003).

⁶⁷⁹ The full liability was also based on Section 1 of the FELA, stating that railroads are liable in damages to any person suffering injury while employed by them. Consequently the railroad company liable in full without apportionment to other employers. At trial the jury was "not to make a deduction for the contribution of non-railroad exposures," so long as it found that Norfolk was negligent and that "dust exposures at [Norfolk] contributed, however slightly, to the plaintiff's injuries." *Norfolk & Western Ry. Co. versus Ayers*, 538 U.S. 135 (Supreme Court of the United States March 10, 2003), p 144.

different and proportional liability is not granted.⁶⁸⁰ Exception to this is when market share liability is used.

Apportionment calls for judgment and is not purely factual; it is about the distribution between the various causes, tortious and non-tortious⁶⁸¹, of the damage. It is thus another principle in legal cause. Residents living nearby a landfill were during a prolonged period exposed to certain carcinogenic substances disposed by Firestone Tire & Rubber Company. The toxic chemicals⁶⁸² contaminated their water wells. At the moment of the claim, none of the residents suffered from cancer, but the fact was that their risk, although unquantifiable, to this disease was increased. In first instance they were awarded damages for their fear of cancer and for the costs of medical monitoring.⁶⁸³ Next, the Court of Appeal reversed the compensation for medical monitoring, but otherwise affirmed the judgment. Then the dossier was brought to the Supreme Court. Analysis showed that the Court of Appeal erred in its reasoning that comparative fault principles, based on plaintiffs' cigarette smoking, were not applicable on the basis that plaintiffs' conduct did not contribute to the water contamination.⁶⁸⁴

US tort law is not to be found under a civil code, but the system has its Restatements of Law to clarify and summarize common law in a particular field.⁶⁸⁵ In the chapter on apportionment of liability it is stated that:

“[i]f the independent tortious conduct of two or more persons is a legal cause of an indivisible injury, the law of the applicable jurisdiction determines whether those persons are jointly and severally liable,

⁶⁸⁰ The Netherlands and France have similar approaches. For more details see paragraphs c) and d).

⁶⁸¹ Some non-tortious cause (e.g. an act of the plaintiff himself) can have a reducing influence on the proportion of liability attributed to the defendant.

⁶⁸² Benzene; toluene; chloroform; 1,1-dichloroethene; methylene chloride; tetrachloroethene; 1,1,1-trichloroethane; trichloroethene; and vinyl chloride.

⁶⁸³ Medical monitoring is analysed in paragraph 4.3.3.

⁶⁸⁴ *Potter versus Firestone Tire and Rubber Company*, 863 P.2d 795 (Supreme Court of California December 27, 1993).

⁶⁸⁵ 'Restatements' are essentially model laws and are an important source of information. Restatements are published by the American Law Institute publishes these restatements, which is a non-profit organisation created to clarify, simplify and improve the law. LEXISNEXIS, L. (2013). *Zimmerman's Research Guide: online legal research encyclopaedia*. Retrieved February 16, 2013, from LexisNexis: <http://law.lexisnexis.com/infopro/zimmermans/disp.aspx?z=1896>.

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severally liable, or liable under some hybrid of joint and several liability.”⁶⁸⁶

Depending on the jurisdiction, a court can reject apportionment, as happened in the case of *Martin versus Owens-Corning Fiberglas Corp.*⁶⁸⁷ The Supreme Court held that the evidence submitted was insufficient to apportion the damages between asbestosis caused by exposure to asbestos and emphysema resulting from smoking.

The other common law country in the study, the United Kingdom, does not have any specific piece of legislation dealing with tort, except for the liability of occupiers of land to lawful visitors.⁶⁸⁸ They set principles by their judgments, but do not discuss the *conditio sine qua non* or *legal cause* explicitly. It is however clear that in practice the two step process is used.

One of the important principles, namely proximity or ‘neighbourhood’, was set in the case *Donoghue versus Stevenson*⁶⁸⁹ and was later formerly recognized in the case of the *Home Office versus Dorset Yacht Company*.⁶⁹⁰ Proximity is not limited to physical proximity but also extends to ‘such close and direct relations’ that a person of whom one should ‘take care’ is directly affected by the careless act.⁶⁹¹ Reasonableness, ‘close’ relationships and being directly affected are not factual observations but rather interpretations of the parties involved in the litigation.

Decisions to what extent a tortfeasor, whose negligence is certain, should be held liable for all the consequences of his behaviour, are made on principles of legal policy.

In *Overseas Tankship (U.K.) Ltd. versus Morts Dock & Engineering Co. Ltd.* two tests for remoteness were used. A ship called the *Wagon Mound* was moored in Sydney harbour. Some oil was carelessly discharged into the harbour, and

⁶⁸⁶ Restatement (Third) of Torts: § 17 - Apportionment of Liability.

⁶⁸⁷ *Martin versus Owens-Corning Fiberglas Corp.*, 528 A.2d 947 (Supreme Court of Pennsylvania July 10, 1987).

⁶⁸⁸ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p 50.

⁶⁸⁹ *Donoghue versus Stevenson*, [1932] A.C. 562 (House of Lords May 26, 1932), p 581.

⁶⁹⁰ *Home Office versus Dorset Yacht Co. Ltd.*, [1970] A.C. 1004 (House of Lords May 6, 1970).

⁶⁹¹ *Donoghue versus Stevenson*, [1932] A.C. 562 (House of Lords May 26, 1932), p. 581.

although the oil was not very flammable, a fire emerged.⁶⁹² The fire was judged to be foreseeable in this particular situation, since the work in the harbour docks caused some sparks. Consequently the crew's conduct was negligent and the duty of care was breached. The question was then to what extent the defendant should be held liable for the consequences of his negligence. It was clear, as the court said, that there should be some limit on liability. This limit can be set in different ways: was the damage the direct consequence of the negligent act, was the damage foreseeable... These are elements of policy and consequently of legal cause.

3.1.2.3 Overcoming the limits of the *conditio sine qua non*

In practice the *conditio sine qua non* test has thus proved not so efficient and effective in non-traditional tort, like chemical liability. The test requires in such cases nearly always supplementation.⁶⁹³ Another example.

In the autumn of 1989 Donna Castillo, pregnant for seven weeks, walked by a field where a tractor was spraying. As the mist drifted over her, she became completely drenched.⁶⁹⁴ Months later her son was born with a rare birth defect. Would the damage have happened if Donna would not have walked by? Would it have happened if the farmer had not sprayed Benlate that day? Would it have drifted onto Donna if the weather had not been foggy? And what would have been the consequence if Donna had not been pregnant. Still several other facts can be found that are *conditio sine qua non* elements for the harm occurring...

One can always and in any case find more than one factual cause. Imagine another situation that proves to be a challenge. A person who develops a disease such as cancer. He claims that his condition is caused by exposures to some toxic substances coming from different chemical plants in his neighbourhood. Let us assume that there is some scientifically proved threshold dose that is sufficient to cause the cancer. Amongst all doses exposed to, those below the threshold limit can be excluded from causation on a factual basis. These exposures fail the *conditio sine qua non* test. Nevertheless, each of the

⁶⁹² Overseas Tankship Ltd. versus Morts Dock & Engineering Co. Ltd. (the Wagon Mound), [1961] A.C. 388 (Judicial Committee - On Appeal from the Supreme Court January 18, 1961).

⁶⁹³ FISCHER, D. (2005-2006, Vol. 94). Insufficient Causes. *Kentucky Law Journal*, p 277.

⁶⁹⁴ Castillo versus E.I. Du Pont De Nemours & Co., Inc., 854 So.2d 1264 (Supreme Court of Florida July 10, 2003).

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exposures prior to the person's disease is a factual cause of the person's disease. The *sine qua non* test is not an effective method to define the factual basis of liability. More scholars are of the same opinion.⁶⁹⁵

How do the different legal systems deal with this complexity?

In the following paragraphs the solutions developed by each country in the study are analysed.

a) The US Common Law approach

In the USA the *conditio sine qua non* test has been refined in order to be able to solve problems with causation. In the Restatement (Third) of Torts⁶⁹⁶ a defendant's conduct is not a cause of damage unless, without that conduct, the event would not have occurred.⁶⁹⁷ Workers who were exposed to benzene at levels several hundred times the allowed exposure, could bring forward evidence supporting the causal link between that exposure and their injuries. Scientific knowledge of the harmful level of exposure to the chemical, plus knowledge that plaintiffs were exposed to such quantities, are facts necessary to sustain plaintiffs' burden in toxic tort case.⁶⁹⁸ Notwithstanding the lack of specific proof that benzene really caused the damage, the probability that it did, was

⁶⁹⁵ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing; SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International; France: FAIRGRIEVE, D., & G'SELL-MARCEZ, F. (2011). Causation in French Law: Pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (pp. 111-129). Oxford and Portland, Oregon: Hart Publishing; QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. *Fondement et perspectives de la jurisprudence "Distilbène"*. *Recueil Dalloz*, pp. 1162 – 1173; LE TOURNEAU, P. (2010). *Droit de la responsabilité et des contrats*. Paris: Dalloz; The Netherlands: BLOMSMA, I., VAN KESSEL, L., & SCHELTEMA, M. (2010). Bewijs en causaliteit. In R. VAN DER POEL, D. SCHEENJES, & T. VAN DER WAL, *Causaliteit* (pp. 13-34). Apeldoorn-Antwerpen: Maklu; United Kingdom: HART, H., & HONORE, T. (1985). *Causation and the law*. Oxford: Oxford University Press; United States: FISCHER, D. (2005-2006, Vol. 94). Insufficient Causes. *Kentucky Law Journal*, pp. 277 – 317; WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, pp. 1735-1826.

⁶⁹⁶ Restatement (Third) of Tort, § 28 - Burden of Proof; Restatement (Third) of Tort, § 27 – Multiple Sufficient Causes.

⁶⁹⁷ Grier versus AMISUB of South Carolina, Inc., 2012 WL 1522737 (Supreme Court of South Carolina May 2, 2012); Ludlow versus Gibbons, 2011 WL 5436481 (Colorado Court of Appeals November 10, 2011); Watson versus Meltzer, 270 P.3d 289 (Court of Appeals of Oregon December 29, 2011); Cowe versus Forum Group, Inc., 575 N.E. 2d 630 (Supreme Court of Indiana July 25, 1991); Yaney versus McCray Memorial Hospital and Wilson, 496 N.E.2d 135 (Court of Appeals of Indiana August 13, 1986); Collins versus American Optometric Association, 693 F.2d 636 (US Court of Appeals, Seventh Circuit November 10, 1982).

⁶⁹⁸ Curtis versus M&S Petroleum, Inc., 174 F.3d 661 (US Court of Appeals May 13, 1999).

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sufficient.⁶⁹⁹ A decision that would not be reached by adhering to a strict interpretation of the *conditio sine qua non*.

Additionally courts, especially those adhering to corrective justice, have resolved doubt about causation, once negligence is established, in the favour of the plaintiff, on condition that the decision remains within reason.⁷⁰⁰

Another solution is the preponderance of evidence. A defendant's conduct is a cause of damage or injury when it is shown by preponderance of evidence that the injury would not have occurred but for the defendant's negligent conduct.⁷⁰¹ Preponderance is not the same as on the balance of probabilities. It is the degree of confidence the fact finder has in the correctness of his factual conclusions.⁷⁰²

In 1959 Charles Sparks joined the US Navy. There he had to remove and inspect the valves in the various pipelines of the ship he was sailing on. First he had to remove insulation of the pipelines, which contained thirteen to twenty per cent asbestos. After this exposure to asbestos, Sparks was undisputedly again exposed to the same substance on two other occasions, once as a sheet metal worker on another Navy ship and then as sheet metal worker for a privately owned shipyard. In the latter case, the contact with asbestos did not come from working with asbestos, but from dust blown into their workplace and into his car parked next to a pipefitting shop. The court, however, decided that the asbestos-containing thermal insulation, i.e. the first exposure to asbestos, was the sole legal cause of Spark's mesothelioma. The conclusion that the Navy "showed strong preference" for using the product and the fact that the experts

⁶⁹⁹ Thereby probable means founded on reason and experience which leads the mind to believe that it happened that way, but also leaves room for doubt. *Moreland versus Eagle Picher Technologies*, 362 S.W.3d 491 (Missouri Court of Appeal, Southern District, Division two March 21, 2012).

⁷⁰⁰ *Kwasny versus U.S.*, 823 F.2d 194 (United States Court of Appeals, Seventh Circuit February 24, 1987).

⁷⁰¹ *Grier versus AMISUB of South Carolina, Inc.*, 2012 WL 1522737 (Supreme Court of South Carolina May 2, 2012); *Ludlow versus Gibbons*, 2011 WL 5436481 (Colorado Court of Appeals November 10, 2011); *Watson versus Meltzer*, 270 P.3d 289 (Court of Appeals of Oregon December 29, 2011); *Cowe versus Forum Group, Inc.*, 575 N.E. 2d 630 (Supreme Court of Indiana July 25, 1991); *Yaney versus McCray Memorial Hospital and Wilson*, 496 N.E.2d 135 (Court of Appeals of Indiana August 13, 1986); *Collins versus American Optometric Association*, 693 F.2d 636 (US Court of Appeals, Seventh Circuit November 10, 1982).

⁷⁰² *Moore versus Ericsson, Inc.*, 7 A.3d 820 (Superior Court of Pennsylvania November 19, 2010); *United States of America versus Fatico*, 458 F.Supp. 388 (United States District Court, E.D. New York July 27, 1978).

of the plaintiff testified that the exposure on the ship was 'the first, and most intense period of exposure' and 'almost certainly sufficient to have caused the mesothelioma', were the basis for the court's decision.⁷⁰³ The equivalence theory would have held all three exposures as a cause. The choice of one preponderant exposure to base liability on was at least an application of the adequacy theory and at most a policy decision, but certainly not just factual.

b) The UK

There are examples in the UK that the application of the *conditio sine qua non* test is not fully factual and the distinction with legal cause is difficult to make.⁷⁰⁴ In the United Kingdom it is accepted that the *conditio sine qua non* test, although a necessary condition for establishing causation, does not provide a comprehensive or exclusive test.⁷⁰⁵ The Fairchild principle, has over the years become a rule to solve liability cases when it is impossible to prove the cause of an illness, due to the lack of scientific knowledge, but also due to the presence of different sources that could have actually caused the damage. On the basis of the Fairchild principle a material increase of risk of harm is sufficient to be held liable.⁷⁰⁶ This is a deviation from the ordinary 'balance of probabilities' test as used under the *conditio sine qua non* standard.

Applied in asbestos cases, the Fairchild principle could also be used in cases relating to damage caused by other chemical substances. Each time when a (legal or natural) person has, negligently, exposed the victim to a significant quantity of a toxic substance, that person can be held liable on the basis of 'materially increasing the risk to damage'. All tortfeasors are then held jointly and severally liable.⁷⁰⁷ The application of the Fairchild rule, i.e. a material

⁷⁰³ Sparks versus Owens-Illinois, Inc., 38 Cal.Rptr.2d 739 (Court of Appeal, First District, Division 2, California February 16, 1995)

⁷⁰⁴ B versus Ministry of Defence, [2013] 1 A.C. 78 (Supreme Court (UK) March 14, 2012); Asmussen versus Filtrona United Kingdom Ltd, [2011] EWHC 1734 (High Court of Justice Queen's Bench Division Newcastle-Upon-Tyne District Registry July 6, 2011); Sienkiewicz versus Greif (UK) Ltd, [2011] I.C.R. 391 (Supreme Court March 9, 2011); Barker versus Corus (UK), [2006] UKHL 20 - appeal from [2004] EWCA Civ 545 (House of Lords May 3, 2006); Fairchild versus Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002); Williams versus University of Birmingham, [2012] P.I.Q.R. P4 (Court of Appeal October 28, 2011).

⁷⁰⁵ Chester versus Afshar, WL 2289136 (House of Lords October 14, 2004).

⁷⁰⁶ Fairchild versus Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002).

⁷⁰⁷ Durham versus BAI (Run Off) Ltd, WL 1015812 (Supreme Court (UK) March 28, 2012).

increase to the risk on damage, should be considered on the basis of the factual situation and not be addressed in the abstract.

c) France

Officially the theory of equivalence (cf. supra) is used in France. Courts decide on the sole basis of the *conditio sine qua non* test. All causes are considered equal; they only have to pass the *conditio sine qua non* test.⁷⁰⁸

Each cause counts, however minor or farfetched the cause may be. For example: a building supervisor who was held liable for the electrocution of a child, despite the fact that multiple causes were identified: unauthorized entry to the site, the child held in his hand an aluminium bar which touched the high-tension cable, the fact that the building area was situated nearby a playing area of children and was not sealed off, etc. All these elements were causes in fact. The child's action in picking up the metal bar would normally be considered the direct (proximate) cause, but applying the equivalence theory it was possible to find the building supervisor liable.⁷⁰⁹ All causes being equal, the judge could opt for another cause than the one that finally led to the injury and still use the *conditio sine qua non* test as the justification.

Although in this particular case, it is difficult to deny that the judgment was influenced by other elements than facts.⁷¹⁰

The theory of adequacy is also used, although not formally referred to. In practice courts chose the one that suits them most for the case at hand, as Le Tourneau writes:

“elles appliquent l'une ou l'autre au gré des espèces, en toute souplesse, d'une façon très favorable aux victimes (cet objectif conduit aussi à un relâchement du lien de causalité) de l'appréciation de la causalité et de la détermination du cheminement du mal. Il ne faut pas mésestimer le rôle de l'empirisme dans cette matière, qui rend difficile tout essai de

⁷⁰⁸ Although Mill, originator of the theory of equivalence, defined cause in terms of sufficient conditions, thereby limiting potential causes for an incident and breaking an endless chain of causation. See HART, H., HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, p. 21, fn. 16.

⁷⁰⁹ MORETEAU, O., & LAFAY, F. (2007). France. In B. WINIGER, H. KOZIOL, B. KOCH, & R. ZIMMERMAN, *Digest of European Tort Law: essential cases on natural causation* (pp. 25 - 28). Wien - New York: Springer, p 28.

⁷¹⁰ For example: the protection of the weaker party in the case, as based in the culture of the '*contrat social*'.

classification doctrinale. La jurisprudence est en fait très pragmatique. Et il est assuré que les rédacteurs des jugements et arrêts apprécient le lien de causalité en s'interrogeant, plus ou moins consciemment, sur la normalité ou non de l'événement et du comportement de l'agent, revenant au critère général de la responsabilité, ainsi que sur la gravité du préjudice, comme sur l'existence ou non d'une assurance du responsable. Où il apparaît de façon éclatante que le droit est un art plus qu'une science. Osons même dire que les juges inventent la réalité (donc la vérité), sous couvert de l'appréciation de la causalité et de la détermination du 'cheminement du mal'.⁷¹¹

It is clear that French courts have found solutions when confronted with the limits of the *conditio sine qua non*. However the methods used to solve the issues are not formally elaborated, but are rather based in the practice of courts. A doctrinal classification remains difficult since the judicial system in France is pragmatic.⁷¹²

Recently the French courts, including the Court of Cassation, more openly limit liability with application of the adequate causality theory.⁷¹³ This theory is in fact a methodology for the assessment of causal links. It provides a 'hierarchy' of causes on the basis of their contribution to the damage or in other words, the importance of a cause increases with the probability that it is at the basis of the resulting damage.⁷¹⁴

⁷¹¹ "They apply one or the other depending on the case, always choosing in favour of the victim (an objective that also leads to weakening the requirements of proof of causation). We must not underestimate the role of empiricism in this matter, which makes any doctrinal classification difficult. Courts are actually very pragmatic. And it is certain that in the judgments causation is questioned, more or less consciously, in relation to the normality of a link between the event and the behaviour of the agent, based on the general test of liability as well as the severity of injury as to the existence or not of a liability insurance. Then it becomes vividly clear that that law is more art than science. We even dare to say that judges invent reality (or the truth), under cover of an appreciation of causal links and the determination of the chain of evil." (Free translation"
LE TOURNEAU, P. (2009 (update October 2013)). Répertoire de droit civil, Responsabilité (en général) - § 3. Théories de la causalité. www.dalloz.fr: Dalloz, nr. 51. (Citations omitted)

⁷¹² LE TOURNEAU, P. (2010). Droit de la responsabilité et des contrats. Paris: Dalloz.

⁷¹³ MORETEAU, O., LAFAY, F. (2007). France. In B. WINIGER, H. KOZIOL, B. KOCH, R. ZIMMERMAN, *Digest of European Tort Law: essential cases on natural causation* (pp. 25 - 28). Wien - New York: Springer, p 26.

⁷¹⁴ LE TOURNEAU, P. (2010). *Droit de la responsabilité et des contrats*. Paris: Dalloz, p 567.

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When a harmful situation is created, the courts easily decide on a causal link with the damage. Exceptionally such decision is taken on the basis of statistical probability.⁷¹⁵

But there exist also some examples of court decisions that are not so flexible in assessing the existence of causal links. When leaving a shed accessible whilst there are dangerous substances stored did not lead to liability because the harm was caused by an object left behind by a third person.⁷¹⁶ Neither was he liable who sold fireworks to minors even when this was against the law. The reason for the judgement was that there was no indication that if the fireworks would have been sold legally, they would have been used differently.⁷¹⁷

Furthermore the French have a particular empirical approach to causation in tort.⁷¹⁸ This is not illogical, since tort cases are all dominated by the particularities of the specific circumstances of the case, and the intuition of the court.⁷¹⁹

In another case, again a child stole explosives from a shack. He injured himself playing with the substances. The shack was easily accessible and in no way locked. It was unclear who placed the explosives there, but the owner of the shack was known. The Court of Cassation decided that there was no causal link between the fault and the damage. There was no causal relation between the defendants, who gave a third party the opportunity to access the shack and store explosives, and the child hurt by these explosives.⁷²⁰ This case is an example of the application of the adequacy theory.

Proportional liability is only considered when the plaintiff has caused part of the damage.⁷²¹ The plaintiff should thereby have made a fault, the simple fact that

⁷¹⁵ CONTE, P. (2002 (updated June 2013)). Théories en matière de causalité. In P. CONTE, *Répertoire de droit civil*. www.dalloz.fr: Dalloz, nr. 136

⁷¹⁶ Cour de Cassation (2^e Chambre) 20 December 1972, nr. 71-13.530.

⁷¹⁷ Cour de Cassation (2^e Chambre) 8 April 1986, *Revue trimestrielle de droit civil*, 1987, p. 557, obs. J. Huet.

⁷¹⁸ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing. p. 418.

⁷¹⁹ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 420.

⁷²⁰ Cour de Cassation (2^e Chambre) 20 December 1972, Paganini versus Zucchelli, *Juris-Classeur Périodique*, 1973.II.17541.

⁷²¹ Only from 1963 up to 1987 the Second Chamber of the French Court of Cassation has accepted proportional liability in cases where the damage was caused by a 'thing' under the responsibility of the defendant. JULIEN, J. (2012). Causalité - Fait de la victime. In P. LE TOURNEAU, *Droit de la responsabilité et des contrats*, Chapitre 2. www.dalloz.fr: Dalloz, nr. 1869.

he acted is not sufficient.⁷²² In such cases the defendant will be held liable for the damage in line with the comparison of the severity of the fault of the plaintiff and his own.⁷²³ The fault of the plaintiff does not have to be related to the situation referred to in the claim. The only condition is that the plaintiff's fault had an aggravating impact on the damage.⁷²⁴

d) The Netherlands

The *conditio sine qua non* should still be proved in liability cases.⁷²⁵ No absolute certainty is required, a reasonable probability that the damage would not have occurred without the act is sufficient.⁷²⁶

The proof of a factual causal link should be delivered before article 6:98 of the Civil Code can be used.⁷²⁷ At least that was the original idea.⁷²⁸ This way the need for proof of a causal link is reinforced, because attribution of compensation only takes place when there is a proven causal link.⁷²⁹

This approach is in fact a two-step process. The factual cause and the legal cause are both determined. Thereby, the latter is formalised through the concept of reasonable attribution (*redelijke toerekening*).⁷³⁰

⁷²² JULIEN, J. (2012). Causalité - Fait de la victime. In P. LE TOURNEAU, *Droit de la responsabilité et des contrats*, Chapitre 2. www.dalloz.fr: Dalloz, nrs. 1869-1870.

⁷²³ Cour d'Appel Paris, 17 June 1994, *La Gazette du Palais*, 1995/67 (explosion of a gas container – liability attributed to the plaintiff, the defendant and the manufacturer of the container); Cour d'Appel Paris, 25 January 1994, *La Gazette du Palais* 1994/609 (defendant sold fireworks to minor).

⁷²⁴ JULIEN, J. (2012). Causalité - Fait de la victime. In P. LE TOURNEAU, *Droit de la responsabilité et des contrats*, Chapitre 2. www.dalloz.fr: Dalloz, nr. 1883.

⁷²⁵ BOUMAN, H. (1998). 244 : *Conditio sine qua non*. In GROENE SERIE, *Onrechtmatige daad*. Den Haag: Kluwer.

⁷²⁶ BOONEKAMP, J. (2014). 15.2 Vergelijking hypothetische toestand; waarschijnlijkheid. In G. SERIE, *Schadevergoeding*. Den Haag: Kluwer.

⁷²⁷ Art. 6:98 reads as follows: "Voor vergoeding komt slechts in aanmerking schade die in zodanig verband staat met de gebeurtenis waarop de aansprakelijkheid van de schuldenaar berust, dat zij hem, mede gezien de aard van de aansprakelijkheid en van de schade, als een gevolg van deze gebeurtenis kan worden toegerekend." Free translation: 'Only damage that is related to the act on which the liability of the defendant is based, will be compensated, in as much as the damage is attributable on the basis of the nature of the liability and on the damage following the event.'

⁷²⁸ Hoge Raad 24 December 2010, LJN BO1799, *Nederlandse Jurisprudentie* 2011/251, note of T.F.E. Tjong Tjin Tai.

⁷²⁹ The Supreme Court wrote in its judgment that the Court of Appeal had failed to appreciate the necessary condition for the application of article 6:98, namely that a condition sine qua non link between the act and the damage should be proved. Hoge Raad 28 March 2003, *V. versus Branderhorst*, *Nederlandse Jurisprudentie* 2003, 389; *Rechtbank Zwolle* 18 January 2012, LJN BV3094.

⁷³⁰ BLOMSMA, I., VAN KESSEL, L., SCHELTEMA, M. (2010). Bewijs en causaliteit. In R. VAN DER POEL, D. SCHEENJES, T. VAN DER WAL, *Causaliteit* (pp. 13-34). Apeldoorn-

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A concrete example: the plaintiff was during his employment exposed to several toxic chemicals. He claimed that his illness was caused by this exposure. The expert was of the opinion that the relation between the exposure to solvents and the illness of the plaintiff was unclear. The reason for this conclusion was the fact that the plaintiff privately abused methyllenchloride and sniffed paracetamol in such a manner that he had 'paracetamol headaches'. But, the expert was convinced that these headaches were on the balance of probabilities for 95 % caused by his work with solvents. The judge however sentenced the defendant to compensate 50 % of the damage suffered by the plaintiff.⁷³¹ The compensation was proportionate using the concept of attribution.

Although attribution as formulated in article 6:98 is thus related to the compensation the defendant owes the plaintiff, the Supreme Court has also applied attribution to both liability and compensation on the basis that the causal link could not be proved with certainty.⁷³²

The concept of attribution is then used when it would be unreasonable and unfair to leave the burden of causal uncertainty on the plaintiff.⁷³³

In the legal systems discussed the need to assess the factual causes of damage is undisputed. The *conditio sine qua non* is one of the cornerstones of liability law. But it is clear that the test is mainly sufficient in traditional, simple tort cases and becomes disputed when causation is complex and/or unclear. The 'naked' but for test is useful, but not always gives the right answer.⁷³⁴ Despite the creative solutions, structural principles are also necessary.

Article 6:99 of the Dutch Civil code is the formalisation of a moral value/policy into a legal text. The commentary on the article refers to equity: when both A and B behaved negligently and caused damage, but the victim cannot prove who did what, it would be unjust to demand the victim to bare the loss only because he is not able to prove who caused it. The methods used to attribute a negligent

Antwerpen: Maklu, p. 17; AKKERMANS, A. (2002). *De omkeringsregel bij het bewijs van causaal verband*. Den Haag: Boom Juridische Uitgevers; Hoge Raad 26 september 2006, LJN AY5693.

⁷³¹ Kantonrechtbank Alkmaar 10 December 2003, LJN AR2457.

⁷³² Hoge Raad 14 December 2012, LJN BX8349, Rechtspraak van de Week 2013/37.

⁷³³ Hoge Raad 24 December 2010, LJN BO1799, Nederlandse Jurisprudentie 2011/251, note of T.F.E. Tjong Tjin Tai.

⁷³⁴ *Smith New Court Securities Ltd versus Scrimgeour Vickers Ltd*, [1996] C.L.C. 1958 (House of Lords November 21, 1996).

act depend on societal, political and socio-economic views in relation to the ideas and opinions living at that moment in society.⁷³⁵ In the case *Eternit Fabrieken B.V.* the court expected from the defendant that he would have taken the obvious initiative to warn the plaintiff for the danger of asbestos, especially since it would not have cost much. Failing to do so is reproachable.⁷³⁶

In the Netherlands liability can be proportional on the basis of shared fault/negligence. How important the contribution of a specific cause is, requires altogether a judgment call. Solely facts will bring no solution. Following case is a concrete example.⁷³⁷ Several potential causes were identified, but it could not be established which of these were a *conditio sine qua non* for the damage. In practice it was however impossible that all of the acts, namely the accidents, were a cause. This situation is similar to the one in the DES case. The *conditio sine qua non* could not be proved, but that did not obstruct the attribution of liability. The court decided to attribute the liability for the damage to the defendants in line with their market share. This way the victim could be compensated for his injury.

Apportionment can also divide liability between the 'fault' of the plaintiff and the fault of the defendant proportionally to the seriousness of each act, but on the basis of article 6:101 Dutch Civil Code, equity can demand that the distribution of the liability is distributed differently.⁷³⁸ Applying equity is a judgment call for

⁷³⁵ SIEBURGH C.H., *Toerekening van een onrechtmatige daad*, Proefschrift ter verkrijging van het doctoraat in de rechtsgeleerdheid, Universiteit Groningen, 29 juni 2000, p 98.

⁷³⁶ Hoge Raad 25 November 2005, LJN AT8782.

⁷³⁷ Hoge Raad 18 December 2009, LJN BK0873, *Nederlands Juristenblad* 2012/614, Meervoudige causaliteit, bewijs en draagplicht, *Bedrijfsjuridische Berichten* 2010, 28 – with reference to Hoge Raad 9 October 1992, *Nederlands Juristenblad* 1994/535.

⁷³⁸ Art. 6:101 of the Dutch Civil Code reads as follows:

“(1) Wanneer de schade mede een gevolg is van een omstandigheid die aan de benadeelde kan worden toegerekend, wordt de vergoedingsplicht verminderd door de schade over de benadeelde en de vergoedingsplichtige te verdelen in evenredigheid met de mate waarin de aan ieder toe te rekenen omstandigheden tot de schade hebben bijgedragen, met dien verstande dat een andere verdeling plaatsvindt of de vergoedingsplicht geheel vervalt of in stand blijft, indien de billijkheid dit wegens de uiteenlopende ernst van de gemaakte fouten of andere omstandigheden van het geval eist.

(2) Betreft de vergoedingsplicht schade, toegebracht aan een zaak die een derde voor de benadeelde in zijn macht had, dan worden bij toepassing van het vorige lid omstandigheden die aan de derde toegerekend kunnen worden, toegerekend aan de benadeelde.

Translation: (1) If the damage is partly the result of a circumstance that can be allocated to the victim, then the reimbursement to the injured is reduced in line with the proportion the injured contributed to the damage; except when the respective severity of faults or

the court.

The complaint of the plaintiff's heirs was that Nefalit did not take sufficient measures to protect their employees from exposure to asbestos. But the deceased also smoked for more than 28 years. Consequently defendants argued that the cigarettes caused the lung cancer. In first instance Nefalit was held liable for 55 % as compensation for both material and non-material damage. The Court of Appeal confirmed this judgment and Nefalit appealed in cassation. The Supreme Court of the Netherlands confirmed and decided that the judgments were correct since apportionment was correctly used. A reasoned estimate is the correct method to approach such situation.⁷³⁹ A motivated estimate is based on facts (the exposure to asbestos and smoking), but is also an assessment of these facts (how important was each exposure) through an interpretation of the information (how important was each exposure). Apportionment is clearly an element of legal cause.

3.1.2.4 Conclusion

The *conditio sine qua non* is so basic that all legal systems use it for causation. It is an essential element of human reasoning based on experience, education, philosophy: if A does not happen, then B would not occur. Or as both Hume and Mill emphasized, causation is essentially about an invariable or constant sequence of events, although Mill stressed the complexity of causal links more than Hume.⁷⁴⁰

The legal systems studied approach causation in two steps: the cause-in-fact and the legal cause. This method has clear advantages, since it separates the factual causes from the causes retained as relevant on the basis of policy, economy or moral and societal values, like justice and fairness. In the US Common Law this two steps approach is explicit. In the academic world of the UK the two step is recognized. UK courts however do not formally follow the two-step process. In Continental Law, i.e. the Netherlands and France, the

other circumstances are so different that for reasons of fairness another distribution of the compensation is justified.

(2) When the compensation concerns damage done to an object that was on behalf of the victim in the custody of a third person, then all circumstances attributable to that third person will be attributed to the victim.

⁷³⁹ Hoge Raad 31 March 2006, LJN AU6092, (Nefalit).

⁷⁴⁰ HUME, D. (2003). *A treatise of human nature*. New York: Dover Publications; MILL, J. (2012). *A system of Logic, Ratiocinative and Inductive: being a connected*. Tebbo.

process is much less explicit. Probably judges and courts in Common Law have to make their reasoning much more formal, because of their role in creation of law as opposed to the role of courts in Continental legal systems. In general, the practical application of the two step process is in both systems quite similar. As said before the two phases are a useful tool to grasp the complexity of causation, especially in non-traditional tort cases like toxic tort or chemical liability. In France is the country in the study that adheres mostly to the *conditio sine qua non* by its official adherence to the doctrine of equivalence. However deviations from the strict one step process in lower court decisions can be found. Even the Court of Cassation is remarkably tolerant in interpreting judgments based on a (hidden) two steps analysis. It remains to be seen if the formal one step approach survives with the increase of complex cases.

The cause-in-fact is a pure factual analysis and the legal cause is thus the 'appreciation' or normative phase, at least in theory. In practice it is nearly impossible to strictly divide both, meaning that policies infiltrate in all human actions. People have interpretations, have different perceptions and observe facts within the framework of the cultural background. Are the two steps an illusion? No, it helps to organize the elements and to make things understandable, just as one divides a huge project into little steps to make it happen. The awareness of the difficulty to separate facts and policies should be sufficient to make sound judgements, as by the way can be seen, explicitly or implicitly, in many court decisions.

Whilst the factual and legal cause bring structure to the search for causation, an analytical method is also necessary. Different methods have been developed, some more suited for toxic tort than others. In the following paragraphs practical suggestions are analysed: common sense, the substantial factor test and the NESS test.

3.2. Our world has become complex: alleged solutions for complex causation

*"La causalité est le domaine où il apparaît de la manière la plus éclatante que le droit est un art, et non pas une science exacte"*⁷⁴¹

As seen in the former chapter, the *conditio sine qua non* test is not always sufficient to draw conclusions on liability, especially not in complex causation cases. Toxic tort is such an area of law where factual proof of a causal relation is most frequently difficult. Chemicals leave in general no trace of their presence in the human body. Furthermore, humans are nowadays exposed to multiple chemicals in the environment, including their homes, offices, and other locations. The long latency periods of diseases with a chemical origin make the discovery of the facts of exposure, the moment of contraction of the disease and the identification of the tortfeasor burdensome, if not impossible. All these factors hinder the fulfilment of the *conditio sine qua non* requirement. Over time academic writers and judges have tried to find solutions to the limitations of the traditional approach. Most of these solutions are related to the interpretation of causation and are thus at first sight situated in step two in the process of identifying causal links. Legal cause leaves more room for different motives supporting the attribution of liability to a defendant and as such partially solves the weaknesses of the *conditio sine qua non* test. However, not all issues of causation can be remedied by policy and value-based interpretations. Factual causation always needs to be proved to a certain extent.

In order to structure legal reasoning, an explanation and identification of causation should be linked to theory and practical knowledge of the world.⁷⁴² Judges and academic writers strive to develop mental models for decision making, aiming at a coherent set.⁷⁴³ A correlation between phenomena is just not enough to decide on the existence of a causal link, neither are all

⁷⁴¹ LAMBERT-FAIVRE, Y. (1992). De la poursuite à la contribution: quelques arcanes de la causalité. *Recueil Dalloz*, pp. 311-319, 331.

⁷⁴² MENASHE, D. (2008, Vol. 12 nr. 1). Is judicial proof of facts a form of scientific explanation? *International Journal of Evidence & Proof*, p 39.

⁷⁴³ A mental model is a representational construction of symbols, which stands for any conceptual or physical object. Mental models of complex decision tasks are constructed through a sequential process of structuring and restructuring. The process is a flexible and dynamic one. In SIMON, D. (1998-1999, Vol. 30). A Psychological Model of Judicial Decision Making. *Rutgers Law Journal*, pp. 78-79 and p 124.

observations acceptable. A sufficient degree of coherence is essential; a decision must endorse the interpretation that best suits the existing principles.⁷⁴⁴

During this quest for solutions, several theories concerning the concept of causation have been developed. A selection of alternative doctrines is made on the basis of their practical relevance for chemical liability with its specific difficulties of evidence: common sense (2.1), substantiality of the cause (2.2), causes considered as elements of a causal entirety (2.3) are analysed in the following paragraphs.

3.2.1 About common sense, inference and other creations of the 'ordinary' mind

The study of the concepts named in the title may surprise, but it should not. Common sense or intuitive thinking can have a considerable influence on court decisions, sometimes explicitly, more often implicitly. Although the concept of intuition is rather vague as it has a flexible definition, we are all familiar with it. Moreover, we all use it in our daily life. People use intuition or reason depending on the characteristics of the context of a decision or problem.⁷⁴⁵ Features that lead to intuitive thinking are multiple intercorrelated cues, less than perfect cue reliability, the lack of an organizing principle to integrate cues, and limited time.⁷⁴⁶ Although there is disagreement about the quality of intuitive thinking, everybody does it, as everybody can think rationally.⁷⁴⁷ When confronted with a problem people are more likely to turn to intuitive thinking first.⁷⁴⁸ Rational thinking can consciously be used, but requires more effort. Intuitive thinking is automatic and unbidden, and is often experienced as a given. Choosing to follow

⁷⁴⁴ SIMON, D. (1998-1999, Vol. 30). A Psychological Model of Judicial Decision Making. *Rutgers Law Journal*, pp 124- 125.

⁷⁴⁵ INBAR, Y., CONE, J., & GILOVICH, T. (2010, Vol. 99, issue 2). People's Intuitions about Intuitive Insight and Intuitive Choice. *Journal of Personality and Social Psychology*, pp. 232-247; SANDERS, J. (2001, Vol. 64). Kumho and how we know. *Law and Contemporary Problems*, pp. 373-420.

⁷⁴⁶ HAMMOND, K. (1996). *Human Judgement and social policy: irreducible uncertainty, inevitable error, unavoidable injustice*. New York: Oxford University Press, p. 163.

⁷⁴⁷ SANDERS, J. (2001, Vol. 64). Kumho and how we know. *Law and Contemporary Problems*, p. 401.

⁷⁴⁸ SANDERS, J. (2001, Vol. 64). Kumho and how we know. *Law and Contemporary Problems*, p. 394.

reason can be experienced as an act that can be punished by an unwanted result.⁷⁴⁹

Far from advocating the use of intuitive reasoning in toxic tort (see example in footnote), the existence of it cannot be ignored.⁷⁵⁰ Therefore the topic is analysed in the next paragraph.

Opposite to the use of common sense are more complex legal doctrines like the substantial factor theory and the NESS method (Necessary Element of a Sufficient Set). The substantial factor and the NESS consist of intellectually developed algorithms for solving causation issues.⁷⁵¹

3.2.1.1 The undisguised use of common sense in court: reprehensible or laudable?

Factual causation is generally considered descriptive and independent of policy goals, although it is embedded in both a scientific and a common sense⁷⁵² understanding of causal relations. But, what exactly is meant by 'common sense'?

Common sense surely has proved to be essential for communication; without it we would not understand each other, nor would we be able to work and live together. Common sense reasoning includes the understanding of both the

⁷⁴⁹ INBAR, Y., CONE, J., & GILOVICH, T. (2010, Vol. 99, issue 2). People's Intuitions about Intuitive Insight and Intuitive Choice. *Journal of Personality and Social Psychology*, pp. 232-247; SANDERS, J. (2001, Vol. 64). Kumho and how we know. *Law and Contemporary Problems*, pp. 373-420

⁷⁵⁰ 'Comparing the relative accuracy of statistical (i.e., formula based) and clinical (i.e., "in the head") judgment in predictions of phenomena from mental illness to parole violations to college performance, literature shows that, time and time again, actuarial formulas outperform expert. Although this literature leaves open exactly how judges are making their decisions (e.g., judges may be engaging in a very deliberative process of weighting and adding different cues, but may be weighting cues incorrectly or ignoring important cues entirely), these results do call into question how much confidence should be placed in intuition, even expert intuition, at least in domains in which an actuarial formula can be empirically derived.' Example borrowed from INBAR, Y., CONE, J., & GILOVICH, T. (2010, Vol. 99, issue 2). *People's Intuitions about Intuitive Insight and Intuitive Choice. Journal of Personality and Social Psychology*, p. 244.

⁷⁵¹ An algorithm is a step-by-step procedure for solving a problem or accomplishing some end. I refrain from using the term in the remainder of the text, although it seems to be nowadays a fashionable term amongst legal philosophers. For example Stapleton uses it when analysing causation. It remains however a term of mathematics and information technology.

⁷⁵² Cfr. Inferences and probabilities – see further in this study.

direct and indirect effects of an action.⁷⁵³ Facts get their meaning through the social context within which individuals live.⁷⁵⁴ The social context consist of the taken-for-granted understandings and expectations of the group of individuals.

The term 'common sense', is used to denominate the appreciation of the relation between cause and effect. Everybody makes everywhere and any time causal judgments, very frequently through an unconscious process. This is not a purely descriptive process, it also contains moral values, beliefs and opinions. People constantly try to disclose the causes of things happening around them. They try to imagine what would have happened if something else did not happen. This thinking process is in a way similar to the technique of the *conditio sine qua non* test, which is based on counterfactual reasoning.

The disclosure of causation is thereby rooted in the human capacity for judgment embedded in the experiences people share.⁷⁵⁵

Common sense thus (1) includes generalizations that link evidence with facts, (2) can be externalized in schemes or scripts and (3) is influenced by the social context in which the social meaning of facts is understood.⁷⁵⁶ The former does not imply that using common sense is irrational. Rationality and common sense are connected, as Thomas Henry Huxley phrased:

"Science is, I believe, nothing but trained and organized common sense."⁷⁵⁷

Many more share his opinion.⁷⁵⁸

Is common sense then also used in legal thinking about liability? Legal reasoning as a whole is predominantly open-ended and contestable, meaning that the weight given to facts and/or assumptions varies between people, in relation to their individual life experiences, their culture and the society they belong to. Consequently it can be concluded that statements on causation in liability cases are influenced by common sense. This seems unavoidable.

⁷⁵³ MacCRIMMON, M. (2001, Vol. 22). What is common about common sense: cautionary tales for travellers crossing disciplinary boundaries? *Cardozo Law Review*, p. 1434.

⁷⁵⁴ LESSIG, L. (1995, Vol. 62). The regulation of social meaning. *University of Chicago Law Review*, p. 993.

⁷⁵⁵ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, pp 432-433.

⁷⁵⁶ MacCRIMMON, M. (2001, Vol. 22). What is common about common sense: cautionary tales for travelers crossing disciplinary boundaries? *Cardozo Law Review*, p. 1443.

⁷⁵⁷ HUXLEY, T. (2011). *Autobiography and Selected Essays*. Public Domain book.

⁷⁵⁸ ALLEN, R. (2000-2001, Vol. 22). Common Sense. *Cardozo Law Review*, p 1421.

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However, is the formal use of the concept helpful in toxic tort or should alternatives like science, statistics or technology be given preference? In general common sense does not provide clear answers in such complex court cases, but, as said, common sense cannot be turned off.

For example: the 'substantial factor' test, used to identify the cause, is based on common sense.⁷⁵⁹ At least this is what Black and Hollander believe.⁷⁶⁰ They refer to the notorious example of the hunters. When two or more hunters simultaneously shoot a victim, it would be sufficient to ask each of the hunters if it would have been necessary to eliminate his rifle shot for the plaintiff not to be killed.⁷⁶¹ Each hunter would say yes and thus each became a cause-in-fact. Just common sense would give the same result as the complex manoeuvres several lawyers and scholars performed to come to this solution. Asking is enough, the 'substantial factor' test is thus not necessary.⁷⁶²

In UK Common law it is frequently held that the answer to the question whether a defendant's act is the cause of damage should be based on common sense.⁷⁶³ Reference is then made to the 'ordinary man' or 'the man in the street'. It has been stated that:

"any layman is quite as competent as the most experienced court to answer ordinary causation questions."⁷⁶⁴

Since there exists no uniform causal requirement for liability in tort, the causal requirements depend in essence on the objective of attributing liability.⁷⁶⁵ Thereby the attribution is highly influenced by policies and values, which are infiltrated by common sense. But:

⁷⁵⁹ See for more details on the substantial factor paragraph 3.2.2.

⁷⁶⁰ BLACK, B., & HOLLANDER, D. (1993, Winter). Unravelling causation: back to the basics. *University of Baltimore Journal of environmental law*, pp. 1-28.

⁷⁶¹ USA: Summers versus Tice, 33 Cal.2d 80, 199 P.2d 1 (Supreme Court of California, in Bank November 17, 1948); France: Cass. Civ. 2e, 2 April 1957, Litzinger versus Kintzler, *Dalloz Recueil* 1957, 492; The Netherlands: Hoge Raad 31 January 2003, LJN AF1301, *Nederlandse Jurisprudentie* 2003, 346 note of J.B.M. Vranken.

⁷⁶² BLACK, B., & HOLLANDER, D. (1993, Winter 3 UBAJEL 1). Unravelling causation: back to the basics. *University of Baltimore Journal of environmental law*, pp. 1-28.p. 5.

⁷⁶³ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, p 91.

⁷⁶⁴ ROBERTSON, D. (1997, June). The common sense of cause in fact. *Texas Law Review*, p 1771.

⁷⁶⁵ Kuwait Airways Corporation versus Iraqi Airways Company (Body Corporate) and Others, [2003] 1 Costs L.R. 130 (House of Lords July 16, 2002).

“common sense knowledge underlying systematic approaches to legal proof should meet the standard for impartiality, which means that common sense knowledge must contain legal understanding of social context.”⁷⁶⁶

Some courts have decided on the basis of what they think is just and equitable, thereby using and, sometimes even explicitly, referring to ‘common sense’ or the logic of the ‘ordinary man’.⁷⁶⁷ Thereby the concept can be hidden in terms like ‘reasonableness, substantiality, presumption, inference and the like. In the following paragraphs the use of common sense is uncovered through court cases and doctrines. The question is if this is the correct approach or is more needed for the proof of causation in toxic tort?

3.2.1.2 Common and multiple causes or multiple actors in Common Law

In the UK the use of common sense is manifest in cases with multiple causes. As it was stated in the *Yorkshire Dale Steamship Company*: the choice of the real or efficient cause amongst all causes had to be made on the basis of common sense.⁷⁶⁸

Also in other courts cases, like *Alphacell Ltd. versus Woodward*, causation is approached in a practical manner using ordinary common sense, and not by using an abstract theory.⁷⁶⁹ *Alphacell* was a manufacturer of paper. The manufacturing of paper needs a lot of water. This water is during its use heavily contaminated and was therefore captured in tanks. One day the lowest tank was overflowing into the river. The cause of this overflow was the obstruction of the pumps with brambles, ferns and long leaves. There was neither negligence nor intent on the part of the paper manufacturer, but notwithstanding the former observation *Alphacell* in fact caused the pollution. Consequently the court decided that the active operation of the plant caused the contamination of the river. The decision was reached using common sense.⁷⁷⁰

⁷⁶⁶ MacCRIMMON, M. (2001, Vol. 22). What is common about common sense: cautionary tales for travelers crossing disciplinary boundaries? *Cardozo Law Review*, p. 1449.

⁷⁶⁷ *Rahman versus Arearose Limited & Anr, University College London NHS Trust*, 2000 WL 741943 (Court of Appeal June 15, 2000).

⁷⁶⁸ *Yorkshire Dale Steamship Company versus Minister of War Transport* (House of Lords May 19, 1942).

⁷⁶⁹ Lord Salmon in *Alphacell Ltd. versus Woodward*, [1972] A.C. 824 (House of Lords May 3, 1972), p. 847.

⁷⁷⁰ Lord Wilberforce in *Alphacell Ltd. versus Woodward*, [1972] A.C. 824 (House of Lords May 3, 1972), p. 834.

Clearly courts in the UK accept the finding of causation by means of using common sense when analysing the factual circumstances of a tort case and if the facts of the case are clear.⁷⁷¹ In more complex cases, with the involvement of scientific evidence (like epidemiological studies) the appreciation of an association as causation is the first difficulty. Methods for assessing the probability of a causal link, like the Bradford Hill criteria – see paragraph 5.1.2.1, c) do not help with the second difficulty, namely the assessment of cause in the specific case before the court. This is where the ‘belief’ of the judge comes into play. This happened in *McGhee*, where there was no quantification of the risk and their Lordships decided to refer to the concept of the ordinary man.⁷⁷²

Cases with multiple causes and/or multiple tortfeasors are often a crusade for the victims. Results like ‘nobody is held liable’, because it is not clear what or who caused the damage, are no fiction. Common sense is also used as an argument for holding a defendant liable, when the court believes that is the right thing to do. Reference is then made to motives of justice and fairness. In other words, in cases where the traditional *conditio sine qua non* test brought no solution because two or more events were each sufficient to cause the damage, the common sense argument was used to base the decision on.⁷⁷³ Fairness and equity or justice are often referred to in UK judgments.⁷⁷⁴ Hart and Honoré both experienced that courts often insist that causation is determined on the basis of common sense principles.⁷⁷⁵ During his working career Fairchild inhaled substantial quantities of asbestos which caused him to contract

⁷⁷¹ *Alphacell Ltd. versus Woodward*, [1972] A.C. 824 (House of Lords May 3, 1972).

⁷⁷² *McGhee v National Coal Board*, 1973 S.L.T. 14 (House of Lords November 15, 1972).

⁷⁷³ *Summers versus Tice; McGhee v National Coal Board*, 1973 S.L.T. 14 (House of Lords November 15, 1972).

⁷⁷⁴ *Sienkiewicz versus Greif (UK) Ltd*, [2011] I.C.R. 391 (Supreme Court March 9, 2011); *Durham versus BAI (Run Off) Ltd*, [2012] P.I.Q.R. P14 (Supreme Court March 28, 2012); *St. George versus the Home Office*, [2008] EWCA Civ 1068 (Court of Appeal (UK) October 8, 2008); *Fairchild versus Glenhaven Funeral Services Ltd. and others*, [2002] 1 W.L.R. 1052 (Court of Appeal December 11, 2001); *Potter versus Firestone Tire and Rubber Company*, 863 P.2d 795 (Supreme Court of California December 27, 1993); *Mauro versus Raymark Industries, Inc.*, 561 A.2d 257 (Supreme Court of New Jersey August 1, 1989); *McGhee versus National Coal Board*, 1973 S.L.T. 14 (House of Lords November 15, 1972); *Overseas Tankship (UK) Ltd versus Miller Steamship Co Pty Ltd*, 58 Vand. L. Rev. 739 (Privy Council (Australia) May 1966, 1967); *Hughes versus Lord Advocate*, [1963] A.C. 837 (House of Lords February 21, 1963); *Bonnington Castings Ltd. versus Wardlaw*, [1956] A.C. 613 (House of Lords March 1, 1956).

⁷⁷⁵ HART, H., & HONORE, T. (1985). *Causation and the law*. Oxford: Oxford University Press, pp 26-28, 92, 118.

mesothelioma.⁷⁷⁶ It quickly became clear that it was impossible to prove who of his employers delivered the fatal asbestos fibre. A strict application of the *conditio sine qua non* test would have led to the acquittal of the defendants, whose negligent acts were certain and beyond doubt, but the causal links unprovable. Such acquittal was experienced as unacceptable.⁷⁷⁷ It was even considered incorrect to insist on the application of a rule when such application would yield unfair results.⁷⁷⁸ Consequently the House of Lords stated that common sense and justice demanded a relaxation of the traditional causation. Their Lordships found that a defendant was liable if he materially contributed to the risk of damage even though it cannot be proved that the defendant's act or omission caused the damage.

a) Justice and fairness bolstered by common sense

In the UK the 'common sense' way of thinking is thus frequently used in tort, whereby justice and fairness are equally important. In the USA the situation is slightly different. There a tradition of imposing minimum requirements for evidence exists. Over the years the concrete criteria for admissibility changed regularly. At this moment experts are scrutinized on their scientifically trustworthiness before being allowed to testify in court.⁷⁷⁹ Scientific evidence needs to follow general principles of methodology and research before it can be used. Additionally it is a standing procedure in US toxic tort to express complex causation in terms of probability. The use of statistics and science is paramount. Factual evidence rules. However this does not mean that judgements cannot be made with the help of common sense. Especially in first instance, where the jurors do decide by their personal appraisal of the evidence submitted. After listening to the factual and scientific evidence, these men and women have the final word, what is influenced by common sense as the thinking of the 'people'. It is mostly in appeal that rulings are motivated by reference to statistic, scientific and/or factual reasoning. The following case is an example thereof.

⁷⁷⁶ Fairchild versus Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002).

⁷⁷⁷ Fairchild versus Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002), par. 10 (citation omitted).

⁷⁷⁸ Lord Bingham of Cornhill in Fairchild versus Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002).

⁷⁷⁹ For example: the Federal Rules of Evidence, the Daubert standard, the Frye standard, preponderance standard, the balance of probability, etc.

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Willamette Industries operated a fibreboard manufacturing plant.⁷⁸⁰ The fibreboard was produced from refined and dried pine wood shavings and pulp. During the process formaldehyde⁷⁸¹ was mixed with the fibres and during that mixing part of the chemical emitted into the air. The Wright family lived nearby the plant of Willamette and claimed they suffered from several afflictions allegedly caused by the emissions of the factory. In court, the expert, Dr. Frank Peretti, testified that the complaints were more likely than not related to exposure to formaldehyde, although he did not base his opinion on any knowledge on the amount of formaldehyde needed to cause such harm. Despite this lack of knowledge, the jury in the trial court was convinced that the Wright family's injuries were a direct result of the constant exposure to the formaldehyde that was emitted from the Willamette plant. The jurors found the evidence presented by the expert sufficient and believed the testimony.

Toxic tort cases in the USA are often influenced by the perception of the jurors (the ordinary men) as convictions demonstrate. The word 'common sense' and its likes appear frequently in court judgements, but also juridical texts and academic writings.⁷⁸² However, it should be noted that in appeal the court in the Willamette case overruled the decision of the trial court on the basis that no scientific evidence was introduced. A change of decision that frequently happens when judgments are considered in appeal and found to be lacking a solid evidential base. This is one of the handicaps of jury litigation and it also proves that the 'thinking of the ordinary' man is not always a sound footing to decide upon.

Despite the examples of judgements using what is called 'junk science'⁷⁸³, it seems that overall, US courts base their judgments not on the 'thinking like the ordinary man'. Science has an important and influential role in complex cases.

⁷⁸⁰ Wright versus Willamette Industries, Inc., 91 F.3d 1105 (US Court of Appeals, Eight Circuit September 19, 1996).

⁷⁸¹ In fact they used a resin of urea formaldehyde.

⁷⁸² The term 'common sense' appears for example more than 70.000 times in Westlaw, as Allen discovered. ALLEN, R. (2000-2001, Vol. 22). Common Sense. *Cardozo Law Review*, p. 14.

⁷⁸³ The more stringent rules on scientific evidence were installed by the Daubert trilogy with the objective to avoid the use of 'junk science' in toxic tort. See for example the first case of the trilogy: Daubert versus Merrel Dow Pharmaceuticals, Inc., 509 U.S. 579 (Supreme Court of the United States June 28, 1993). The Alcolac case is an example of the use of junk science. The Alcolac Company was accused of damaging the immune

b) An interesting difference between acute and chronic damage

Sometimes US courts even make a distinction between two 'injuries', whereby one is evaluated by common sense and the other by scientific or specialist knowledge. An example is the case of Johnson versus Arkema.⁷⁸⁴ Johnson was working with a machine that applied a chemical to glass bottles. The machine was designed to capture any vapours coming from the chemical, but failed to perform this function. Johnson consequently was exposed to the vaporized chemical substance and its by-products. He allegedly suffered immediately from a sore throat, burning and watery eyes, chest pain and difficult breathing. Weeks later Johnson was diagnosed with chemical pneumonitis, a condition that over the years will develop into pulmonary fibrosis, which is a chronic lung disease. In court expert testimony was deemed necessary for assessing the liability of the defendant for the chronic injuries, i.e. the pulmonary fibrosis, allegedly caused by the exposure to toxic chemicals. The defendant was however without expert testimony held liable for the acute damage (the sore throat, the watering eyes, etc.), caused by the same chemical. This decision was based on the reasoning that the occurrence of the acute damage complained of was such that general experience and common sense testimonies of laypersons were sufficient to find that the chemical caused that acute damage.⁷⁸⁵

A similar case is the one of Morgan versus Compugraphic Corporation, which held that

“[g]enerally, lay testimony establishing a sequence of events which provides a strong, logically traceable connection between the event and the condition is sufficient proof of causation.”⁷⁸⁶

Expert testimony is necessary to establish causation as to medical conditions outside the common knowledge and experience of jurors.⁷⁸⁷ On the other hand

systems of families by the emissions of toxic substances. Later it was observed by top scientists that the evidence brought forward by the experts of the plaintiffs was not meeting scientific standards. *Elam versus Alcolac, Inc.*, 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988). See also HUBER, P. W. (1991-1995). *Galileo's Revenge: Junk Science in the Courtroom*. New York: Basic Books, pp. 92-107 and further analysed in paragraph 2.1.4.2 and part V and VI.

⁷⁸⁴ Johnson versus Arkema, Inc., 685 F.3d 452 (United States Court of Appeals June 20, 2012).

⁷⁸⁵ Johnson versus Arkema, Inc., 685 F.3d 452 (United States Court of Appeals June 20, 2012).

⁷⁸⁶ Morgan versus Compugraphic Corp., 675 S.W.2d 729 (Supreme Court of Texas July 11, 1984).

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non-expert evidence is sufficient to support a finding of causation in limited circumstances, namely when the occurrence and the conditions complained of are such that general experience and common sense of the ordinary man is sufficient to evaluate the probability of the causation.⁷⁸⁸

This is an interesting way of approaching the complexity of damage caused by chemicals. It is based on the postulation that immediate consequences are more evident to a layperson and thus more trustworthy, than long term effects. There is however also another reason for increasing the standard proof for long term effects. During long latency periods the likelihood increases that other causes could be at the origin of the damage that occurred. Besides that, injuries with long term latency periods are frequently serious diseases, like cancer, of which the pathogenesis is not fully understood. The complexity of the causal links consequently augments. This is one of the major bottlenecks in proving chemical liability. Proof becomes very difficult and even the best scientists frequently do not succeed in helping out.

The UK landmark case of *Fairchild*, considered as a breakthrough for situations where causal links are uncertain or not provable, refers in its judgement to common sense. The legal concept of causation is based "on the practical way in which the ordinary man's mind works in the everyday affairs of life".⁷⁸⁹ A distinction is made between causation in litigation and causation in science. In science causation is the explanation of cause and effect, whilst in law it is situational; meaning that causation depends on the context in which responsibility for the damage is to be attributed to the tortfeasor and on the purpose for which the causal question is to be answered. Contrary to legal causation, scientific causation is not subject to 'soft' values as fairness, justice or equity.⁷⁹⁰ As in *McGhee* their Lordships are convinced that following common sense it is considered unrealistic that negligence increasing the risk of damage

⁷⁸⁷ In its 2007 decision in *Guevara versus Ferrer*, the Texas Supreme Court summarized the meaning of *Morgan*. *Guevara versus Ferrer*, 247 S.W.3d 662 (Supreme Court of Texas August 31, 2007), p. 665.

⁷⁸⁸ *Guevara versus Ferrer*, 247 S.W.3d 662 (Supreme Court of Texas August 31, 2007), pp. 668-669.

⁷⁸⁹ *Fairchild versus Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002).

⁷⁹⁰ *Fairchild versus Glenhaven Funeral Services Ltd. and others*, [2002] 1 W.L.R. 1052 (Court of Appeal December 11, 2001).

would be regarded as if it did not contribute to causing the damage. When the process of causation is scientifically not identifiable, there is

“nothing irrational in drawing the inferences as a matter of common sense”.⁷⁹¹

Lord Reid thereby referred to experience as a basis for attribution of liability. He said that the exposure to dust and the lack of washing facilities as a cause for the injury was sufficiently supported by the practical experience of the ordinary man. It is indeed accepted that the legal concept of causation is not solely based on logic, but also on a pragmatic appreciation similar to ‘how the ordinary man’s mind works in every-days affairs of life’.⁷⁹² Thereby the principle of ‘*res ipsa loquitur*’ can be used.⁷⁹³ The latter is then seen as the formalisation of the common sense of appreciating that ‘things are what they seem to be’.

c) Secondary exposure

In *Zimko versus American Cyanamid*, the plaintiff was as a child exposed to asbestos brought home by his father working for the defendant. The link between the deathly disease (mesothelioma) of the (grown up) child and the exposure to asbestos dust through the presence of the substance on his father’s clothes was established.⁷⁹⁴ But was the employer of the father liable? It was the general duty of the employer, even in the absence of a formal duty, to act reasonably in view of risks of danger to household members of his employees. Reasonableness in this situation should be understood as common sense, but not as the ordinary man thinks. Instead it should be appreciated as how an employer within an industry should behave in line with the prevailing industry

⁷⁹¹ *McGhee versus National Coal Board*, 1973 S.L.T. 14 (House of Lords November 15, 1972).

⁷⁹² Lord Reid in *Fairchild v. Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002).

⁷⁹³ The principle of ‘*res ipsa loquitur*’ is not further discussed in this dissertation. In the highly scientific and technological content of chemical liability, the use of ‘things are what they seem to be’ adds no or very little value. Thereby it must be noted that I understand ‘*res ipsa loquitur*’ as the simplest version of common sense and thus, I would rather call it ‘observation’.

⁷⁹⁴ *Zimko versus American Cyanamid*, 905 So.2d 465 (Court of Appeal of Louisiana, Fourth Circuit July 15, 2005).

practices.⁷⁹⁵ Persons of a household would fall within the range of reasonable apprehension of the defendant as being affected by his alleged negligence.⁷⁹⁶

A tortfeasor can be held liable for damage caused to a person with whom he has no direct relation. The condition is that the damage is foreseeable.

3.2.1.3 Does formal legislation accept the use of common sense? The Continental approach

The courts in the Netherlands and France are in general reluctant to admit that common sense is a reliable tool. In the following paragraphs, however, examples of the use of the concept during the search for hidden or not so hidden references to common sense in doctrine and court decisions are shared.

a) France: how far can one bend the concept of common sense?

Proof of causation can in France be determined by all means.⁷⁹⁷ Judges are allowed to freely apply various criteria.⁷⁹⁸ It is thereby difficult to assess their decision methodology, since judgments give very few information on the different factors that have been taken into account for evaluating causation.⁷⁹⁹

“Il appartient en premier lieu au juge, souvent, de « remettre à plat » les éléments du litige, pour, au-delà des confusions, délibérément entretenues ou non, délimiter le périmètre exact de la question juridique posée, et donc de l’incertitude alléguée, de distinguer notamment à cette occasion incertitude et ambiguïté; incertitude et complexité.”⁸⁰⁰

In concreto it is the task of a judge to (re-)evaluate all the elements in a case, in order to, define and limit the exact extent of the juridical question at hand. By doing so, the judge will also define the alleged uncertainty. He will distinguish in particular uncertainty and ambiguity, plus uncertainty and complexity.⁸⁰¹

⁷⁹⁵ See Part II for more information on this topic.

⁷⁹⁶ Matter of New York City Asbestos Litigation, 14 A.D.3d 112 (Supreme Court, Appellate Division, First Department, New York December 2, 2004).

⁷⁹⁷ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, 1710.

⁷⁹⁸ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 53.

⁷⁹⁹ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 54.

⁸⁰⁰ BREILLAT, Y. (2005). L'office du juge et l'incertitude, *Bulletin d'information*, 2005, www.Cassation.fr, p. 2.

⁸⁰¹ Free translation.

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Common sense is in France equally a solution to difficulties with causation.⁸⁰² According to Lambert-Faivre⁸⁰³ it is the common sense of judges and of the Court of Cassation that is at the basis of selecting and accepting evidence that supports their presumptions. Nobody objects to this approach, since it is in line with the French standard of proof in law.⁸⁰⁴ Basically the concept is the underlying notion of concepts like 'a sufficient cause' (causalité suffisante). This can thus be classified as a common sense evaluation of what happened and proof of the causal link exist between the act and the damage.⁸⁰⁵ This argumentation is accepted by the Court of Cassation.⁸⁰⁶

Causation in France is based on two theories: '*l'équivalence des conditions*' and '*la causalité adéquate*'.⁸⁰⁷ Having the theory of equivalence as the primary doctrine, multiple causes are frequently considered. It is necessary to analyse all of these potential causes and then decide on the 'actual' cause. The role of the judge and the counsel (barrister) is not considered neutral; he needs to make a choice amongst all the equivalent causal events. The chain of causation has to be breached to avoid endless sequences. This delicate task is performed by the use of *inter alia* common sense.⁸⁰⁸

A cause is adequate when it is:

“dans le cours habituel des choses et selon l'expérience de la vie.”⁸⁰⁹

Or as Van Gerven describes: the adequacy theory is a probabilistic theory whereby probabilities must be assessed by an observer who knows all the circumstances, and who is equipped with the general experience of mankind.⁸¹⁰ For example: carrying a lighter into a warehouse full of very flammable chemicals could be considered as negligent. But when a friend of the individual

⁸⁰² BREILLAT, Y. (2005). L'office du juge et l'incertitude, *Bulletin d'information*, 2005, www.Cassation.fr, p. 1.

⁸⁰³ LAMBERT-FAIVRE, Y. (1992). De la poursuite à la contribution: quelques arcanes de la causalité. *Recueil Dalloz*, 1992, pp. 311-319.

⁸⁰⁴ Article 1353 of the French Code Civil.

⁸⁰⁵ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, 1713.

⁸⁰⁶ Cour de Cassation, (1ère Chambre) 13 octobre 1999, B., n/ 276;

⁸⁰⁷ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, par. 1715-1716.

⁸⁰⁸ In fact professors Viney and Jourdain use the word 'empiricism', referring to the application of the theory that knowledge comes from experience.

⁸⁰⁹ A cause is adequate if it fits in the normal chain of events and accords with the experiences of life. LE TOURNEAU, P. (2010). *Droit de la responsabilité et des contrats*. Paris: Dalloz. p. 567.

⁸¹⁰ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 453.

with the lighter grasps this object, uses it and drops it when lightened, common sense tells us that the first negligence of carrying the lighter has no relation with the fire that devastated the building.

One could consider the application of the adequacy theory as a limited exception to this reluctance of referring to common sense, i.e. the causal judgments of the ordinary man reflect the fact that the alleged cause has or has not increased the probability of the damage.⁸¹¹ Therewith the 'adequate' course is identified. Following is a hypothetical example of a situation where a wrongful act does not significantly increase the risk of damage, but harm still occurs.⁸¹² A man negligently inflicts a scratch on the hand of his friend Rolf. Normally this scratch would heal quickly and no lasting or serious harm would result. But a toxic chemical coming from the pesticide Rolf bought later that day came into contact with the wound. A few months after the scratch doctors discovered that the hand was severely infected and amputation followed. During the surgical removal the anaesthetist gave Rolf an overdose and the man died. Applying the equivalence theory, the man causing the scratch is not only liable for that wound, but also for the infection, the loss of the hand and the death. This is a startling result; the infection and death were not at all foreseeable for the person who caused the scratch. Applying the adequacy theory the scratch would not be regarded as the ultimate cause of the infection and the infection nor for the death.⁸¹³

i) Presumptions

Presumptions are accepted as a tool to make causal links when the *conditio sine qua non* facts cannot be identified.⁸¹⁴ It is however required that the presumptions follow the conditions mentioned in article 1353 of the Civil

⁸¹¹ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: The Clarendon Press, pp 432-433.

⁸¹² The use of a hypothetical example is aimed at improving the understanding of the analysis. Such examples are clearer than real chemical liability cases, which are often very complex in their analysis. It also happens frequently, especially in Continental law that no relevant cases dealing with the subject at hand could be found.

⁸¹³ An exception is made when the victim is abnormally susceptible for cancer (thin-skull), then the scratch would be regarded as causing the cancer. Stapleton, law, causation and common sense, p. 131.

⁸¹⁴ Cassation Civile (1re Chambre), 24 January 2006, Bulletin Civile 2006.I.34; Cassation Civile (1re Chambre), 28 March 2000, Bulletin Civile 2000.I.108; Cassation Civile (1re Chambre), 5 February 1991, Dalloz 1951/456. Note Massip; Cassation Civile (2e chambre), 29 April 1969, Dalloz 1969/534; BREILLAT, Y. (2005). L'office du juge et l'incertitude, *Bulletin d'information*, 2005, www.Cassation.fr, p. 3.

Code.⁸¹⁵ This article reads as follows: assumptions that are not established by law, are left to the insight and the prudence of the magistrate, who must validate that they are serious, precise and concordant, and this only in cases where the law allows testimonial evidence, unless the act concerns fraud or deceit.

The Court of Cassation described it more pragmatically as follows: for a presumption to be accepted as proof there should not be any other causes explaining what happened.⁸¹⁶ This is what the French call reasoning by exclusion. In fact it is reasoning by default: if there are no other causes, then the one that is discovered is the real one. A judge can make his decision on the basis of a single fact when this fact is such that, according to the opinion of the judge, it provides the necessary evidence. Assuming that judges use common sense, all the previous leads to the conclusion that a presumption is frequently based on common sense. However not everybody approves this state of affairs. Presumptions lead to presumed causal links, what has been compared with

“une sorte de pétition de principe entre le fait générateur et les préjudices invoqués”⁸¹⁷

or, in English, a presumed causal link is based on an assumption of the initial point or ‘*petitio principii*’⁸¹⁸ between a source of an event and the alleged damage. For the time being presumptions are still accepted and the power of the judge remains unchanged.⁸¹⁹

The jurisprudential approach of causation is, in line with the French legal culture, much more pragmatic than the development of legal doctrine in this area, which is particularly theoretic.⁸²⁰ Lawyers and courts in France are not neutral, they even do not try to give that impression. The victim of a negligent act is protected by all means. Courts make judgements on values, especially when a

⁸¹⁵ Art. 1353 du Code civil: “les présomptions qui ne sont point établies par la loi, sont abandonnées aux lumières et à la prudence du magistrat, qui ne doit admettre que des présomptions graves, précises et concordantes, et dans les cas seulement où la loi admet les preuves testimoniales, à moins que l’acte ne soit attaqué pour cause de fraude ou de dol”.

⁸¹⁶ Cassation Civile (3e Chambre), 10 June 2004, Bulletin Civile 2004.III.203.

⁸¹⁷ LAMBERT-FAIVRE, Y. (1992). De la poursuite à la contribution: quelques arcanes de la causalité. *Recueil Dalloz*, 1992, p. 312.

⁸¹⁸ *Petitio principii*: when a proposition which requires proof is assumed without proof.

⁸¹⁹ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, 1731-1740.

⁸²⁰ BREILLAT, Y. (2005). L’office du juge et l’incertitude, *Bulletin d’information*, 2005, www.Cassation.fr, pp. 1-7.

choice amongst the vast chain of possible causes is necessary.⁸²¹ This judgment is made by common sense, intuition and experience.

French courts have over the years solved complex causation cases by shifting away the basis of the liability from the act immediately leading to the damage (like who shot the victim) towards an activity that can be attributed to the 'group' including the actual tortfeasor (like all hunters).⁸²² In the case of the hunting accident, the Court of Cassation decided that, failing the identification of the actual shot, the real cause of the accident was the concerted action of the seven hunters who decide to fire a salvo to mark the end of the hunt, thereby harming the plaintiff.⁸²³ Such actors all at the origin of the damage are in France called: '*coauteurs*'. This approach is confirmed in more recent cases.⁸²⁴ A presumption of causation, failing the identification of the actual causal act, is the basis for attributing liability *in solidum* to the group members.⁸²⁵ Still, the defendant can always start a recourse action (*une action récursoire*) against the other defendants.⁸²⁶ The plaintiff is now relieved from the burden to prove the actual causing act, but another challenge facing him is the condition that he should bring before the court all the persons who may have caused the damage.⁸²⁷

ii) Alternative causation as understood in France

The French notion 'alternative causation' refers to the problem of having multiple alleged and potential tortfeasors, whereby it is impossible to find amongst them the one, who really caused the damage. This alternative causation mainly aims to benefit the plaintiff.⁸²⁸ Thereby the alternative

⁸²¹ LE TOURNEAU, P. (2010). *Droit de la responsabilité et des contrats*. Paris: Dalloz, p. 564.

⁸²² VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 443.

⁸²³ Cassation Civile (2^e chambre), 4 January 1957, *Dalloz* 1957/264; Cassation Civile 2e, 22 June 1977, *Bulletin Civile* 1977.II.164.

⁸²⁴ Cassation Civile (2e chambre), 2 April 1997, *Juris-Classeur Périodique* 1997; Cassation Civile (2e chambre), 8 March 1995, (Bzouard versus AGF).

⁸²⁵ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 443.

⁸²⁶ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, 1735-1736.

⁸²⁷ Cassation Civile (1re chambre), 28 January 2010, *Bulletin Civile* 2010.I.22; Cassation Civile (1re chambre), 17 June 2010, *Dalloz* 2010/1625.

⁸²⁸ Cassation Civile (1re chambre), 24 September 2009, *Bulletin Civile* 2009.I.186; Cassation Civile (1re chambre), 24 September 2009, *Bulletin Civile* 2009.I.187.

causation is applied independently from the use of presumptions.⁸²⁹ The normal use of alternative causation recognizes that it is (quasi) certain that not all of the defendants are at the basis of the damage, whilst a presumption finds every defendant involved liable.⁸³⁰ Applying the alternative causation, as is done in France, does hold all 'alternative' tortfeasors liable. It is considered a fiction with a pure legal content until the defendant proves the factual causation.⁸³¹ Furthermore it is an illusion that alternative causation can be applied without any proof of causal links. The plaintiff has to submit some proof of a causal link connecting the event with the alleged tortfeasor. If one attempts to apply alternative causation without such evidence then one is even further away from 'reality' than with a presumption. A presumption is 'a search for the truth and thus has to be a verisimilitude.⁸³² The latter assumes a causal link under the premise that each activity and damage are linked unless it is impossible in the real world.⁸³³

In 2009 the French Court of Cassation ruled two landmark judgments in the cases of two women who had cancer allegedly caused by the DES medicine (called Distilbène in France) taken by their mother during pregnancy.⁸³⁴ Although the Court of Appeal recognized that Distilbène can cause cancer, both claims were rejected. The first one because the plaintiff could not prove her exposure in utero and the second one because she could not prove which of both defendants had produced the Distilbène her mother took. This is a situation frequently occurring in chemical liability cases, typically because the latency period of a disease is very long, or, as in this case, because the damage extends across generations.

⁸²⁹ QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. Fondement et perspectives de la jurisprudence "Distilbène". *Recueil Dalloz*, p. 1170.

⁸³⁰ QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. Fondement et perspectives de la jurisprudence "Distilbène". *Recueil Dalloz*, p. 1166 e.v.

⁸³¹ QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. Fondement et perspectives de la jurisprudence "Distilbène". *Recueil Dalloz*, p. 1166 ff.

⁸³² QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. Fondement et perspectives de la jurisprudence "Distilbène". *Recueil Dalloz*, p. 1166 ff.

⁸³³ QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. Fondement et perspectives de la jurisprudence "Distilbène". *Recueil Dalloz*, p. 1166 ff.

⁸³⁴ Cassation Civile (1re chambre), 24 September 2009, Bulletin Civile 2009.I.186; Cassation Civile (1re chambre), 24 September 2009, Bulletin Civile 2009.I.187.

PART III – Causation

The Court of Cassation accepted the reasoning of the Court of Appeal concerning the claim of the first plaintiff.⁸³⁵ It is correct to require the plaintiff to prove at least her exposure to the medicinal product.⁸³⁶

Concerning the second case, the exposure to Distilbène is proved and it is thus certain that this substance caused the cancer.⁸³⁷ Consequently, the Court of Cassation decided that it is for the defendants to prove that their own marketed medicine was not the cause of the cancer.⁸³⁸ Since then the Court of Cassation has accepted alternative causation in similar cases and in some the court has even extended it.⁸³⁹ Des cases are easier than many cases concerning chemical substances would be. The causal link between the intake of the medication and the damage was scientifically proved and accepted. This is often not the case with chemicals – the substances tend to disappear from the body and, given the multitude of chemicals in our life, it will be difficult to identify the culpable substance. Only when the former was successfully completed the search for the tortfeasor can begin. This is maybe a worst case scenario, but not at all unrealistic. Most chemical liability cases will have some aspects of the described worst case. Using then alternative causation will not solve the problem with identifying the causal links, it will only transfer the burden to the party who most probably has more knowledge and more financial capacity. These defendants will however encounter similar difficulties as the plaintiffs, only now in proving their innocence.

A last remark: one should in this discussion not forget that the plaintiff still has to prove the exposure to the damaging factor, before any reversal can be done.

b) The Netherlands

In general 'common sense' is present in Dutch litigation. Concepts like the reasonable attribution and presumption use it, sometimes hidden in the arguments, sometimes openly. In the absence of legal rules or when legal rules are not sufficient, the courts take as a criterion 'the relevant societal ideas at the

⁸³⁵ Cassation Civile (1re chambre), 24 September 2009, *Bulletin Civile* 2009.I.186.

⁸³⁶ GALLMEISTER, I. (2009, September 24). Une avancée décisive pour les victims du Distilbène. *Recueil Dalloz*, p. 2342.

⁸³⁷ Cassation Civile (1re chambre), 24 September 2009, *Bulletin Civile* 2009.I.187

⁸³⁸ GALLMEISTER, I. (2009, September 24). Une avancée décisive pour les victims du Distilbène. *Recueil Dalloz*, p. 2342.

⁸³⁹ Cassation Civile (1re chambre), 28 January 2010, *Bulletin Civile* 2010.I.22; Cassation Civile (1re Chambre), 17 June 2010, *Dalloz* 2010/1625.

time the culpable behaviour or negligence took place'.⁸⁴⁰ Reference to 'what should have been known' is not compared to the mind of the average ordinary man, but to the relevant societal class the alleged tortfeasor belongs to.⁸⁴¹ In the following paragraphs I will focus on the particular solutions relating to common sense that are used in the Netherlands when dealing with complex causation: reasonable attribution and presumption.

i) Reasonable attribution infiltrated by common sense

No explicit reference to common sense could be found in legislation. The rather new concept of reasonable attribution has however some characteristics of common sense. It is certainly a concept that has its benefits for all parties involved in a toxic tort case: it can be a limit to the scope of the liability of the defendant, and it allows granting a claim to the benefit of the plaintiff if it seems reasonable to the court. But above all, it allows the judge to find a balance between opposing interests and a solution for difficult and complex claims. The concept will not help with uncertainty about the factual causes (phase 1), but it can help with the assessment of (uncertain) causal links (phase 2). No doubt a concept that is worthwhile elaborating in the context of chemical liability.

Originally the theory of the reasonable attribution is developed by Köster in 1963.⁸⁴² The theory is meant to be flexible and to enable judges to categorize claims according to the specificities of each category of tort.⁸⁴³

In 1970 the Dutch Supreme Court decides to follow the theory of reasonable attribution instead of the theory of adequate causation.⁸⁴⁴ This change is motivated by the desire to introduce a more refined criterion for attributing liability than the adequacy theory provides. The adequacy theory lacks the ability to distinguish amongst different causal elements, mainly due to his focus

⁸⁴⁰ Hoge Raad 17 December 2004, *Nederlandse Jurisprudentie* 2006, 147, conclusion Advocate-General Spier, note of C.J.H. Brunner. (Hertel/Van der Lugt).

⁸⁴¹ Hoge Raad 17 December 2004, *Nederlandse Jurisprudentie* 2006, 147, conclusion Advocate-General Spier, note of C.J.H. Brunner. (Hertel/Van der Lugt).

⁸⁴² DIJKSHOORN, W. (2011). *De leer van de redelijke toerekening: back to the eighties. Aansprakelijkheid, verzekering & schade*, p. 30.

⁸⁴³ ASSER, C., HARTKAMP, A., & SIEBURGH, C. (2010). *Verbintenissenrecht* 6. Deventer: Kluwer, nr. 58.

⁸⁴⁴ Hoge Raad 20 March 1970, *Nederlandse Jurisprudentie* 1970, 251. (waterwingebied-arrest)

on the foreseeability of the damage.⁸⁴⁵ It is not because the damage was foreseeable, that the attribution of liability is reasonable.⁸⁴⁶

Concepts like proximity, the nature of liability and, in lack of scientific evidence, probability are frequently based on a personal judgement, and in that sense related to the thinking of the 'ordinary person'.

In 1992 the doctrine of reasonable attribution is translated into the law.⁸⁴⁷ Surprisingly the adjective 'reasonable' is not retained in the text. This way the legislator wants to avoid the impression that judges are completely free to follow their personal opinions in deciding liability claims.⁸⁴⁸ Consequently the condition of reasonableness moved to the obligatory motivation of judgments.⁸⁴⁹ This is probably correct, at least is it justified to require a motivation why a decision is taken.

The formalisation of the motives and arguments to make a certain decision do, however, not exclude differences in judgments when causation is uncertain; not even in similar situations.⁸⁵⁰ The power of judge remains broad. The Supreme Court ruled, for example, in favour of a plaintiff referring to the 'attitude of the party' (the defendant), who had kept information from the plaintiff.⁸⁵¹ The argument for the decision referred to the legal obligation to submit in court all relevant facts truthfully, also upon request of a plaintiff.⁸⁵²

The Supreme Court of the Netherlands now uses the freedom provided by the principle of reasonable attribution fully. Originally the court limited the application of reasonable attribution to damage which was a typical consequence

⁸⁴⁵ DIJKSHOORN, W. (2011). De leer van de redelijke toerekening: back to the eighties. *Aansprakelijkheid, verzekering & schade*, p. 30

⁸⁴⁶ Hoge Raad 29 april 2011, *Jurisprudentie aansprakelijkheid* 2011-109, 3.4.4, note of Gouweloos. (Bouwcombinatie en Paans/Liander).

⁸⁴⁷ Art. 6:98 Burgerlijk Wetboek: "Voor vergoeding komt slechts in aanmerking schade die in zodanig verband staat met de gebeurtenis waarop de aansprakelijkheid van de schuldenaar berust, dat zij hem, mede gezien de aard van de aansprakelijkheid en van de schade, als een gevolg van deze gebeurtenis kan worden toegerekend".

⁸⁴⁸ DIJKSHOORN, W. (2011). De leer van de redelijke toerekening: back to the eighties. *Aansprakelijkheid, verzekering & schade*, p. 31.

⁸⁴⁹ DIJKSHOORN, W. (2011). De leer van de redelijke toerekening: back to the eighties. *Aansprakelijkheid, verzekering & schade*, p. 31.

⁸⁵⁰ ASSER, C., HARTKAMP, A., & SIEBURGH, C. (2012). *Redelijke toerekening afhankelijk van alle omstandigheden*. Deventer: Kluwer Law, par. 63.

⁸⁵¹ Hoge Raad 9 May 2003, *Nederlandse jurisprudentie* 2005, 168, conclusion by Advocate-general Weesling-Van Gent (Beliën versus Noord-Brabant)

⁸⁵² Art. 21 Wetboek van Burgerlijke Rechtsvordering, the Netherlands.

of the causing act.⁸⁵³ This was often explained as a restriction of attribution, namely only typical damage for a certain event should be attributed. During the following years it became however clear that any restriction on interpretation no longer exists.

In 2007 a huge fire started in a waste transportation company (ATF). As a consequence toxic chemicals were emitted posing a serious risk for human health.⁸⁵⁴ Friesland Foods, a dairy company, sued the ATF in tort. The defendant argued that Friesland Foods was not damaged by the events and that only the farmers in the region could file claims. In second order it was said that the contamination of the milk was not a result of the emission caused by the fire, but a consequence of the contractual obligations Friesland Foods had towards the farmers. The court found that Friesland Foods was directly damaged, since the company had to take precautions, and had to adapt its production process and management. The impact on Friesland Foods was foreseeable for ATF. Besides, the article in the Civil Code concerning liability for human health and environment does not provoke a limited application of attribution.⁸⁵⁵

In the Frieslandhal case a group of children started a fire in a market building and when they left, they forgot to extinguish it.⁸⁵⁶ The building burned down and

⁸⁵³ Hoge Raad 13 June 1975, *Nederlandse jurisprudentie* 1975, 509, note of G.J. Scholten. (Amercentrale-arrest)

⁸⁵⁴ Hof Leeuwarden 19 September 2007, LJN BC9803. (ATF/Friesland Coberco Foods)

⁸⁵⁵ Art. 6:175 Civil Code: (free translation)

1. The person who uses a substance professionally or who guards a substance, whilst it is known that this substance has characteristics that are dangers for people or objects, is liable when the danger materializes. [...] Seriously dangerous are substances that are considered explosive, oxidizing, flammable, toxic or very toxic following the criteria and methods mentioned article 9.2.3.1, third paragraph of the Environmental management law.
2. If the substance is under the control of a custodian, then that person is liable as mentioned in paragraph one. [...]
3. [...]
4. If the damage is a consequence of pollution coming from emissions of the substance into the air, water or soil, then the person who was indicated as the one who started the pollution will be held liable in accordance with paragraph one of this article. [...]
5. [...].
6. A substance is supposed to comply with the description mentioned in the first sentence of the first paragraph when it is classified as such by a ruling of the governmental authority. [...] The classification can be limited to certain concentrations of the substance, to certain dangerous characteristics as mentioned in the ruling and to certain situation described in the ruling.

⁸⁵⁶ Hoge Raad 25 April 2008, *Nederlandse jurisprudentie* 2008, 262, conclusion by Advocate-general Spier. (Frieslandhal-arrest)

the tavern in the building was completely demolished. The Court of Appeal decided that the loss of income suffered by the tenant of the tavern caused by the failure to conclude a new lease contract was too far away from the fire to attribute liability to the parents of the children. It was not foreseeable that the tenant could not continue such an exceptionally beneficial and productive business. The Supreme Court disagreed and considered the damage attributable to defendants. The loss of income was directly related to the fire and the *conditio sine qua non* requirement was fulfilled. The exceptionally high income and beneficial lease conditions were not relevant and no impediment to conclude for liability. Thus the liability could be reasonably attributed to the parents.

Reasonable attribution is a concept that can be interpreted in a broad manner; its meaning depends on the circumstances of a case.⁸⁵⁷

The Supreme Court held the defendants liable for the loss of income of the bartender, but not for the lucrative contract.

At first sight this decision is contrary to the former standpoint of the Supreme Court in the case of the Amercentrale, although the same arguments are used.

“de tekst van het artikel geen beperking tot bepaalde gevolgen inhoudt en dat ook de strekking van het artikel eerder voor een ruime dan voor een enge opvatting aangaande de omvang van de aansprakelijkheid [...] pleit.”⁸⁵⁸

But in the Amercentrale the consequences were different. The Supreme Court judged that the exceptional character of the liability of owners of a construction, namely a strict liability, the link between the damage and the causing act should be closer than normally would be required. Only normal consequences of the demolition of the building should lead to liability.⁸⁵⁹

In the Frieslandhal case, atypical consequences were attributed to the tortfeasors. Is there a contradiction between both cases? In general scholars are of the opinion that attribution is to be looked at in relation to the type of liability

⁸⁵⁷ ASSER, C., HARTKAMP, A., & SIEBURGH, C. (2012). *Redelijkheid toerekening afhankelijk van alle omstandigheden*. Deventer: Kluwer Law. par. 63.

⁸⁵⁸ “The text of the article does not contain any limitation of the consequences and the wording rather directs towards a broad interpretation than towards a limited one.” in Hoge Raad 25 April 2008, *Nederlandse jurisprudentie* 2008, 262, conclusion by Advocate-general Spier, 4.27. (Frieslandhal-arrest)

⁸⁵⁹ Hoge Raad 13 June 1975, LJN AC3080, *Nederlandse Jurisprudentie* 1975/509. (Amercentrale)

at hand in the case.⁸⁶⁰ It is, according to them, on this basis that the choice for a limited or a broad interpretation of reasonable attribution will be taken.⁸⁶¹ There is thus no a contradiction between the two decisions of the Supreme Court. Even if risk/strict liability is imposed, the intent of the rule to implement broad or restricted responsibilities is an aspect to be taken into account by the judge when attributing liability.

The nature of the liability overruled in the Frieslandhal case the requirement of foreseeability. The text of article 6:98 however states that several factors should be taken into account. Thus it seems that there is room for still other decisions. Brunner elaborated following criteria, which could help with the assessment of attribution:

1. The more probable the results when assessed on experience, the more justified attribution is.
2. The more proximate the damage is to the tortious act, the more attribution is justified.
3. The nature of the liability has an impact on the extent of damage that should be attributed.⁸⁶²

Attribution is an important concept. It differs with causal theories taking only one factor into account. Consequently it can be used in complex causation situations, like in toxic tort.

It is still not clear on what basis the consequences of an act can be reasonably imputed to an alleged tortfeasor, lacking any clear guidelines through the litigation of the Hoge Raad.⁸⁶³ The objective of the concept is however clear: it is aimed at determining the scope of a tortfeasor's liability in a more societal acceptable manner. Consequently it is an important theory for chemical liability. In chemical tort cases it is not unlikely that multiple causes, multiple tortfeasors and huge damages all come together. Proof of causation is difficult if not

⁸⁶⁰ DIJKSHOORN, W. (2011). De leer van de redelijke toerekening: back to the eighties. *Aansprakelijkheid, verzekering & schade*; ASSER, C., HARTKAMP, A., & SIEBURGH, C. (2012). *Redelijkheid toerekening afhankelijk van alle omstandigheden*. Deventer: Kluwer Law. par. 63.

⁸⁶¹ Hoge Raad 25 April 2008, *Nederlandse jurisprudentie* 2008/262, conclusion by Advocate-general Spier. (Frieslandhal-arrest)

⁸⁶² BRUNNER, C.J.H., *Causaliteit en toerekening van schade, Verkeersrecht*, p. 213

⁸⁶³ Hoge Raad 5 October 2010, LJV BN2293, conclusion van de Advocaat-generaal over culpa en de causaliteitsleer van de redelijke toerekening, par. 11.

impossible and where science lacks (full) insight, common sense through reason is useful, even in complex cases.

Thereby attribution is not a matter of evidence, but a question that the court should answer on the basis of an evaluation of all the circumstances of the case. Causation in jurisprudence is more than cause and effect. Causal links should be legally relevant.⁸⁶⁴ Attribution of liability should be based on the fulfilment of certain requirements. Reasonableness cannot provide this basis.⁸⁶⁵ Foreseeability and proximity on the contrary are suitable arguments to assign liability to a defendant.

According to some it is still necessary to fulfil the *conditio sine qua non* test or the condition of foreseeability in order to be able to apply the concept of reasonable attribution. Fokkens observes that the reasonable attribution concept cannot be applied if the *conditio sine qua non* principle is not met.⁸⁶⁶ The abidance of that principle is a factor of great importance.⁸⁶⁷ Only in exceptional circumstances liability can be attributed to a tortfeasor when the *conditio sine qua non* requirement is not fulfilled.⁸⁶⁸

The Hoge Raad however expressed a different opinion in 2010.⁸⁶⁹ The open and rather vague nature of the concept of reasonable attribution makes it possible to adapt the concept to the specific circumstances of the case. Neither foreseeability nor the *conditio sine qua non* are necessary for attributing liability. Since the doctrine of the reasonable attribution has its own normative character, it can be used without the two principles.⁸⁷⁰ One would not need the reasonable attribution if other causal doctrines were workable in the absence of sufficient concrete data or the 'normal sequence of things'.⁸⁷¹ Reference is made to a case

⁸⁶⁴ Hoge Raad 20 februari 2007, LJN AZ2105, *Nederlandse jurisprudentie* 2007/263, with note of Reijntjes.

⁸⁶⁵ Hoge Raad 20 februari 2007, LJN AZ2105, *Nederlandse jurisprudentie* 2007/263, with note of Reijntjes.

⁸⁶⁶ Hoge Raad 18 mei 2004, LJN AO6457, *Nederlandse jurisprudentie* 2004, 512, conclusion of P-G Fokkens.

⁸⁶⁷ Hoge Raad 17 juni 1980, *Nederlandse Jurisprudentie* 1980/580. Hoge Raad 25 juni 1996, *Nederlandse Jurisprudentie* 1997/563.

⁸⁶⁸ Hoge Raad 30 september 2003, LJN AF9666.

⁸⁶⁹ Hoge Raad 5 October 2010, LJN BN2292, conclusion of Advocate-General on culpa en de causaliteitsleer van de redelijke toerekening.

⁸⁷⁰ Hoge Raad 5 October 2010, LJN BN2292, conclusion of Advocate-General on culpa en de causaliteitsleer van de redelijke toerekening, par. 12.

⁸⁷¹ Hoge Raad 5 October 2010, LJN BN2292, conclusion of Advocate-General on culpa en de causaliteitsleer van de redelijke toerekening, par. 12.

of 1978⁸⁷² in which the Supreme Court of the Netherlands did not consider foreseeability. The circumstances of the case were the following. A passenger of a car is hospitalized after a traffic accident and 12 days later this person dies from a pulmonary embolism. This embolism was the result of a thrombosis caused by the prolonged confinement to a hospital bed. Is the car accident the cause of this person's death? Experts claim that the original injury of the passenger, as caused by the accident, should not have led to his passing away. It was held that causation should be decided upon through the concept of reasonable attribution, namely if the act (in casu: the car accident) was sufficient to realize the damage or to increase considerably the risk on damage, this act is to be regarded as the cause.⁸⁷³ Thus the final judgment depends on the considerable freedom of the court to use or not to use concepts like *conditio sine qua non*, foreseeability, attitude of the parties, etc.

In essence judgment calls of attribution are rooted in common sense. Especially the formulation 'taking into account the nature (of the damage) and that of the liability' refers to a human judgment, what cannot be performed without common sense.

ii) Presumption

In the Netherlands some use of common sense reasoning can be found in the principle of reversal of proof. The '*omkeringsregel*' (as it is called in Dutch) puts the duty to prove actual causation from the plaintiff to the defendant. The latter should prove that he did not cause the damage. The idea originated in a negligence case brought to the Dutch Supreme Court in 1996. The court said that if a tortious act creates a risk on damage and this risk subsequently materialises, then the causal link between the act and the damage is considered a given. In other words the link is presumed. Consequently the defendant should prove that the damage would also have occurred but for his act.⁸⁷⁴

⁸⁷² Hoge raad 12 september 1978, *Nederlandse jurisprudentie* 1979/60, (Letale longembolie-arrest). See also: Hoge Raad 23 December 1980, *Nederlandse jurisprudentie* 1981/534 (Aortaperforatie).

⁸⁷³ Hoge Raad 28 November 2006, LJV AZ0247; Hoge Raad 13 Juni 2006, LJV AV8535; Hoge Raad 20 september 2005, LJV AT8303, conclusion of Advocate-General Vellinga, (uses also foreseeability); Hoge Raad 30 september 2003, LJV AF9666.

⁸⁷⁴ Hoge Raad 26 January 1996, LJV ZC1976, *Nederlandse Jurisprudentie* 1996/607.

However, the core requirement is that the plaintiff proves his exposure and that it is plausible that the exposure caused the harm.⁸⁷⁵ Only then a reversal of proof can happen. Both the exposure to substances that can harm and the development of such related harm are necessary for assuming a causal link.

The presumption of causation is sufficiently justified on the basis of what is commonly known about the disease and its causes.⁸⁷⁶ It is not sufficient that the plaintiff states that he was possibly exposed to toxic substances.⁸⁷⁷ This means that the rule is not applicable if the link between the negative health impact and the circumstances allegedly causing the harm is too uncertain or too vague. In such situation it is even not sufficient that an expert concludes that a causal link exists, this is not sufficient when that expert only refers to his knowledge, experience and intuition.⁸⁷⁸

The Dutch Supreme Court formulated its reasoning as follows:

“Terecht heeft het hof vervolgens geoordeeld dat nu vaststaat dat zich bij de werknemer de asbestziekte mesotheliom heeft geopenbaard, het gestelde causaal verband in beginsel vaststaat nu immers door toepassing van de omkeringsregel het causaal verband (in de zin van: *condicio sine qua non* verband) tussen de onrechtmatige blootstelling van de werknemer aan asbeststof en de ziekte die zich bij hem openbaarde, nu juist tot op door de derde te leveren tegenbewijs wordt verondersteld.”⁸⁷⁹

3.2.1.4 A love-hate relation between the standard of law and common sense

Or is it, as Ralph Waldo’s remarked:

⁸⁷⁵ Hoge Raad 7 June 2013, LJN BZ1717, *Rechtspraak Arbeidsrecht* 2013/123; Hoge Raad 26 January 2006, LJN AA9666, *Nederlandse Jurisprudentie* 2001/597

⁸⁷⁶ Hoge Raad 7 June 2013, LJN BZ1717, *Rechtspraak Arbeidsrecht* 2013/123; Hoge Raad 7 June 2013, LJN BZ1721, *RAR* 2013/122; Hoge Raad 17 November 2000, LJN AA8369 *Nederlandse Jurisprudentie* 2001/596, note of W.D.H. Asser

⁸⁷⁷ Hoge Raad 23 June 2006, LJN AW6166, *Rechtspraak Arbeidsrecht* 2006/110.

⁸⁷⁸ Hoge Raad 7 June 2013, LJN BZ1717, *Rechtspraak Arbeidsrecht* 2013/123.

⁸⁷⁹ The Court has properly judged that, since the employee has developed mesothelioma, the causal link between the tortious exposure and the disease is in principle established by the application of the reversal of proof. The causal remains established until evidence of the opposite is delivered. Hoge Raad 17 December 2004, *Nederlandse jurisprudentie* 2006, 147, LJN AR3290, conclusion Advocate-General Spier, note of C.J.H. Brunner. (Hertel/Van der Lugt).

“common sense is genius dressed in working clothes”.⁸⁸⁰

Common sense knowledge has been recognized as crucial for our understanding of the world throughout the history of Western civilization.⁸⁸¹ Factual determinations in daily life generally rely on common sense, because facts derive their meaning from frameworks of understanding within which individuals live.⁸⁸²

Approximately a century ago Roscoe Pound said:

“When there exists divergence between the standard of law and the standard of common sense, the latter will prevail in the end.”⁸⁸³

Although this statement is most probably no longer completely justified, the opinions and ordinary reasoning, still have influence on court decisions. Whilst toxic tort needs scientific evidence, persons not schooled in science have to work in court with the evidence.

Besides that, command and control in law and regulations are no longer effective and efficient.⁸⁸⁴ The norm aiming at installing a certain behaviour has to be implemented by human beings. It is the individual who decides if he will follow the law and many times he does not conform. In a pluralistic society, where values are disputed, there is no automatic inclination to regulatory convenience.⁸⁸⁵ Brownsword sees however two principles that are widely accepted. The first is that one should not harm others. The second is: precaution should be exercised in the face of uncertain but potentially serious and irreversible risks.⁸⁸⁶

A concrete example thereof is the dissenting opinion of the EU six Member States on the calculation of SVHC⁸⁸⁷ in complex products.⁸⁸⁸ Once the

⁸⁸⁰ ALLEN, R. (2000-2001, Vol. 22). Common Sense. *Cardozo Law Review*, p. 1421.

⁸⁸¹ MacCRIMMON, M. (2001, Vol. 22). What is common about common sense: cautionary tales for travellers crossing disciplinary boundaries? *Cardozo Law Review*, p. 1433.

⁸⁸² LESSIG, L. (1995, Vol. 62). The Regulation of Social Meaning. *University of Chicago Law Review*, p. 952.

⁸⁸³ POUND, R. (1907, Vol. 19). The Need of a sociological jurisprudence. *Green Bag*, p. 615.

⁸⁸⁴ BROWNSWORD, R. (2008). *Rights, Regulation, and the Technological Revolution*. Oxford University Press, p. 240.

⁸⁸⁵ BROWNSWORD, R. (2008). *Rights, Regulation, and the Technological Revolution*. Oxford University Press, pp. 100-101.

⁸⁸⁶ BROWNSWORD, R. (2008). *Rights, Regulation, and the Technological Revolution*. Oxford University Press, p. 101.

⁸⁸⁷ SVHC refers to Substances of Very High Concern as defined in REACH. These are thus very toxic substances with a potential hazard for human health and the environment.

concentration of SVHCs in articles exceeds 0,1 weight by weight notification to ECHA and communication in the supply chain is obligatory. However, many products are in fact complex articles, consisting of many articles sometimes with SVHCs. The calculation of the concentration of SVHC in complex articles is open for interpretation due to the lack of clear definitions in the legal text of REACH. Two formulas, one defended by ECHA and the other by six Member States exist. The latter find it common sense that the concentration is calculated to the part of the product wherein the SVHC is found and not to the whole product. The threshold limit is more easily reached when the concentration of the SVHC is calculated to the part of a complex product (for example the battery of car) than when the concentration is calculated the complex product in itself (for example the car) containing the SVHC.⁸⁸⁹ In line with the objectives of the regulation, i.e. protection of human health and environment, and the importance it gives to precaution, the dissenting calculation stands a good chance to prevail, it is seen as common sense to use the most stringent formula. If one aims at protecting human health and environment the concentration should be calculated in the most precautionary manner, thus in relation to the part containing it.⁸⁹⁰ Six countries thus decided to go against the official interpretation of the Commission, thereby *de facto* not accepting its command.

a) Common sense and the challenge of toxic tort

Hart and Honoré believe that 'common sense' is a flexible concept, subtly influenced by context. Whilst it was common practice to use common sense in earlier times, the concept now can be questioned on the basis of increased insights in our world and the steep evolution of science. How important is the role of common sense in toxic tort? Does it bring the necessary insights in toxic tort cases? Science has become a major element in proving causation between the exposure to a chemical and the allegedly resulting damage. Even when

⁸⁸⁸ For a full elaboration of this issue, see HOPPENBROUWERS, M. (2011, Vol. issue 4). The Story of the Button on the Jacket - Substances of Very High Concern in Complex Products. *Journal for European Environmental and Planning Law*, pp. 353-371.

⁸⁸⁹ The REACH legal text does not contain a definition of the core element (complex product) in the formula and their interpretation is as valid as the one of the European Commission. HOPPENBROUWERS, M. (2011, 8.4). The Story of the Button on the Jacket - Substances of Very High Concern in Complex Products. *Journal for European Environmental and Planning Law*, pp. 353-371.

⁸⁹⁰ HOPPENBROUWERS, M. (2011, 8.4). The Story of the Button on the Jacket - Substances of Very High Concern in Complex Products. *Journal for European Environmental and Planning Law*, pp. 362-368.

science cannot provide the necessary insight in causal links, common sense applied to causation would not help. It might however give some ideas and solution for the attribution of liability once it is established what substance caused the damage. The concept is part of the legal cause and can justify some decisions that would be experienced as unfair, unjust and/or incorrect when using the 'normal' standards. In short, common sense is sometimes consciously used to bring policy arguments into liability cases. Good examples are the cases dealing with the Fairchild principle⁸⁹¹, whereby the inability to prove causation was replaced by a reasoning fitting appropriately in the system.

On the other hand, common sense, if unexamined, can and does lead to judgmental errors.⁸⁹² We all know about occasions that inconsistent opinions were adopted, or when new information was not considered. Common sense is seldom defined and the reason for relying on it is seldom motivated. Fact determination in legal processes is however close to non-specialist reasoning in a given society.⁸⁹³ Some disagree with the former and suggest that common sense can exclude many perspectives on reality as immaterial, regardless of their pertinence. But facts are shaped by normative values, as Zuckerman states.⁸⁹⁴ At least facts are perceived and interpreted by people who have values and norms.

b) Abuse of common sense

Common sense can be abused by defendants or plaintiffs to achieve what they want, meaning that they play on the common understanding of non-scientifically schooled people, to achieve a desired outcome. A striking example is the case of Alcolac where the aversion of the public for chemicals, was misused to convince the jury that the defendant was guilty. Later on it was scientifically proved that Alcolac's only fault was odour, what did not cause the alleged diseases. Before explaining what happened, it should be said that the expert evidence was not up

⁸⁹¹ For example: *Fairchild v Glenhaven Funeral Services Ltd. and others*, [2002] 1 W.L.R. 1052 (Court of Appeal December 11, 2001); *Sienkiewicz versus Greif (UK) Ltd*, [2011] I.C.R. 391 (Supreme Court March 9, 2011).

⁸⁹² MacCRIMMON, M. (2001, Vol. 22). What is common about common sense: cautionary tales for travellers crossing disciplinary boundaries? *Cardozo Law Review*, p. 1435.

⁸⁹³ MacCRIMMON, M. (2001, Vol. 22). What is common about common sense: cautionary tales for travellers crossing disciplinary boundaries? *Cardozo Law Review*, p. 1439.

⁸⁹⁴ ZUCKERMAN, A. (1986, May/July). Law, fact or justice? *Boston University Law Review*, pp. 487-512.

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to standard, and was (consciously) prepared to influence the common sense of the people in the jury.⁸⁹⁵

Alcolac, a manufacturer of specialty chemicals was sued by local residents for allegedly causing injuries like nerve damage, heart disease, brain damage, kidney infections, headaches, vomiting. Over 165 witnesses were heard. Experts were called into the court to testify on immunology. They found abnormalities in the immune system of every citizen. Alcolac was convicted. Afterwards top scientists analysed the evidence submitted in the case. Amongst them was Professor of Medicine Stuart Schlossman of Harvard, who was also head of the Tumour Immunology and Immunotherapy department of the Dana-Farber Cancer Institute.⁸⁹⁶ He observed that none of the Alcolac victims had suffered from any kind of recurrent infection what would point at a damaged immune system. Neither were the laboratory tests abnormal.⁸⁹⁷ Why could Alcolac not convince the jury? No immunologist can deny that chemicals can cause damage to humans. People generalize this knowledge to all situations, certainly when they are reinforced to think that way, for example by lawyers from a victim. This is also common sense... This example is by no means an exception, nor is it specific for jury litigation. Judges, who are no chemists, immunologists or the like, are as vulnerable for wrong common sense arguments as other laypersons.

Should we not rather recognize the role of common sense and so be able to 'control' it, than rejecting it as a danger to litigation? Common sense cannot be excluded, without it we would not understand each other⁸⁹⁸, but science should interfere in the quest for truth. And common sense should be handled with care when used for the interpretation of evidence in litigation.

⁸⁹⁵ HUBER, P. W. (1991 - 1995). *Galileo's Revenge: Junk Science in the Courtroom*. New York: Basic Books.

⁸⁹⁶ Since the founding of the Dana-Farber Cancer Institute in 1947, the institute has been committed to providing adults and children with cancer with the best treatment available today while developing tomorrow's cures through cutting-edge research. Read about our history, our breakthroughs, and the resources that help us support the health of our neighbourhoods and communities. www.dana-farber.org (accessed on 9 March 2013).

⁸⁹⁷ HUBER, P. W. (1991 - 1995). *Galileo's Revenge: Junk Science in the Courtroom*. New York: Basic Books, pp. 100-102.

⁸⁹⁸ LESSIG, L. (1995, Vol. 62). The Regulation of Social Meaning. *University of Chicago Law Review*, p. 974.

3.2.1.5 Why make a fuss about common sense?

All countries studied use the concept of common sense. Some more openly (like the UK and France), other more hidden into other concepts (like the US and the Netherlands). Common sense reasoning makes people understand the direct and indirect effects of an action.⁸⁹⁹ Facts are given a meaning on the basis of the 'frameworks of understanding within which individuals live'.⁹⁰⁰

Common sense in these systems is used in a flexible way. This is possible since there exists no definition of the concept. On the other hand everybody understands what is meant by it. One of the major advantages of the 'vagueness' of common sense is the fact that it can be used to motivate and support decisions based on fairness and equity. In all four countries examples can be found. A good example is the UK, where the concept is known to support the victim in court cases with complex and uncertain causation. Famous is the example of *Fairchild versus Glenhaven*, in which it was declared that it would be incorrect to insist the application of a rule when this would be unfair.⁹⁰¹

In the US jury litigation decisions are easily based on common sense or 'thinking like the ordinary man', but also the Supreme Court uses the concept common sense to attain the result it desires.⁹⁰²

The UK, the Netherlands and the USA have all different mechanisms structure the assessment of tortious liability.⁹⁰³ These mechanisms can be based in common sense. To name a few: the UK uses the duty of care and the requirement linked to the nature of the liability, the Netherlands have their reasonable attribution and the US has besides the duty of care, its rules on (scientific) evidence. France is different. The Court of Cassation relaxes the requirement concerning liability regularly, making liability broader than what

⁸⁹⁹ MacCRIMMON, M. (2000-2001, Vol. 22). What is common about common sense? Cautionary tales for travellers crossing disciplinary boundaries. *Cardozo Law Review*, p. 1434.

⁹⁰⁰ LESSIG, L. (1995, Summer). The regulation of social meaning. *University of Chicago Law Review*, p. 952.

⁹⁰¹ *Fairchild versus Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002).

⁹⁰² *Anderson versus Welding Testing Laboratory, Inc.*, 294 So.2d 298 (Court of Appeal of Louisiana, First Circuit April 22, 1974).

⁹⁰³ BORGHETTI, J.-S. (2008). Les intérêts protégés et l'étendu des préjudices réparables en droit de la responsabilité civile extra-contractuelle. In M. FABRE-MAGNAN, J. GHESTIN, P. JOURDAIN, & C. LABRUSSE-RIOU, *Etudes offertes à Geneviève Viney, Liber Amicorum* (pp. 145-171). Paris: Lextenso éditions.

exists in other legal systems.⁹⁰⁴ Indeed proof by all means is allowed and the acceptance of causes is easy because of the adherence to the theory of equivalence. Cases with multiple causes are consequently more frequent.⁹⁰⁵ Creativity to solve cases is also remarkably present: the creation of 'virtual' groups is such a construction that enables courts to judge multiple tortfeasors, or multiple causes together in liability. These defendants or these causes are just considered to form a group.⁹⁰⁶ This attitude is in line with the objective to protect victims of an injury as much as possible⁹⁰⁷, whereby the ultimate goal of the court is often a 'common sense' solution.⁹⁰⁸

In France liability decisions can be based on the appreciation of a judge, more, judges seldom document or communicate their reasoning in detail. Although article 455 of the Code of Civil Procedure states that a judgement should be motivated, the fact that the article refers to the duty to consider the arguments of the parties seems to limit the motivation to an appreciation of these arguments.⁹⁰⁹

The situation is different in the Netherlands. When using the Dutch concept of reasonable attribution, which is very often an application of common sense, the decision has to be clearly argued and explained. In the UK the House of Lords, now called the Supreme Court, has considerable authority. They make the rules and if they decide on the basis of common sense, like in *Fairchild*, a principle can get the value of law. However, the Parliament can blow the whistle as they did with the 2006 Compensation act after a decision in the *Barker versus Corus*

⁹⁰⁴ BORGHETTI, J.-S. (2008). Les intérêts protégés et l'étendu des préjudices réparables en droit de la responsabilité civile extra-contractuelle. In M. FABRE-MAGNAN, J. GHESTIN, P. JOURDAIN, & C. LABRUSSE-RIOU, *Etudes offertes à Geneviève Viney, Liber Amicorum* (pp. 145-171). Paris: Lextenso éditions, pp. 171-172.

⁹⁰⁵ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 464.

⁹⁰⁶ QUEZEL-AMBRUNAZ, C. (2010). La fiction de la causalité alternative. Fondement et perspectives de la jurisprudence "Distilbène". *Recueil Dalloz*, pp. 1162-1165; VINEY, G. (2010). La responsabilité des fabricants de médicaments et de vaccins : les affres de la preuve. *Recueil Dalloz*, p. 391; LAMBERT-FAIVRE, Y. (1992). De la poursuite à la contribution: quelques arcanes de la causalité. *Recueil Dalloz*, p. 313.

⁹⁰⁷ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 57.

⁹⁰⁸ Cassation Civile (2e Chambre), 8 February 1989, n° 87-19.671, *Dalloz jurisprudence*; Cassation Civil (1re Chambre), 17 November 1982, n° 81-13.530, *Dalloz jurisprudence*; see also: par. 2.1.3.1.

⁹⁰⁹ Art. 455 of the Code of Civil Procedure: The judgement must set forth succinctly the respective claims of the parties and their grounds. Such presentation may take the form of a reference to the pleadings of the parties with the indication of their date. The judgement must be reasoned. It pronounces the decision in the form of operative part. Translated by legifrance.fr

case.⁹¹⁰ In practice the House of Lords was overruled by the law. Their Lordships' use of common sense is thus not unlimited.

But the concept of common sense is still used frequently to make choices amongst different causes, or to solve uncertain causation resulting in a negative outcome for the victim. It is interesting that also the US courts use common sense to get the result they want. The differences in proof of causation depending on the nature of the damage, i.e. acute or chronic, are interesting. Common sense is used twice. First, people differ in their appreciation and explanation of chronic damage (certainly if latency periods are long) versus acute damage. This differentiation is based on common sense, i.e. the thoughts that there is a difference. Secondly, the observations relating to acute damage are much more direct and noticeable. It is thus logic that laypersons make causal links between, for example, exposure to a chemical and the watering eyes of the person exposed. It is also more likely that there really exists a causal link, since one fact (exposure) is close to the other (watering eyes).

Whilst it is clear that common sense is an important and an unavoidable element in liability cases, no matter how complex these might be, it is also certain that more is needed when dealing with issues like damage caused by chemicals. Erroneous common sense assumptions can lead to inferential errors. In toxic tort with its complex causation issues, the risk of incorrect assumptions is high, especially since physical or measurable observations of what happened in the case at hand is frequently absent and/or impossible.

Consequences of toxic exposure cannot be proved by common sense only. Other tests have been developed. The substantial factor test, being such a formula, is analysed in the following paragraph.

3.2.2 The substantial factor test

Although the *conditio sine qua non* test works well in many cases, it was no longer deemed acceptable in situations with several potential causes.⁹¹¹ The application of the *conditio sine qua non* only tests if the absence of an individual

⁹¹⁰ *Barker versus Corus (UK)*, [2006] UKHL 20 - appeal from [2004] EWCA Civ 545 (House of Lords May 3, 2006); JONES, M. (2006, Vol. 22 Issue 4). Proving causation - beyond the "but for" test. *Professional negligence*, pp. 251-269.

⁹¹¹ BARTHOLOMEW, M., & McARDLE, P. (2011, April). Causing infringement. *Vanderbilt Law Review*, p. 722; FISCHER, D. (1999, Summer). Successive causes and the enigma of duplicated harm. *Tennessee Law Review*, pp. 1127-1169.

act prevents the occurrence of the damage. This is precisely what does not work in situations with a multitude of potential causes, then the damage can still materialize through the other acts. This phenomenon of different origins allegedly all leading to the damage is named 'overdetermined' causation.⁹¹² In such circumstances it is impossible to identify one particular act that can be unquestionably associated with the damage.⁹¹³ This means that it is possible to identify several acts that could have caused the damage. The *conditio sine qua non* test assumes a linear and deductive connection and ignores the presence of multifactor causation.⁹¹⁴ A solution was desirable.

To avoid misunderstandings, the substantial factor theory is not the same as the adequacy theory, although some elements seem to point towards similarity. One difference is that the adequacy theory requires the *conditio sine qua non* to be fulfilled and only then a cause is considered. The substantial factor test has on the contrary been used in cases where the *conditio sine qua non* was not met. It is only required that the contribution of the cause is more than negligible or theoretical.

The theory is considered to lack distinctiveness.⁹¹⁵ A cause is adequate if it fits in the normal chain of events and accords with the experiences of life.⁹¹⁶ The principle of adequacy accepts only that cause which normally brings along that specific type of damage.⁹¹⁷

⁹¹² Anderson versus Minneapolis, St. Paul & Sault Ste. Marie Ry. Co., 179 N.W. 45 (Supreme Court of Minnesota September 17, 1920).

⁹¹³ As was the case in Summers versus Tice where two hunters shot a man and it was impossible to prove which defendant caused the death of that man. Consequently, applying the *conditio sine qua non* would result in finding none liable.

⁹¹⁴ CONWAY-JONES, D. (2002, January). Factual causation in toxic tort litigation: a philosophical view of proof and certainty in uncertain disciplines. *University of Richmond Law Review*, p. 887; Warren versus Parkhurst, 92 N.Y.S. 725 (Supreme Court, Montgomery County, New York December 1904).

⁹¹⁵ DIJKSHOORN, W. (2011). De leer van de redelijke toerekening: back to the eighties. *Aansprakelijkheid, verzekering & schade*, p. 30; VAN DAM, C. (2006). *European Tort Law*. Oxford: Oxford University Press; BOONEKAMP, R. (2014). 2.4 Leer van de adequate veroorzaking bij: Burgerlijk Wetboek 6, artikel 98. In *Groene Serie Schadevergoeding*. Kluwer.

⁹¹⁶ LE TOURNEAU, P. (2010). *Droit de la responsabilité et des contrats*. Paris: Dalloz. p. 567.

⁹¹⁷ MORETEAU, O., & LAFAY, F. (2007). France. In B. WINIGER, H. KOZIOL, B. KOCH, & R. ZIMMERMAN, *Digest of European Tort Law: essential cases on natural causation* (pp. 25 - 28). Wien - New York: Springer, p. 27.

3.2.2.1 The substantial factor standard: what, why and how

In December 1911, Jeremiah Smith was the first to suggest an answer to this issue, namely the substantial factor standard. It looked like a very simple formula:

“The defendant’s tort must be distinctly traceable as one of the substantial efficient antecedents; as having had a substantial share in subjecting plaintiff to the damage.”⁹¹⁸

Originally Smith’s test only referred to cases whereby each act was independently sufficient to bring about the damage. In the accompanying explanation it was clearly stated that an act could only be a substantial factor if it satisfied the *conditio sine qua non* test. Indeed, the substantial factor was not meant to replace the *conditio sine qua non*, but rather developed as a guide for solving legal cause issues.⁹¹⁹ The formula inherently refers to qualitative appreciations of causation.⁹²⁰

Later the substantial factor test was included as part of the legal cause in the first (1934) and second US Restatement of Torts (1965). The definition in the second restatement reads as follows:⁹²¹

“The actor's negligent conduct is a legal cause of harm to another if (a) his conduct is a substantial factor in bringing about the harm, and (b) there is no rule of law relieving the actor from liability because of the manner in which his negligence has resulted in the harm.”

The substantial factor assumes that causes may occur practically simultaneously and that it then is not obvious to find the actual cause for the damage.⁹²² The substantial factor test should identify the most suitable cause. Thereby the formula gives quite some facultative power to the fact finder. He may evaluate a causal link as substantial even when the cause is in the sense of the *conditio*

⁹¹⁸ SMITH, J. (1911, December). Legal cause in actions of tort. *Harvard Law Review*, p. 109.

⁹¹⁹ SMITH, J. (1911, December). Legal cause in actions of tort. *Harvard Law Review*, pp. 108-110.

⁹²⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1783; PROSSER, W., KEETON, R., DOBBS, D., & OWEN, D. (1984). *Prosser and Keeton on Torts*. St. Paul: West Publishing CO, pp. 266-269.

⁹²¹ Restatement (Second) of Torts, Division 2. Negligence, Chapter 16, Topic 1, Title A. General Principles, § 433, current through August 2012, Westlaw International.

⁹²² CONWAY-JONES, D. (2002, January 35 URMDLR 875). Factual causation in toxic tort litigation: a philosophical view of proof and certainty in uncertain disciplines. *University of Richmond Law Review*, p. 889.

sine qua non not necessary for the damage.⁹²³ When a cause plays an important role in the production of the damage, even when the damage could have occurred in the absence of that cause, the defendant at the basis of that cause can be held liable.⁹²⁴ This way the substantial factor test accepts the use of intuitive and experiential knowledge, without excluding scientific proof. Consequently it recognizes implicitly that fairness and justice cannot in all cases be resolved 'with surgical precision'.⁹²⁵ The former is particularly useful in cases relating to toxic chemicals where the manifestation of the damage may be the result of several, confluent causes.⁹²⁶

One concrete, important example is the action of Borel against Fibreboard Products.⁹²⁷ This case is also the first one of an extensive US litigation concerning asbestos exposure.⁹²⁸ The Borel court used the substantial evidence rule, what resulted in a judgment stating that the asbestos of each defendant was a *conditio sine qua non* for the plaintiff's asbestosis.⁹²⁹

The later Rutherford case was however more illuminating concerning the use of the substantial factor principle.⁹³⁰ Rutherford worked during 40 years with asbestos containing products. When he developed lung cancer he filed a personal injury claim against nineteen manufacturers and/or distributors of the products. All defendants, except Owens-Illinois, settled before the trial. In 1997, eleven years after the submission of the claim, the Supreme Court decided in favour of Rutherford. They did so on the basis that it cannot be expected of a

⁹²³ CoTemp, Inc. versus Houston West Corp., 222 S.W.3d 487 (Court of Appeals of Texas, Houston April 12, 2007).

⁹²⁴ Elam versus Alcolac, Inc., 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988), p. 174.

⁹²⁵ CONWAY-JONES, D. (2002, January). Factual causation in toxic tort litigation: a philosophical view of proof and certainty in uncertain disciplines. *University of Richmond Law Review*, p. 889.

⁹²⁶ Allen versus United States of America, 588 F.Supp. 247 (US District Court, D. Utah, Central Division May 10, 1984); Basco versus Sterling Drug, Inc., 416 F.2d 417 (United States Court of Appeals Second Circuit October 7, 1969); GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal* (Yale L.J.), pp. 376-402; HARRIS, O. (1986, September). Toxic tort litigation and the causation element: is there any hope of reconciliation? *Southwestern Law Journal*, p. 909.

⁹²⁷ Borel versus Fibreboard Paper Products Corp., 493 F.2d 176 (1973).

⁹²⁸ SANDERS, J. (2011). Risky business: causation in Asbestos Cancer Cases (and beyond?). In R. GOLDBERG, *Perspectives on causation* (pp. 11-40). Oxford and Portland, Oregon: Hart Publishing, p. 15.

⁹²⁹ Borel versus Fibreboard Paper Products Corp., 493 F.2d 176 (1973).

⁹³⁰ Rutherford et al. versus Owens-Illinois Inc., 941 P.2d 1203 (Supreme Court of California October 22, 1997), p. 1219.

plaintiff to demonstrate the specific fibres that caused his disease. On the other hand it is considered feasible for the plaintiff to prove that the exposure to defendant's asbestos containing products is a substantial factor in the overall exposure.⁹³¹ This is in line with the appreciation that the substantial factor standard is a relatively broad one, even to the extent, as explained in Rutherford, that it is only required that the contribution of the individual cause be more than negligible or theoretical.⁹³²

A court may also reject a necessary cause as not substantial. To be held liable it is not enough that the harm would not have occurred in absence of the negligent act. The latter is a necessary condition, but can be a non-substantial one. Thereby the term 'non-substantial' is to be understood in the popular sense, i.e. something is not substantial if the reasonable person would not consider the act as the cause of the damage.⁹³³ In summary: non-substantial cause is not considered to bring liability, despite the fact that the cause may fulfil the *conditio sine qua non* and thus is a necessary condition for the damage.

It is thus required for the attribution of liability that the defendant's negligent conduct is a substantial factor in bringing about the damage, although this in itself is not necessarily conclusive.⁹³⁴ The substantial factor formula thus requires that (1) the judge determines whether the tortious conduct, as a factor, has contributed to the damage and, (2) whether the conduct had contributed enough to make the alleged tortfeasor responsible.⁹³⁵ Residents of a former uranium and vanadium milling town have experienced this when they sued Union Carbide. They asserted personal injuries based on disease or death allegedly caused by radiation and claimed for medical monitoring to detect the onset of disease in asymptomatic plaintiffs. Following the substantial factor test for causation, plaintiffs failed to prove either that their exposure to the radiation was a *conditio sine qua non* cause of their medical conditions or, in other words, that "such exposure was a necessary component [...] that would have caused

⁹³¹ Rutherford et al. versus Owens-Illinois Inc., 941 P.2d 1203 (Supreme Court of California October 22, 1997), p. 1219.

⁹³² Rutherford et al. versus Owens-Illinois Inc., 941 P.2d 1203 (Supreme Court of California October 22, 1997), p. 1220.

⁹³³ Restatement (Second) of Torts, Division 2. Negligence, Chapter 16, § 431. What Constitutes Legal Cause?

⁹³⁴ Restatement (Second) of Torts, Division 2. Negligence, Chapter 16, § 431. What Constitutes Legal Cause?

⁹³⁵ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1782.

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the medical conditions”.⁹³⁶ Or in other words, a conduct is not substantial unless it is sufficiently significant to bring about the damage in the absence of other causes.⁹³⁷

Is there no limit to the freedom of courts in this matter? The Restatement (Second) of Torts contains considerations which the court should take into account when (1) answering the substantial factor question and (2) for determining whether upon the evidence there is room for a reasonable difference of opinion as to whether the defendant's negligence is a substantial factor.⁹³⁸ Despite this effort courts have approached the use of the substantial factor liberally.⁹³⁹ California courts, for example, have definitively adopted the substantial factor test and thus require only that the contribution of an individual cause is more than negligible or theoretical.⁹⁴⁰

The substantial factor test applies also in product liability claims as a replacement of the *conditio sine qua non* if concurrent independent causes are present. Concurrent independent causes are multiple forces operating at the same time and independently, each of which would have been sufficient by itself to bring about the harm. A contrario, when there are no other causes, the substantial factor test will not apply and the *conditio sine qua non* will be used.⁹⁴¹

When in the original version the substantial factor test was not meant to replace the *conditio sine qua non*, later interpretations accepted liability based on the test without meeting the condition. There is however no uniformity in the

⁹³⁶ June versus Union Carbide Corp, 577 F.3d 1234 (United States Court of Appeals, Tenth Circuit August 21, 2009).

⁹³⁷ June versus Union Carbide Corp, 577 F.3d 1234 (United States Court of Appeals, Tenth Circuit August 21, 2009), pp. 1244-1245.

⁹³⁸ Restatement (Second) of Torts, Division 2. Negligence, Chapter 16, § 433. Considerations Important In Determining Whether Negligent Conduct Is Substantial Factor in Producing Harm.

⁹³⁹ Wilson versus AC&S, Inc., 169 Ohio App.3d 720 (Court of Appeals of Ohio, Twelfth District, Butler County December 18, 2006), p. 740; James versus Chevron U.S.A., Inc., 301 N.J.Super. 512 (Superior Court of New Jersey, Appellate Division May 27, 1997); Lineaweaver versus Plant Insulation Co., 37 Cal.Rptr.2d 902 (Court of Appeal, First District, Division 1, California January 31, 1995); Nutt versus GAF Corp., 526 A.2d 564 (Superior Court of Delaware, New Castle County February 12, 1987), p. 567; Borel versus Fibreboard Paper Products Corp., 493 F.2d 1076 (1973), p. 1094; Kostel versus Schwartz, 756 N.W.2d 363 (Supreme Court of South Dakota August 20, 2008), p. 384.

⁹⁴⁰ Xavier versus Philip Morris USA Inc., 787 F.Supp.2d 1075 (United States District Court, N.D. California April 18, 2011), p. 1080.

⁹⁴¹ Xavier versus Philip Morris USA Inc., 787 F.Supp.2d 1075 (United States District Court, N.D. California April 18, 2011).

application, as seen in the case mentioned in the former paragraph. It remains tricky to abolish the *conditio sine qua non* requirement completely. The use of the substantial factor formula makes it necessary for judges or jurors not only to assess whether the defendant's act had contributed to the damage, but also whether it contributed enough to make the defendant liable.⁹⁴² The latter is clearly an appreciation and thus cannot be part of the factual, *conditio sine qua non* phase of the causation process. In other words the substantial factor test is not a replacement for the *conditio sine qua non* test, assuming that the latter is a factual and non-normative element in a liability case.

Thus, in the stage of the causation process the focus is on the factual circumstances of the case, whilst in the legal phase the attention is directed to policy and values. The substantial factor test provides such liberty that it is an element of the legal cause. In itself the substantial factor should not and does not preclude nor empty the *conditio sine qua non*. A quite recent example demonstrating that a court can (still) require proof of the *conditio sine qua non* is the case of Wilcox versus Homestake Mining. The plaintiffs claimed that their exposure to radioactive and non-radioactive hazardous substances released from the uranium milling facility, owned by the defendant, led to injuries. At first instance the claim of the plaintiffs was rejected, on failure to comply with the *conditio sine qua non* standard. Plaintiffs appealed.⁹⁴³ Their plea was that in toxic tort cases involving multiple potential contributing causes the requirement of the *conditio sine qua non* standard is not applicable; causation may be proved by the substantial factor test. They refer to the Restatement (Second) of Torts allowing that the *conditio sine qua non* standard should not be met in cases in which multiple acts each may be a "cause of indivisible injury".⁹⁴⁴ The court disagreed and said that the substantial factor does not create an alternative ground for the factual proof.⁹⁴⁵ Thus without evidence on the causing facts, there is no room for the 'next step', i.e. the substantial factor.

⁹⁴² WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1783.

⁹⁴³ Wilcox versus Homestake Mining Co., 619 F.3d 1165 (United States Court of Appeals, Tenth Circuit September 8, 2010). See also: Robertson versus Allied Signal, Inc., 914 F.2d 360 (United States Court of Appeals, Third Circuit August 28, 1990); Elam versus Alcolac, Inc., 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988).

⁹⁴⁴ Restatement (Second) of Torts, Chapter 16, § 432, (2).

⁹⁴⁵ Wilcox versus Homestake Mining Co., 619 F.3d 1165 (United States Court of Appeals, Tenth Circuit September 8, 2010), p. 1168.

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But there are other court judgements.⁹⁴⁶

The case of Elam versus Alcolac demonstrates this. The chemical plant of Alcolac was sued by the local residents for biological injuries allegedly sustained as a result of exposure to toxic chemicals emitted by the factory. According to the Court of Appeal the substantial factor test is particularly suited for cases like this one. The damage sustained as a result of chronic exposure to toxic chemicals frequently is the result of confluence of causes and the substantial factor standard enables attribution of liability to causes which have played an important role in the damage, even when that damage would have occurred absent that cause.⁹⁴⁷

It was only required to prove:

“some reasonable connection between an act or omission of the defendant and the damage the plaintiff has suffered.”⁹⁴⁸

In a claim against a cigarette manufacturer it was sufficient to provide evidence that the manufacturer’s conduct was a substantial factor in causing the deceased smoker’s lung cancer. The plaintiff was not required to prove that the manufacturer’s activity was a *conditio sine qua non* for the fatal disease to occur.⁹⁴⁹

We can thus safely conclude that the courts differ in their interpretation of the substantial factor test. Furthermore it is clear that the substantial factor analysis brings little ‘factual’ guidance to the trier of fact. Neither does the Restatement (Second) of Torts solve through its guidelines the amalgam of interpretations and uses of the standard. It is no surprise that the substantial factor was no longer included in the new Restatement (Third) of Torts. Courts, however, still apply the test and consequently the concept is still relevant, especially when the causing factors are small in quantity, for example the sole fibre needed for the onset of mesothelioma.

⁹⁴⁶ Mitchell versus Gonzales, 54 Cal.3d 1041 (Supreme Court of California December 9, 1991); Elam versus Alcolac, 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988).

⁹⁴⁷ Elam versus Alcolac, Inc., 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988).

⁹⁴⁸ Elam versus Alcolac, Inc., 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988), p. 173.

⁹⁴⁹ Cipollone versus Liggett Group, Inc., 893 F.2d 541 (United States Court of Appeals, Third Circuit January 5, 1990).

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The contribution of an individual cause has to be more than theoretical or infinitesimal, in order to be considered substantial. Each of the causes should be sufficient by itself to bring about the harm.⁹⁵⁰ Liability is not attributed when the causal fact has a very marginal contribution, like in some cases concerning asbestosis.⁹⁵¹ Even when experts testify under oath that any exposure to asbestos, no matter how minimal, is a substantial contributing factor in asbestos diseases, the courts reject such ‘generalizations’ when the exposure is considered *de minimis*, especially when there is no evidence excluding other possible sources of exposure.⁹⁵² Plaintiffs should in such cases provide evidence meeting the frequency, regularity and proximity test if they want to rely on the substantial factor theory.⁹⁵³

Remarkable is the argument of the court in *Free versus Ametek*: since there is no scientifically established safe level of exposure to asbestos, doctors could not testify that

“any exposure at the level of 0.1 fibres/cc year or less is a substantial contributing factor to the development of mesothelioma”.⁹⁵⁴

One would expect that exposure to a substance so dangerous that no level, however minimal, is safe, such exposure would be considered substantial. And some courts do hold any exposure, particularly to asbestos, sufficient to make the exposure a substantial factor.⁹⁵⁵

⁹⁵⁰ *Bartel versus John Crane, Inc.*, 316 F. Supp. 2d at 604 (United States District Court, N.D. Ohio May 3, 2004); *Rutherford et al. versus Owens-Illinois Inc.*, 941 P.2d 1203 (Supreme Court of California October 22, 1997), p. 1214; *Wright versus Willamette Industries, Inc.*, 91 F.3d 1105 (US Court of Appeals, Eight Circuit September 19, 1996).

⁹⁵¹ *Georgia-Pacific Corp. versus Stephens*, 239 S.W.3d 304 (Court of Appeals of Texas, Houston August 13, 2007), pp. 320-321; *Basile and Dalbo versus American Honda Motor Company, Inc. et. al.*, 2007 WL 712049 (Court of Common Pleas of Pennsylvania, Indiana County February 22, 2007); *Summers versus Certaineed Corp.*, 886 A.2d 240 (Superior Court of Pennsylvania August 25, 2005), p. 244; *Bartel versus John Crane, Inc.*, 316 F. Supp. 2d at 604 (United States District Court, N.D. Ohio May 3, 2004), p. 611.

⁹⁵² *Gregg versus V-J Auto Parts, Co.*, 943 A.2d 229 (Supreme Court of Pennsylvania December 28, 2007), p. 229.

⁹⁵³ *Gregg versus V-J Auto Parts, Co.*, 943 A.2d 229 (Supreme Court of Pennsylvania December 28, 2007), p. 227; *Jones versus John Crane, Inc.*, 132 Cal.App.4th 990 (Court of Appeal, First District California September 30, 2005), p. 990; *Lohrmann versus Pittsburgh Corning Corp.*, 782 F.2d 1156 (United States Court of Appeals, Fourth Circuit January 30, 1986), pp. 1162-1163.

⁹⁵⁴ *Free versus Ametek*, 2008 WL 728387 (Superior Court of Washington, King County February 28, 2008).

⁹⁵⁵ *Hoerner versus ANCO Insulations, Inc.*, 812 So. 2d 45 (Court of Appeal of Louisiana, Fourth District March 4, 2002); *Spain versus Owens Corning Fiberglass Corp.*, 710 N.E.2d

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Other courts want to make sure by these decisions that defendants are not held liable for causing damage if exposure was only *de minimis* whilst other parties were responsible for far greater exposure.⁹⁵⁶ The argument, based on the corrective justice doctrine, was that deciding differently would be unfair and not equitable.⁹⁵⁷

The *de minimis* rule could have another meaning in toxic tort. If one fibre or one molecule of a toxic substance is sufficient to cause harm, then it becomes difficult to apply the normal limits for classification as *de minimis*. Similarly, if the inflicted harm is a signature disease, defining a minimum exposure would be difficult and superfluous.

One fibre of asbestos can cause mesothelioma.⁹⁵⁸ Furthermore the disease is a signature disease, meaning that it is nearly 100 % certain that it is caused by asbestos. That could explain the lenient approach to requirements concerning proof in such cases. Plaintiffs do not need to prove that fibres coming from the defendant were the actual ones that started the process of malignant cellular growth.⁹⁵⁹ Proving exposure is considered enough to meet the substantial factor test. The exposure needs only to be 'a substantial factor in contributing to the aggregate dose of asbestos'.⁹⁶⁰

Similar approaches can be found in claims for damage caused by *inter alia* PCBs, lead and benzene. In the case of Parker versus Mobil Oil Corp. a gas station employee, Parker, sued the company for his development of acute myeloid leukaemia allegedly caused by low-level exposures to benzene in gasoline.⁹⁶¹

528 (Appellate Court of Illinois, Fourth District November 17, 1998); Thacker versus UNR Industries, Inc., 603 N.E.2d 449 (Supreme Court of Illinois September 21, 1992).

⁹⁵⁶ Georgia-Pacific Corp. versus Stephens, 239 S.W.3d 304 (Court of Appeals of Texas, Houston August 13, 2007); Summers versus Certaineed Corp., 886 A.2d 240 (Superior Court of Pennsylvania August 25, 2005); Borg-Warner Corp. v. Flores, 153 S.W.3d 209 (Court of Appeals of Texas December 16, 2004); Bartel v. John Crane, Inc., 316 F. Supp. 2d at 604 (United States District Court, N.D. Ohio May 3, 2004).

⁹⁵⁷ BERNSTEIN, D. (2008, Fall). Getting to causation in toxic tort cases. *Brooklyn Law Review*, p. 51.

⁹⁵⁸ Scientific opinions differ on the conclusion that one fibre of asbestos is sufficient to cause mesothelioma. In asbestos litigation it is accepted that one fibre is enough.

⁹⁵⁹ Jones versus John Crane, Inc., 132 Cal.App.4th 990 (Court of Appeal, First District California September 30, 2005).

⁹⁶⁰ Rutherford et al. versus Owens-Illinois Inc., 941 P.2d 1203 (Supreme Court of California October 22, 1997), p. 1203.

⁹⁶¹ Parker versus Mobil Oil Corp., 857 N.E.2d 1114 (Court of Appeals of New York October 17, 2006).

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Epidemiological studies have demonstrated that high exposures to pure benzene cause the disease, but studies have not demonstrated the occurrence of the leukaemia from low-exposure gas station work. The highly qualified experts, testifying in court, could not quantify the plaintiff's exposure to benzene, neither did they present evidence that the plaintiff's dose approached those shown to cause acute myeloid leukaemia in the existing epidemiological studies. Consequently the court found against Parker holding that there was no evidence that exposure to benzene as component of gasoline caused plaintiff to contract the leukaemia.⁹⁶²

Analogous decisions were taken in relation to PCB exposures.⁹⁶³ In *Nelson versus Tennessee Gas Pipeline* plaintiffs alleged that they were injured by environmental exposure to polychlorinated biphenyls (PCBs), which were released into the air, water, and soil surrounding a natural gas pipeline pumping station.⁹⁶⁴ Plaintiffs just assumed that the exposure they had received was sufficient to make them ill. They especially said to suffer from brain injuries. However the assumption that PCBs can cause brain disorders is not supported by scientific literature. Consequently plaintiffs failed to deliver evidence of causation.

The argument used for rejecting minimal dose exposure, even when a substance is not safe at any level, is the reasoning that the substantial factor test is meaningless without the ability granted to the court to make a decision on the acceptance of the cause.⁹⁶⁵ Being part of the legal cause, courts have the authority to decide if and why an act will be considered substantial. Furthermore, it is true that the pleading of parties and experts sometimes shows illogical conclusions. For example: stating that any occupational or private exposure to a chemical substance causes damage, whilst later in the same testimony claiming that a life time background or environmental exposure of a

⁹⁶² *Parker versus Mobil Oil Corp.*, 857 N.E.2d 1114 (Court of Appeals of New York October 17, 2006), pp. 449-450.

⁹⁶³ *General Electric Company versus Robert Joiner*, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

⁹⁶⁴ *Nelson versus Tennessee Gas Pipeline Co.*, 243 F.3d 244 (United States Court of Appeals, Sixth Circuit March 9, 2001), pp. 252-254.

⁹⁶⁵ *Bartel versus John Crane, Inc.*, 316 F. Supp. 2d 604 (United States District Court, N.D. Ohio May 3, 2004), pp. 604-606.

comparable level does not cause the disease is at least astonishing.⁹⁶⁶ This happens frequently. There are indeed many chemical substances present in the environment and in private premises. On top several noxious substances have no threshold below which they are not toxic: lead concerning its neurotoxicity⁹⁶⁷, benzene causing aplastic anaemia, acute leukaemia, and bone marrow abnormalities⁹⁶⁸ and arsenic leading to neurological dysfunction and death.⁹⁶⁹

When using only the *conditio sine qua non* for a necessity test, nearly every potential cause would be eliminated. Only few acts are by themselves sufficient to produce a particular consequence.

To use only the substantial factor test would mean that any condition that is sufficient in combination with other conditions to produce a particular consequence would be retained as a cause, even though the condition would not be sufficient by itself.⁹⁷⁰ A combination of both the *conditio sine qua non* and the legal cause is thus essential.

3.2.2.2 Is there a comparable principle in the Continental law system?

Originally developed in the Common Law system, the question now arises if a similar causation test like the substantial factor approach exists in the Continental law system, and particularly in the Netherlands and France.

First it should be noted that in these countries the substantiality of a cause is rarely questioned directly, probably because of the freedom their judges have in deciding on a claim.⁹⁷¹ The law provides guidance, but the courts interpret the facts and situations. That is so in both countries. But in France scholars are often sceptical of theories on causation; they assert that courts decide causation

⁹⁶⁶ In re Toxic Substances Cases, 2006 WL 2404008 (Court of Common Pleas of Pennsylvania, Allegheny County, First Judicial District, Civil Trial Division August 17, 2006).

⁹⁶⁷ Agency for Toxic Substances & Disease Registry (ATSDR), U.S. Dep't of Health & Human Servs., Toxicological Profile for Lead 21 (2007), www.atsdr.cdc.gov/toxprofiles/tp13.pdf

⁹⁶⁸ MERCK. (2012, August). Overview of Leukemia. Retrieved April 22, 2013, from *Merck Manual Home Health Handbook*: www.merckmanuals.com/home/print/blood_disorders/leukemias/overview_of_leukemia.html, (accessed on 27 April 2013).

⁹⁶⁹ CRANOR, C. F., & ESATMOND, D. A. (2001, Vol. 64 issue 4). Scientific Ignorance and reliable patterns of evidence in toxic tort causation: is there a need for liability reform? *Law and Contemporary Problems*, p. 17.

⁹⁷⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, pp. 1735-.p 1776

⁹⁷¹ The reasonable attribution is not about substantiality of a cause, but relates to the question if the attribution of liability to an (alleged) tortfeasor is justified.

issues intuitively.⁹⁷² However there are signs that things are changing. In the Netherlands the body of law concerning liability is well elaborated. Still courts have an important role in interpretation of these articles. Both countries are now discussed separately on their approach of substantiality of causal links.

a) France: creative solutions

French courts have by now started to use more, but various, theories of causation making it impossible to pinpoint a prevailing theory.⁹⁷³ Despite the former it is safe to say that the doctrine of equivalence and the principle of adequate causation are the most influential.⁹⁷⁴ But above all, the French tort law approaches causation empirically.⁹⁷⁵

i) Theory versus practice and vice versa

In the theory of equivalence every condition leading to damage is considered a cause. It makes no difference if a cause is direct or indirect, normal or abnormal.⁹⁷⁶ It happens that the ultimate damage is linked to the first condition in time, even when this condition is far away from the final harm. A notorious example is the person who is injured in an accident and consequently transported to the hospital, and finally gets injured due to a transfusion with infected blood.⁹⁷⁷ The court linked the plaintiff's ultimate damage to the car accident without considering if the accident is a substantial or direct cause for the damage caused by the infected blood. This is an example of the classic application of the equivalence theory.⁹⁷⁸ Applying the theory of adequate causation can be the basis for a choice between multiple causes. Originally the

⁹⁷² FAIRGRIEVE, D., & G'SELL-MARCEZ, F. (2011). Causation in French Law: Pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (pp. 111-129). Oxford and Portland, Oregon: Hart Publishing, p. 111.

⁹⁷³ FAIRGRIEVE, D., & G'SELL-MARCEZ, F. (2011). Causation in French Law: Pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (pp. 111-129). Oxford and Portland, Oregon: Hart Publishing, p. 111.

⁹⁷⁴ FAIRGRIEVE, D., & G'SELL-MARCEZ, F. (2011). Causation in French Law: Pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (pp. 111-129). Oxford and Portland, Oregon: Hart Publishing, p. 117.

⁹⁷⁵ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 418.

⁹⁷⁶ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 127.

⁹⁷⁷ Cassation Criminelle 5 October 2004, Dalloz 2004/2972.

⁹⁷⁸ VINEY, G. (2010). La responsabilité des fabricants de médicaments et de vaccins : les affres de la preuve. *Recueil Dalloz*, p. 391; BRUN, P., & JOURDAIN, P. (2006). Responsabilité civile. *Recueil Dalloz*, p. 1932; LAMBERT-FAIVRE, Y. (1992). De la poursuite à la contribution: quelques arcanes de la causalité. *Recueil Dalloz*, pp. 311-314.

standard of adequacy means that a given fact is an adequate cause only if that condition has significantly increased the objective probability of the occurrence of the damage.⁹⁷⁹ This sounds like a method to identify the substantial factor. However, the French courts apply it differently; they have followed the more lenient approach that an adequate cause is a cause tending to lead to a certain result, according to human experience and in the ordinary course of things.⁹⁸⁰ Thereby the focus is on breaking a chain of causation that is too long.⁹⁸¹ Dejean de la Bâtie confirmed this by stating that the failure to watch and secure a shack used for storing explosives did not in and of itself explain the harm done to the child playing with the explosives after he stole these. By deciding along these lines the French Court of Cassation applied the adequacy theory.⁹⁸² Compared to the theory of Von Kries, the French interpretation still establishes a hierarchy between different factors based on the increased probability of the outcome, although not referring to the substantiality of the condition.

In fact the principle of adequacy comes down to the acceptance of only that cause which normally brings along that specific type of damage.⁹⁸³ The theory can thus be used in cases with multiple conditions: the act should have significantly increased the objective probability of the occurrence of the damage.⁹⁸⁴ One could say that the principle can be used as a filter to detect the most substantial cause amongst different options, although differences with the substantial factor test remain.

The question to be asked is if above 'theoretical' rules are also used in practice? Court decisions can be found where in similar factual situations the outcome is

⁹⁷⁹ VON KRIES, I. (1889, Vol. 9). Über die Begriffe der Wahrscheinlichkeit um Möglichkeit. *Zeitschrift für die gesamte Strafrechtswissenschaft*, pp. 528–537.

⁹⁸⁰ FAIRGRIEVE, D., & G'SELL-MARCEZ, F. (2011). Causation in French Law: Pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (pp. 111-129). Oxford and Portland, Oregon: Hart Publishing, p. 118.

⁹⁸¹ Cassation Civile (2e chambre), 8 February 1988, *Juris-Classeur Périodique* 1990.II.21544, note of N. Dejean de la Bâtie; Cassation Civile (2e chambre), 20 December 1972, *Juris-Classeur Périodique* 1973.II.17541. (Pagani versus Zucchelli).

⁹⁸² VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 426.

⁹⁸³ MORETEAU, O., & LAFAY, F. (2007). France. In B. WINIGER, H. KOZIOL, B. KOCH, & R. ZIMMERMAN, *Digest of European Tort Law: essential cases on natural causation* (pp. 25 - 28). Wien - New York: Springer, p. 27.

⁹⁸⁴ Cassation Civile (2e Chambre), 6 January 2000, *Bulletin Civile* 2000.II.4.

different. The reason for the different outcomes is the desire present in the French courts to avoid negative outcomes for the victims.⁹⁸⁵

We can safely conclude that the French courts approach causation pragmatically. They apply the theory of equivalent causes, but also frequently resort to the principle of adequate causation. It is not clear which theory is the most frequently applied. The approach differs on a case by case basis.⁹⁸⁶ In medical malpractice cases it has been judged that the plaintiff's harm was not resulting from a previous accident, even when that accident made the treatment necessary. Furthermore the objective of the adequacy theory and the practical application thereof, indicate that the theory is not fully comparable with the substantial factor standard.

In fact a defendant cannot be partly⁹⁸⁷ relieved from liability on the basis of another cause⁹⁸⁸ which has contributed to the injury.⁹⁸⁹ Such exoneration can only happen in relation to the plaintiff and on condition that the latter made a fault.⁹⁹⁰ Consequently the question whether or not the other causes were substantial is void.

ii) Another creative solution: presumptions

In France a lot is left to the discretion of the judge. The appreciation of the facts is left to the courts and they can use presumption. The substance dexfenfluramine, component of a medicinal product, allegedly causes hypertension. Expert testimony and epidemiological studies show that the substance can indeed stimulate hypertension, but different factors in otherwise healthy people also cause this condition. Consequently the scientist concluded that the substance partly caused the disease. Despite this conclusion, the Court of Appeal concludes that the substance is a direct and adequate cause for the condition of the plaintiff in absence of any other explanation for the

⁹⁸⁵ Cassation Civile (2e chambre), 20 October 2005, *Bulletin Civile* 2005.II.274; Cassation Civile (2e chambre), 20 October 2005, *Bulletin Civile* 2005.II.275.

⁹⁸⁶ FAIRGRIEVE, D., & G'SELL-MARCEZ, F. (2011). Causation in French Law: Pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (pp. 111-129). Oxford and Portland, Oregon: Hart Publishing, p. 121.

⁹⁸⁷ A defendant can be fully exonerated of liability on the basis of another external cause meeting three condition, i.e. foreign to him, unforeseeable and unavoidable. This is what the French call "cause étrangère". See also VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, pp. 330-332, 435.

⁹⁸⁸ Except when the victim also cause part of his own injury.

⁹⁸⁹ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 435.

⁹⁹⁰ See paragraph 3.1.2.3, i).

hypertension. The Court of Cassation confirmed the judgement, because there were substantial presumptions that the dexfenfluramine caused the damage.⁹⁹¹ The sole conditions required for presumptions are that they should be 'substantial', i.e. serious, precise and concurrent. A specific (doctrinal) test does not exist. However the Court of Cassation demands a proved scientific link, at least probable or plausible, between the substance and the damage. Additionally it is also necessary that no other causes could have resulted in the damage.⁹⁹² When a causal link is scientifically recognized, even if there is still some scientific uncertainty, a factual presumption exists.⁹⁹³ The former only needs to be completed by additional indications.⁹⁹⁴ Finally it is the court who evaluates the value and applicability of the presumptions, also in cases that are brought under product liability, as the French tend to do with some negligence cases.⁹⁹⁵

Some mandatory presumptions also exist (*présomptions de droit*), requiring a judge to assume a certain fact once a certain fact is established. For example the law of 2002 concerning blood transfusions and infections caused by the transfusion, installed an imputable presumption that the blood transfusion caused the contamination.⁹⁹⁶ Similar to the former initiative a fund for victims of asbestos exposure has also been created. The creation of such funds is in line with the evolution towards the socialization of risks.⁹⁹⁷

b) The Netherlands

In the Netherlands the first test of causation is also the *conditio sine qua non*. They also used the adequacy principle, defined as the condition that damage was reasonably foreseeable. Foreseeability seems to be a clear requirement, but in fact it is not. Why not? According to 't Hart this is mainly the consequence of the elaboration of the concept foreseeability in litigation.⁹⁹⁸ *Inter alia* the

⁹⁹¹ Cassation Civile (1re chambre), 24 January 2006, Bulletin Civile 2006.I.35. (Isoméride).

⁹⁹² BRUN, P., & JOURDAIN, P. (2006). Responsabilité civile. *Recueil Dalloz*, p. 1932.

⁹⁹³ VINEY, G. (2010). La responsabilité des fabricants de médicaments et de vaccins : les affres de la preuve. *Recueil Dalloz*, pp. 395-496.

⁹⁹⁴ BRUN, P., & JOURDAIN, P. (2006). Responsabilité civile. *Recueil Dalloz*, p. 1934.

⁹⁹⁵ Cassation Civile (1re chambre), 24 January 2006, Bulletin Civile 2006.I.35. (Isoméride).

⁹⁹⁶ BRUN, P., & JOURDAIN, P. (2006). Responsabilité civile. *Recueil Dalloz*, p. 1930.

⁹⁹⁷ ARBOUSSET, H. (2007). L'action subrogatoire du FIVA: un 'antidote à l'irresponsabilité' de toute personne juridique. *Recueil Dalloz*, pp. 1643-1650.

⁹⁹⁸ Hoge Raad 25 June 1996, LJN ZD102559, *Nederlandse Jurisprudentie* 1997, 563, note of 't Hart.

Supreme Court of the Netherlands was very flexible when evaluating it.⁹⁹⁹ On top the concept led to difficulties in complex liability cases, because of its retro-active and hypothetical evaluation of the situation.

i) Reasonable attribution plus the conditio sine qua non equals the substantial factor, or not?

As mentioned before, in the Netherlands the theory of adequacy was replaced by the doctrine of 'reasonable attribution'.¹⁰⁰⁰

With the introduction of attribution, the Supreme Court of the Netherlands accepts that a lack of *conditio sine qua non* can be remedied by another means, like the substantiality of a cause. Explicit reference to the substantial factor test as developed in the US is made in the 'Groninger hiv' case, in the sense that one should check if the causal act is followed by a normal consequence.¹⁰⁰¹ The allowance of this approach is an improvement for the finding in cases, where the *conditio sine qua non* cannot provide an answer. It should however be noted that neither in the US, nor in the Netherlands the search for the substantial factor excludes the use of the *conditio sine qua non* principle. The added value of *conditio sine qua non* remains. In the Netherlands the usefulness of the principle is recently confirmed in court judgments.¹⁰⁰²

The difference between the substantial factor test and the reasonable attribution lies mainly in the fact that the first one claims to be a cause-in-fact test and the second one recognizes the use of normative judgements.¹⁰⁰³ The core question is however if the substantial factor test is really a pure factual cause test. For that discussion, I refer to paragraph 3.2.2.1.

Anyhow, in the Netherlands the court is allowed to refer to different factors for its motivation concerning attribution, for example foreseeability and the type of

⁹⁹⁹ Hoge Raad 25 June 1996, LJN ZD102559, *Nederlandse Jurisprudentie* 1997, 563, note of 't Hart, par. 5.

¹⁰⁰⁰ For a more detailed analysis of reasonable attribution, see chapter 'common sense'.

¹⁰⁰¹ Hoge Raad 27 March 2012, *Nederlandse Jurisprudentie* 2012, 301, note of N. Keijzer.

¹⁰⁰² Hoge Raad 5 October 2010, *Rechtspraak van de Week* 2010, 1190; Hoge Raad 16 June 2000, LJN AA6233, *Nederlandse Jurisprudentie* 2000/584; AKKERMANS, A. (2002). *De 'omkeringsregel' bij het bewijs van causaal verband*. Den Haag: Boom Juridische Uitgevers, p. 47.

¹⁰⁰³ DEN HOED, J. (2009). Flexibiliteit in objectieve factoren; enkele notities over de schadetoerekening. In M. DUKER, L. PIETERSE, & A. SCHILD, *Welberaden - beschouwingen over de rechtsontwikkeling in de rechtspraak van de Hoge Raad der Nederlanden* (pp. 217-246). Nijmegen: Wolf Legal Publishers, p. 224; Hoge Raad 25 June 1996, LJN ZD0496, *Nederlandse Jurisprudentie* 1997, 563, note of 't Hart, par. 6.

damage. These factors differ depending on the situation.¹⁰⁰⁴ A judge is obliged to motivate his decisions. He needs to do this in such a way that his reasoning becomes clear and transparent. Motivation includes a reference to the importance of the circumstances taken into account.

A contrario the former implies that a judge is not obliged to take into account matters he deems not of importance.

Academics considered the freedom the Supreme Court in this matter a threat for legal certainty.¹⁰⁰⁵ Guidelines were developed that would enable judges to decide in concrete cases when attribution is justified. On the basis of an analysis of litigation the following factors were found as having an important impact: the normative standard, the fault *an sich*, the nature of the activity and the nature of the damage, plus foreseeability and proximity.¹⁰⁰⁶ The more a consequence is in line with common experience and thus more foreseeable, the more attribution is justified. Attribution is less acceptable when the consequence at hand is exceptional, abnormal or not probable. Also, the closer the negative consequence is to the tortious act, the more attribution is equitable.¹⁰⁰⁷

The former constitutes a search for substantiality and supports the conclusion that reasonable attribution is comparable to a substantial factor test.

A concrete example explains. In the case *Cijsouw I* it was decided that an employer can be responsible for his employee's disease if he failed to take the necessary safety management measures and consequently increased the risk for the employee substantially, even when the employer was not familiar with the disease or the onset of the disease.¹⁰⁰⁸ The tortfeasor could escape liability upon

¹⁰⁰⁴ DEN HOED, J. (2009). Flexibiliteit in objectieve factoren; enkele notities over de schadetoerekening. In M. DUKER, L. PIETERSE, & A. SCHILD, *Welberaden - beschouwingen over de rechtsontwikkeling in de rechtspraak van de Hoge Raad der Nederlanden* (pp. 217-246). Nijmegen: Wolf Legal Publishers, p. 217.

¹⁰⁰⁵ DEN HOED, J. (2009). Flexibiliteit in objectieve factoren; enkele notities over de schadetoerekening. In M. DUKER, L. PIETERSE, & A. SCHILD, *Welberaden - beschouwingen over de rechtsontwikkeling in de rechtspraak van de Hoge Raad der Nederlanden* (pp. 217-246). Nijmegen: Wolf Legal Publishers, pp. 217-218.

¹⁰⁰⁶ ASSER, C., HARTKAMP, A., & SIEBURGH, C. (2012). *Redelijkheid toerekening afhankelijk van alle omstandigheden*. Deventer: Kluwer Law, § 64.

¹⁰⁰⁷ HARTKAMP, A., & SIEBURGH, C. (2008). De verbintenis in het algemeen, tweede gedeelte. In ASSER, *Boek 6 BW*, art. 98 (pp. § 63-68), par. 64.

¹⁰⁰⁸ Hoge Raad 25 juni 1993, *Nederlandse Jurisprudentie* 1993, 686

proof that the risk management measures would not have prevented the onset of the damage.¹⁰⁰⁹

Another example is also about a fatal disease. Despite the fact that it was impossible to prove scientifically that the lung cancer was caused by the exposure to asbestos, that exposure was considered by the Court of Appeal as a factor substantially increasing the risk on developing lung cancer. Consequently the exposure should be considered as the cause of the illness of the plaintiff. The legal cause (i.e. policy and societal aspects) played an important role, next to the significance of the exposure, in attributing liability to the defendant.¹⁰¹⁰

Both cases show an approach comparable with the one of the House of Lords in *Fairchild*.¹⁰¹¹

ii) Alternative causation: finding substantiality by putting the burden of proof on the defendant

Interesting is also the discussion on 'alternative' causation, or putting the duty of proof on the defendant. The Supreme Court has developed a rule in this matter: when in certain circumstances a risk is created through negligence and this risk materialises, then a causal link between the creation of the risk and the damage is assumed. Consequently it is up to the alleged tortfeasor, i.e. the defendant to prove that the damage would also have occurred absent his acts.¹⁰¹² Thereby a close relation should exist between the protective objective of the infringed norm and the materialised risk.¹⁰¹³

The application of the rule has a normative component, and a factual aspect.¹⁰¹⁴ The presence of this factual component makes Klaassen write that alternative

¹⁰⁰⁹ Hoge Raad 25 juni 1993, *Nederlandse Jurisprudentie* 1993, 686

¹⁰¹⁰ Hoge Raad 31 March 2006, LJV AU6092, conclusion of Advocate-general Spier. (Nefalit).

¹⁰¹¹ *Fairchild v. Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002).

¹⁰¹² Hoge Raad 26 January 1996, *Nederlandse Jurisprudentie* 1996, 607; AKKERMANS, A. (2002). *De 'omkeringsregel' bij het bewijs van causaal verband*. Den Haag: Boom Juridische Uitgevers, pp. 15-17.

¹⁰¹³ Hoge Raad 29 November 2002, *Rechtspraak van de Week* 2002, 190; Hoge Raad 29 November 2002, *Rechtspraak van de Week* 2002, 191.

¹⁰¹⁴ AKKERMANS, A. (2002). *De 'omkeringsregel' bij het bewijs van causaal verband*. Den Haag: Boom Juridische Uitgevers, pp. 123-133.

causation is justified when there exists a presumption of a causal link or for solving the last bit of uncertainty concerning causation.¹⁰¹⁵

The statement of Klaassen also confirms that some causation already should be established before the burden of proof can be shifted to the defendant(s).

The reversal of proof is mainly applied in cases where damage and causation provide perspectives that are interchangeable between the two. These are interchangeable insofar the proof of damage consists in a proof of the existence thereof and the proof of causation is based on the *conditio sine qua non*. They both need a comparison between what happened and what would have happened if the factor leading to liability would not have occurred. However, since that comparison is hypothetical and consequently can actually not be proved, a reasonable probability is considered sufficient. Only if 1) the basis for attribution of liability is known and (2) the evidential difficulties the plaintiff encounters are related to the hypothetical character of the comparison, a reversal of the burden of proof is justified. It is just because the difficulties encountered in relation to causation that the alternative causation is used. Again concretisation should clarify. If a product is defective, then this defect is a substantial element in the case. If somebody is exposed to asbestos, that exposure is a substantial factor in the link between the alleged tortfeasor and the disease of the plaintiff and thus a substantial factor. Consequently in these cases the requirement of providing evidence can be put on the defendant. The reversal is thereby applicable if the created risk on damage materialized.

The reversal of the burden of proof finds its importance in difficult and/or uncertain causation. It however does not solve the issues related to causation; it only transfers these to another party. In essence it comes down to the following: the plaintiff has to prove a beginning of a causal link between the act of the alleged tortfeasor and his damage. This can be done through, for example, an assumption or an inference. Then the part of causation that is not yet established should be proved in the negative by the defendant along normal rules for causation, if that defendant wants to escape liability. Or formulated in yet another way: the defendant now has the difficult or impossible task to prove what the plaintiff(s) could not. On top the defendant has to prove that he is

¹⁰¹⁵ KLAASSEN, C. (2012, September 18). Kroniek Causaliteit in het aansprakelijkheidsrecht. *Aansprakelijkheid, verzekering & schade*, pp. 19-29.

innocent. It is very difficult and sometimes even impossible to prove that one did not do something. Still the theories on causation can equally and similarly be applied in situations with a reversed burden of proof.

A reversal of the burden of proof also exists in cases with multiple causes and multiple tortfeasors. This topic is analysed in the next chapter.

3.2.3 Wright and the bramble bush: a new causation test

Causation is not equivalent to responsibility. Equating causation with responsibility mingles cause-in-fact with normative elements. Some scholars do not have a fundamental problem with that.¹⁰¹⁶

Malone, for example, was convinced that the quest for factual causation was impregnated with normative considerations.¹⁰¹⁷ Hart and Honoré also combined a cause-in-fact inquiry with a proximity evaluation, whereby the combined approach was based on common sense principles.¹⁰¹⁸

Others advocate a strict distinction between cause-in-fact and legal cause. Examples of situations where the causing person is not the person responsible for the damage can be found in all four countries. The distinction between causation and responsibility exists in several circumstances.¹⁰¹⁹ In France a

¹⁰¹⁶ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*; FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, pp. 277-317; AKKERMANS, A. (1997). *Proportionele aansprakelijkheid bij onzeker causaal verband*. Zwolle: W.E.J. Tjeenk Willink; HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press; MORETEAU, O., & LAFAY, F. (2007). France. In B. WINIGER, H. KOZIOL, B. KOCH, & R. ZIMMERMAN, *Digest of European Tort Law: essential cases on natural causation* (pp. 25 - 28). Wien - New York: Springer; ROBINSON, G. (1982, April 68 VA L. REV. 713). Multiple causation in tort law: reflections on the DES cases. *Virginia Law Review*, pp. 713-761; DELGADO, R. (1982, July 70 CALIF. L. REV. 881). Beyond Sindell: Relaxation of cause-in-fact rules for indeterminate plaintiffs. *California Law Review*, p. 881-909.

¹⁰¹⁷ MALONE, W. (1956, December). Ruminations on cause-in-fact. *Stanford Law Review*, pp. 60-89.

¹⁰¹⁸ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press.

¹⁰¹⁹ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*; FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, pp. 277-317; AKKERMANS, A. (1997). *Proportionele aansprakelijkheid bij onzeker causaal verband*. Zwolle: W.E.J. Tjeenk Willink; HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press; MORETEAU, O., & LAFAY, F. (2007). France. In B. WINIGER, H. KOZIOL, B. KOCH, & R. ZIMMERMAN, *Digest of European Tort Law: essential cases on natural causation* (pp. 25 - 28). Wien - New York: Springer; ROBINSON, G. (1982, April 68 VA L. REV. 713). Multiple causation in tort law: reflections on the DES cases. *Virginia Law Review*, pp. 713-761; DELGADO, R. (1982, July 70 CALIF.

victim can (often) choose who to sue and thus pick the party with the highest solvency. This defendant will be held liable in full, despite the fact that other persons also caused part of the damage, but were not accused. Claims for exposure to asbestos are such cases, where causation and liability do not necessarily coincide. When several exposures could possibly have caused mesothelioma, it frequently happens that only one exposure is considered as the basis for liability.

Amongst the supporters of the factual and legal cause was Wright. He believes that much of the disagreement and discussions on causation come from the failure to make a distinction between the causal inquiry and the legal cause.¹⁰²⁰ He wanted to find a solution.

3.2.3.1 The Necessary Element of a Sufficient Set: unravelling complex causation

As a reaction to the deficiencies of the *conditio sine qua non* test in complex causation cases, Wright developed the NESS test in 1985.¹⁰²¹ The test is based on the theory of Hume and on the analysis of Hart and Honoré. As Hume believed in causal laws¹⁰²² and generalisation, he claimed that there always exists a unique and sufficient set of antecedent conditions that need to be present for the realization of a particular consequence.¹⁰²³ On the other hand Hume also noticed that not all antecedent conditions are causally relevant, whereby it becomes necessary to make a distinction between the relevant and the irrelevant causes. Not everybody agreed with the latter. John Stuart Mill, for example, asserted that there may exist a plurality of potential causes for any

L. REV. 881). Beyond Sindell: Relaxation of cause-in-fact rules for indeterminate plaintiffs. *California Law Review*, p. 881-909.

¹⁰²⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1740.

¹⁰²¹ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1774.

¹⁰²² "A causal law is an empirically derived statement that describes a successional relation between a set of abstract conditions [...] that constitute the antecedent and one or more specified conditions of a distinct abstract event or state of affairs that constitute the consequent such that [...] the instantiation of all the conditions in the antecedent entails the immediate instantiation of the consequent, which would not be entailed if less than all of the conditions in the antecedent were instantiated." (References omitted). WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In R. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 289.

¹⁰²³ HUME, D., *An enquiry concerning human understanding and concerning the principles of morals*, L.A. Selby-Bigge, Oxford, 1902, fn. 18. (Kindle edition)

consequence.¹⁰²⁴ Finally it was generally accepted that 'ordinary experience' supports the theory recognizing a plurality of potential causes for a given consequence, but that something like a 'dominant regularity' exists as well, namely the antecedent conditions that invariably are connected with a certain consequence.¹⁰²⁵ The plurality theory became thus part of the dominant regularity. Antecedent conditions should thereby be restricted to those that are necessary.¹⁰²⁶ Rewriting and restructuring what Hart and Honoré had begun, Wright elaborated the 'Necessary Element of a Sufficient Set' or NESS test, incorporating the philosophic thoughts on "dominant regularity" of Hume.

The original definition of the NESS test read:

"a particular condition was a cause of a specific consequence if and only if it was a necessary element of a set of antecedent actual conditions that was sufficient for the occurrence of the consequence."¹⁰²⁷

Actually Wright wanted to find a solution for cases of 'overdetermined causation'.¹⁰²⁸ In his work over-determination refers to a situation in which a factor other than the specified act would have been sufficient to produce the damage if the specified act did not happen.¹⁰²⁹ The term 'overdetermined' is

¹⁰²⁴ MILL, J. (1843). *A System of Logic*. Honolulu: University Press of the Pacific. (Kindle edition)

¹⁰²⁵ HART, H., & HONORE, T. (1985). *Causation in the law*. Oxford: Oxford University Press, pp. 19-20.

¹⁰²⁶ WRIGHT, R. (1985, Vol. 73). *Causation in tort law*. *California Law Review*, p. 1790.

¹⁰²⁷ WRIGHT, R. (1985, Vol. 73). *Causation in tort law*. *California Law Review*, p. 1774.

¹⁰²⁸ The term 'overdetermined' is used by Wright as the overarching concept. In the Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27: the insufficient act of one tortfeasor becomes sufficient when combined with the conduct by other persons. When this happens, it is said that 'the conduct over-determines the harm', i.e. it is more than sufficient to cause the harm. This circumstance thus creates the multiple-sufficient-causal-set situation. Other scholars put over-determination and pre-emption on the same level, e.g. Stapleton uses the term overdetermined only for duplicative causation. STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*.

¹⁰²⁹ Wright divides overdetermined causation further in 'pre-emptive causation' and 'duplicative causation'. WRIGHT, R. (1985, Vol. 73). *Causation in tort law*. *California Law Review*, pp. 1775-1776.

The first, pre-emptive causation, refers to the well discussed situation whereby a second act in time causes damage that the first act in time would otherwise would have caused. For example: X plans to drink a cup of tea, but the tea is poisoned. Before X can drink, Y shoots him. The poisoning of the tea was thus not a cause of X's death.

The second, duplicative causation, refers to the situation where two or more independent acts are sufficient to cause the damage. For example: twenty-six mill owners were sued for discharging mill sewage and other foul matters into a stream, above the plaintiff. The damage done by each individual mill owner was minimal, but together they greatly injured the premises of the plaintiff. The court held that as an action at law could not be

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used as the overarching concept.¹⁰³⁰ He then makes two distinctions: pre-emptive and duplicative causation.¹⁰³¹

The formal, most common definitions of 'pre-empted' and 'duplicated' in relation to causation are as follows. (1) An effect is pre-empted when the effects of the specified act have a more immediate result than the effects of the other act or, as Wright defines it, the specified act has "more immediately operative effects".¹⁰³² For example: Chris was employed as a heating installator and used during his work asbestos containing isolation material. He died because a circuit breaker failed to prevent his electrocution after his electric radio fell in the bathtub he sat in. The autopsy revealed that Chris had mesothelioma, a fatal disease caused by asbestos exposure. The defect of circuit breaker is the factual cause of Chris' death; the mesothelioma is not a factual cause, although the disease would certainly have killed Chris. Whether compensation for liability will be reduced because the mesothelioma shortened Chris' life expectancy is an interesting policy question, however beyond the scope of this research. The electrocution pre-empted the fatality of the disease.

(2) In the same situation as above, Chris is hospitalized and in the last days of his life. To ease his pain, he gets administered a dose of morphine. However, due to his weak situation, one day he dies immediately after the injection. The normal sequence of events however could have been such that he also died at exact the same moment of his fatal disease. Two independent sources could have killed Chris; either could have done so in the absence of the other. This is duplicative causation.

One should however note that the understanding of 'over-determination' is not the same amongst scholars. In fact more recent studies seem to equal

maintained against the defendants jointly and a remedy at law against each individual was inadequate, equity would grant relief to prevent such damage, which otherwise could not adequately be repaired.

¹⁰³⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1775.

¹⁰³¹ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In R. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 292.

¹⁰³² WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1775-1776.

duplicative causation with over-determination, whilst pre-emption is considered a separate category.¹⁰³³

Some use the term as referring to the situation where a result is caused by two different causes that are both sufficient.¹⁰³⁴ Others say over-determination is also referring to nearly simultaneous causes.¹⁰³⁵

Stapleton defines overdetermined events as situations with multiple sufficient historical factors, each factor sufficient to cause exactly the same damage at the same time and place.¹⁰³⁶ She clarifies: the two hunters (like in Summers versus Tice¹⁰³⁷) carelessly shooting into the bushes, hitting the victim with two bullets, simultaneously, is an overdetermined event. If the case would be described as 'death by two bullets in the brain' then the situation would not be overdetermined.¹⁰³⁸

Wright's definition of the term is used in this research, since it is that meaning he uses in the NESS test he developed. Thus, duplication in causation refers to the combination of the effects of both causal factors.¹⁰³⁹ In the following paragraph the NESS test is analysed further.

a) NESS: indispensable necessity subordinated to sufficiency

Since Wright believes that identifying and proving factual causation is primordial in liability cases, he focuses on the cause-in-fact independent from normative elements. The NESS test aims at bringing a solution for multiple causes, as it is

¹⁰³³ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*; FISCHER, D. (2005-2006, Vol. 94). Insufficient Causes. *Kentucky Law Journal*, pp. 277-317.

¹⁰³⁴ NIDA-RUMELIN, M., Qualia: The Knowledge Argument, in *The Stanford Encyclopaedia of Philosophy* (September 3, 2002), available at [http:// plato.stanford.edu/entries/qualia-knowledge](http://plato.stanford.edu/entries/qualia-knowledge)

¹⁰³⁵ HALL, N. (2004). Two concepts of causation. In J. COLLINS, N. HALL, & L. PAUL, *Causation and counterfactuals* (pp. 225-276). Massachusetts: Massachusetts Institute of Technology, p. 235.

¹⁰³⁶ STAPLETON, J. (2001, April). Legal cause: cause-in-fact and the scope of liability for consequences. *Vanderbilt Law Review*, fn. 38; STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*, fn. 19.

¹⁰³⁷ Summers versus Tice, 33 Cal.2d 80, 199 P.2d 1 (Supreme Court of California, in Bank November 17, 1948).

¹⁰³⁸ STAPLETON, J. (2001, April). Legal cause: cause-in-fact and the scope of liability for consequences. *Vanderbilt Law Review*, fn. 38.

¹⁰³⁹ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1775.

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less restrictive or more inclusive since it does not limit causation to causes that are necessary for the result as required in the *conditio sine qua non*.¹⁰⁴⁰

i) The NESS formula

The NESS test does not require that each factor is sufficient to cause the damage by itself. This requirement is judged to be too restrictive.¹⁰⁴¹ Besides, courts have in practice not required the independent sufficiency of each factor, as is shown in the following pollution case.¹⁰⁴² Firstly we will see how at the time of the pleading in 1904 the court approached the difficulties the case posed and secondly we will see if the NESS test brings a solution for such a situation.

Twenty individual mill owners discharged waste into the same stream. Each committed a wrong, but the only damage to the plaintiff is caused by the combined act of all the mill owners together. The individual contributions were on itself insufficient to cause the damage. The court held that an action at law cannot be maintained against the defendants jointly, since each was only liable for his own wrong, and that wrong was on itself insufficient to attribute liability. The judgment was consequently based on the use of the stream by each defendant, which in connection with the similar use of the other mill owners was unreasonable and unlawful.¹⁰⁴³ The court used thereby its authority to infer unity of action and based its opinion on the fact that each defendant was deliberately acting with the others in causing the destruction of the plaintiff's property.¹⁰⁴⁴ Relief for the victim of the pollution was granted formally on the basis of equity. The Court found that:

“equity will grant adequate relief in any case which may arise and will, if necessary, invent a remedy to prevent a wrong which otherwise cannot adequately be met.”¹⁰⁴⁵

¹⁰⁴⁰ WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, pp. 1002-1094.

¹⁰⁴¹ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1791.

¹⁰⁴² Warren versus Parkhurst, 92 N.Y.S. 725 (Supreme Court, Montgomery County, New York December 1904).

¹⁰⁴³ Warren versus Parkhurst, 92 N.Y.S. 725 (Supreme Court, Montgomery County, New York December 1904), p. 468.

¹⁰⁴⁴ Warren versus Parkhurst, 92 N.Y.S. 725 (Supreme Court, Montgomery County, New York December 1904), p. 469.

¹⁰⁴⁵ Warren versus Parkhurst, 92 N.Y.S. 725 (Supreme Court, Montgomery County, New York December 1904), p. 466.

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Nearly unrestricted powers at the time of the case granted to the courts, made it possible to invent a remedy for attributing liability that otherwise could not be adequately dealt with.¹⁰⁴⁶ The *conditio sine qua non* requirement was not met, but the tortious conduct of each of the mill owners clearly contributed to the injury and that was considered a factual observation.¹⁰⁴⁷ Neither act of an individual tortfeasor was independently sufficient for the damage, but each act was necessary for the sufficiency of a set of conditions leading to the damage.¹⁰⁴⁸ The plaintiff could recover from each defendant who contributed to the pollution of the stream.

It is this approach that Wright elaborated and refined further. Because the NESS test attributes causation to very small conditions that merge with or into substantial conditions¹⁰⁴⁹, recourse to equity as a solution for the failure of *conditio sine qua non* is not necessary when applying the formula. Although each individual contribution was neither necessary nor sufficient for the damage, the fact that each defendant's pollution was 'necessary for the sufficiency of a set of antecedent conditions' led to liability.¹⁰⁵⁰ A cause is a factual cause when the harm would not have occurred absent the conduct, regardless of the fact that the harm only occurred through a combination of several tortious acts.¹⁰⁵¹ In practice it is thus not always necessary to prove that each cause on itself would have been sufficient for the damage to occur. Evidence that a cause contributed to the damage is enough.¹⁰⁵²

The NESS test requires strong sufficiency rather than strong necessity and on that basis solves the issues the *conditio sine qua non* has with duplicative or overdetermined causation (e.g. the two hunters dilemma). Minimally sufficient sets of existing conditions are constructed by including at least so much

¹⁰⁴⁶ A court of equity had the power to grant adequate relief in any case which aroused, and the fact that an exact precedent was not found did not deny the right in a particular case, for it was the peculiar province of such a court to grant relief in unusual and extraordinary situations and to invent, if necessary, a remedy to prevent a wrong which otherwise could not be adequately met. *Warren versus Parkhurst*, 92 N.Y.S. 725 (Supreme Court, Montgomery County, New York December 1904), pp. 468-469.

¹⁰⁴⁷ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1793.

¹⁰⁴⁸ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1793.

¹⁰⁴⁹ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1794.

¹⁰⁵⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1793.

¹⁰⁵¹ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012.

¹⁰⁵² WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1792.

conditions that the inclusion of the “non-independently-sufficient” condition was necessary to come to a sufficient set.¹⁰⁵³ This limits the necessity test in NESS to the relevant causal generalisations and their causal laws. A condition needs merely to be part of the instantiation of the antecedent conditions.¹⁰⁵⁴

In order to make the former clearer, an example is appropriate. Imagine that a teaspoon of water is added to a flooding river. That teaspoon of water contributed to the flood. Is it the cause of the flood? If a million or more people would all contribute a teaspoon of water to a river and consequently there is a flood destroying your house, then any of the teaspoons of water contributed to the demolition. Wrights says that in causation it does not matter who supplied the different bits of water.¹⁰⁵⁵ It also does not matter who specifically contributed the ‘over the limit’ water. Everyone contributed, however minimal. Whether each individual should be liable for the damage, is another question. Determining whether a contribution of an actor is trivial compared to the contribution of the others in the causal set implies a judgment, which is based on fairness, equitable-loss distribution and administrative costs.¹⁰⁵⁶

Dirk worked for 35 years as an asbestos-insulation installer. He was exposed to asbestos fibres from insulation manufactured by several manufacturers. This exposure to asbestos was substantially more than required to cause mesothelioma. Dirk's exposure to the product of one manufacturer X, however, lasted only for one day and occurred at a location where he was not using the product, but other employees did. Expert's testified that Dirk could have inhaled asbestos fibres but that the amount would be minimal compared to the other

¹⁰⁵³ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, pp. 303-307.

¹⁰⁵⁴ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 304.

¹⁰⁵⁵ Example elaborated on the basis of WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, pp. 304-305.

¹⁰⁵⁶ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 36: Trivial Contributions To Multiple Sufficient Causes, REST 3d TORTS-PEH § 36, (b), current through August 2012, (accessed on April 16, 2013).

exposures during his working career. Manufacturer X would, despite the tortious conduct, not be held liable, because of its minimal contribution.¹⁰⁵⁷

Vice versa the limitation of liability is logically not applicable if the trivial contributing cause is necessary for the damage, i.e. in cases of over-determination.

ii) The challenge of pre-emption

The former is a solution to duplicative causation, but concerning pre-emptive causation the test is less performing. In pre-emptive causation situations Wright sees only one actually sufficient set, namely the one including the factors actually leading to the damage. The tortious actions of third persons that did not result in damage are not taken into account when analysing the case, on condition that the act did not actually result in a risk or potential damage.¹⁰⁵⁸

For example: X is shot and killed by Y just when he was about to drink a cup of poisoned tea offered by Z. The gun shot pre-empted the drinking of the poison and thus the potential effect.¹⁰⁵⁹ The tea would only be a cause if the poison would have been drunk before X was shot.

Failure to provide safety information on the use of a chemical is, following Wright's reasoning, not a cause of the damage if the information would not have been read anyway. On the basis of a Ness analysis the pre-empted cause is not relevant for the causation.¹⁰⁶⁰

This aspect of the NESS test is criticised frequently and heavily. This aspect, together with other (alleged) deficiencies of the test, are discussed in the following paragraph.

b) Critics of and changes to the NESS test

Meanwhile the NESS standard indeed continues to be the subject of many discussions. Alleged weaknesses are pointed out by several scholars like Stapleton, Fumerton and Kress. Subsequently Wright has replied to these

¹⁰⁵⁷ Based on example in Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 36: Trivial Contributions to Multiple Sufficient Causes, REST 3d TORTS-PEH § 36, illustrations, current through August 2012, (accessed on April 16, 2013).

¹⁰⁵⁸ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 1024.

¹⁰⁵⁹ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, pp. 1801-1802.

¹⁰⁶⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, p. 1802.

objections, what then again was followed by other discussions. Although very interesting and pleasant brain gymnastics, this paragraph is limited to the bottlenecks that are relevant within this research concerning chemical liability.

i) Pre-emption and omissions

Following the thought in the former paragraph, I will start with the issue of pre-emptive causation. Pre-emption is important in chemical liability: if one is exposed to a negligently escaped chemical causing a disease or other damage, but then is developing a similar disease on the basis of smoking (or something else), then such situation should be analysed and treated carefully. It is not so that the chain of causation stops by the pre-empting cause, in casu the smoking.

A person is exposed to a fatal dose of a chemical for which no antidote exists. Before the chemical kills him, the ambulance transporting him to the hospital is involved in an accident and the poisoned person dies instantly. According to Wright's theory the exposure to the noxious substance is not a NESS for the person's death, being pre-empted by the road accident. The actual cause of death is the collision. This conclusion was severely criticised.¹⁰⁶¹ For example Stapleton claims that in such a situation both occurrences are causes.¹⁰⁶² To this assertion Wright replies by stating that an element that guarantees an outcome and an element that actually causes the outcome should be distinguished.¹⁰⁶³ Only the last one should be included in the necessary set. Focus should be on what really happened and not on speculation about counterfactual scenarios, dixit Wright.¹⁰⁶⁴

¹⁰⁶¹ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*; MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing; FUMERTON, R., & KRESS, K. (2001, Vol. 64). Causation and the law: pre-emption, lawful sufficiency and causal sufficiency. *Law and Contemporary Problems*, pp. 83-105.

¹⁰⁶² STAPLETON, J. (2008, spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*, pp. 477-478.

¹⁰⁶³ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 299.

¹⁰⁶⁴ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 299.

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NESS does not require lawful sufficiency, otherwise each condition guaranteeing the damage is then to be taken into account.¹⁰⁶⁵ Neither does NESS requires strong necessity, because that would mean that the traditional *conditio sine qua non* should be met¹⁰⁶⁶, and that does not work in complex multiple cause cases. NESS requires causal sufficiency or

“the condition at issue must be part of the instantiation of a fully instantiated causal law that is part of a sequence of such fully instantiated causal laws that link the condition at issue with the consequence.”¹⁰⁶⁷

Combining pre-emption with omissions makes the situation even more complex. A concrete example should make the thoughts of Wright and of the differing authors more transparent.

DMF, a chemical company, supplies a chemical to JP, a distributor, but the accompanying brochure does not specify risk management measures to be taken when using the substance. JP fails to read the brochure. When the chemical is used, noxious fumes are emitted into the air and a visitor gets injured. This would not have happened if DMF would have provided correct information, if JP had read the brochure and had paid attention. Each omission is insufficient to be a *conditio sine qua non*, and each omission depends on the other to attain the given result.

Wright would conclude that the wrongful failure to provide the distributor with the correct information is pre-empted by the use without safety precautions. This does not feel right. Both omitters caused the damage because if neither would have occurred the damage would not have resulted. Both omissions depend on each other. Fischer finds it unfair that an innocent person will not be compensated because each tortfeasor can hide behind the negligence of the

¹⁰⁶⁵ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, pp. 297-298.

¹⁰⁶⁶ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 298.

¹⁰⁶⁷ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 298.

other.¹⁰⁶⁸ The NESS test visualizes the causal problems, but does not bring a factual solution in such cases.¹⁰⁶⁹

After above remarks Wright made some changes to the definition of the NESS test: he replaced 'a necessary element of a sufficient set' by 'necessary for the sufficiency of a sufficient set'. The full definition reads now as:

"a condition contributed to some consequence if and only if it was necessary for the sufficiency of a set of existing antecedent conditions that was sufficient for the occurrence of the consequence."¹⁰⁷⁰

As already mentioned Stapleton is convinced that omission cannot be pre-empted. She bases her arguments on the observation that omissions have no sequence and thus should always be taken into account.¹⁰⁷¹

But it remains a fact that it is difficult to avoid circularity in pre-empted causation, especially if the notion of dependency is put central.¹⁰⁷² For example: a toxic chemical clear as water and without smell, is put into an 'old' water bottle and no marks are put on the bottle to alert for the new content. X drinks from the bottle assuming that it still contains water. Feeling very sick, X drives towards the hospital, but is killed during transport, because the driver failed to brake. The notion of dependency, i.e. each factor (the chemical, the drinking, the car accident) is dependent on the other. Without the chemical in the bottle X would not have drunk poison, and he would not have driven to the hospital, thus would not have been killed in the car accident. Wright however would say that the failure to brake is the cause of X's death. The last act is considered the cause. One can perfectly argue the opposite: without putting the chemical in the water bottle nothing would have happened. The first act is then the cause. It is clear that the NESS test, as explained by Wright has some difficulties with such a situation. On the other hand Wright correctly refers to the common habit of using causal generalisation whereby only some of the antecedent conditions are retained as causal. Thereby the search is only for so much specificity as is

¹⁰⁶⁸ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p. 301.

¹⁰⁶⁹ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p. 302.

¹⁰⁷⁰ WRIGHT, R. (2001, April). Once more into the bramble bush: duty, causal contribution, and the extent of legal responsibility. *Vanderbilt Law Review*, pp.1102-1103.

¹⁰⁷¹ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*, p. 478.

¹⁰⁷² MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing, p. 328.

possible and needed.¹⁰⁷³ If on intuition it is possible that an empirical law exists explaining the connection between the event and the result, then there is no problem with making other events redundant.¹⁰⁷⁴ Of course philosophers will find other arguments to rebut the former, but proceeding in a different way would easily become burdensome and unnecessarily lengthy and make pragmatic determination of causation impossible. The NESS formula requires causal sufficiency rather than lawful (strong) necessity.¹⁰⁷⁵

Despite the counterarguments of Wright, dependently sufficient successive omission cases remain an issue.¹⁰⁷⁶

Maybe, or should I rather write probably, it is true that a comprehensive standard or test for causation is unattainable, when even Fischer tempers his aversion for intuition by stating that a 'commonly held and strong intuition' could be the solution in omission cases. After all, successive omission cases raise 'more than simple fact questions'. They require judgments about responsibility.¹⁰⁷⁷

ii) Keeping it strictly factual leads to an infinite number of causes

According to Fumerton the application of the NESS formula in combination with Wright's objective to keep it strictly factual, leads to a countless number of conditions that are lawfully sufficient both through their occurrence and through their absence.¹⁰⁷⁸ Sticking to a strict 'non-normative' cause-in-fact leads unavoidably to such a situation.¹⁰⁷⁹ Only through incorporating policy and legal sufficiency elements causes can be limited. In fact, the situation is comparable with the application of the equivalence theory, which proved in practice that innumerable causes can be detected making a judgment impossible without (informal) filtering. Wright solves this issue by suggesting that one should only

¹⁰⁷³ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing. p. 290.

¹⁰⁷⁴ MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing, pp. 333-

¹⁰⁷⁵ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 298.

¹⁰⁷⁶ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p. 317.

¹⁰⁷⁷ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p. 317.

¹⁰⁷⁸ FUMERTON, R., & KRESS, K. (2001, Vol. 64). Causation and the law: pre-emption, lawful sufficiency and causal sufficiency. *Law and Contemporary Problems*, p. 98.

¹⁰⁷⁹ FUMERTON, R., & KRESS, K. (2001, Vol. 64). Causation and the law: pre-emption, lawful sufficiency and causal sufficiency. *Law and Contemporary Problems*, p. 99.

look at tortious causes.¹⁰⁸⁰ But when are causal conditions tortious? Indeed, that is a decision of the court.

On the other hand, it seems impossible to achieve a full distinction between legally sufficient causes and causally necessary and sufficient factual conditions. This, however, does not imply that such a distinction, even incomplete, between causes is not useful when analysing complex causation cases. For as long one remains aware of the non-factual appreciation of the cause-in-fact, there should not be a problem. Especially in chemical liability policy and legally oriented analysis of a dossier is important in view of the particular difficulties such cases entail in relation to long latency periods, multiple causes and tortfeasors, scientific uncertainty, etc.

All of the former does not imply that the NESS formula has no practical value.¹⁰⁸¹ Despite the criticism and the 'handicaps' the test offers a coherent approach in cases where the *conditio sine qua non* is insufficient or impossible, especially in situations with over-determination¹⁰⁸² or when the tortious act is in itself not sufficient to cause the damage.¹⁰⁸³ Liability cases relating to damage caused by noxious chemicals surely can benefit from the test. Indeed, often such damage is the result of many insufficient and unnecessary contributions, whereby the threshold only is exceeded through the accumulation of all the contributions.

The NESS test has indeed received a lot of criticism since its development in 1985. And the test does have some 'handicaps', but it offers a comprehensive and structured approach in complex cases with difficult causation.

3.2.3.2 Practical application of the NESS test

The NESS test is in theory a useful instrument for the discovery of different sources of wrongful acts, or exposures to chemicals in toxic tort. The question is now if the test is also practicable in court. The next paragraphs deal with the acceptance of the test and look for court cases applying it.

¹⁰⁸⁰ WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, pp. 1793; 1803-1813.

¹⁰⁸¹ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*, p. 472.

¹⁰⁸² MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing, p. 323.

¹⁰⁸³ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p 278.

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a) The NESS test as incorporated in the Restatement (third) of Torts.

Over the last twenty five years NESS has gained increasing support amongst legal scholars in the USA.¹⁰⁸⁴ The test seems to be sufficiently comprehensive and factual to satisfy.¹⁰⁸⁵

In the recent, third Restatement of Torts it is recognized that the *conditio sine qua non* standard is not the exclusive method to the determination of factual cause.¹⁰⁸⁶ Multiple sufficient causes and multiple sufficient causal sets are also factual causes that, according to 'our common understanding of causation', have to be recognized even if the traditional test does not.¹⁰⁸⁷

The Restatement indeed makes a difference between multiple causes that are each sufficient and multiple causes whereby some were individually not sufficient. In the case of multiple sufficient causes, all these causes should be taken into account regardless if one or more are innocent. Tortious conduct needs only be one of the factual causes of harm.¹⁰⁸⁸ If one cause is innocent this will be taken into account when attributing compensation and, eventually, apportionment of damages. The former is not a matter for the causal question.¹⁰⁸⁹ Insufficient causes can be left out for attribution of liability, if the court assesses these as trivial (factual basis) or *de minimis* (legal basis), but they remain a factual cause.¹⁰⁹⁰

¹⁰⁸⁴ BARTHOLOMEW, M., & McARDLE, P. (2011, April). Causing infringement. *Vanderbilt Law Review*, fn. 310.

¹⁰⁸⁵ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*, p. 472.

¹⁰⁸⁶ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012; Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012. (Accessed on April 16, 2013).

¹⁰⁸⁷ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012; Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012. (Accessed on April 16, 2013).

¹⁰⁸⁸ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012, (accessed on May 6, 2013).

¹⁰⁸⁹ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012; Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012. (Accessed on April 16, 2013).

¹⁰⁹⁰ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 36: Trivial Contributions To Multiple Sufficient Causes, REST 3d TORTS-PEH § 36, current through August 2012, (accessed on April 16, 2013).

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When the damage is caused by multiple factors, of which one was insufficient to cause the damage on itself, the combination with the conduct of other persons can be sufficient to cause the result. Then a *multiple sufficient causal set* is created and the aggregated effect is decisive.¹⁰⁹¹ This is in the Restatement called overdetermined causation. When this happens ‘the conduct overdetermines the harm’, i.e. the acts are more than sufficient to cause the harm. Such circumstances thus create a ‘multiple sufficient causal set’ situation.¹⁰⁹² In concreto: X, Y and Z all discharge a toxic chemical into the nearby fishpond. The family of the fisherman eating the fish all turn ill and have to be hospitalized. Two out of four die. However, each individual company discharges below the limit deemed dangerous. A contrario, together they discharge twice the permitted amount. Following the ‘multiple-sufficient-causal-set’ standard each company is a factual cause of the poisoning.

Imagine now that the chemical leaks into the pond due to unusual rainfall. After the rain the threshold limit is not exceeded and the fish remain healthy. Then the companies discharge into the pond, however below the threshold limit. Putting all together, namely the pollution by the rain and the one resulting from the discharges, the concentration is well above the threshold. In this situation each company’s act is a factual cause of the damage to the family.

Multiple causes, and especially incremental causes, insufficient by themselves, occur frequently in claims concerning persons who have been exposed to toxic chemicals.¹⁰⁹³ When in such cases the victim sues multiple actors claiming that each defendant provided some dose of a toxic substance that caused his harm, it might very well be that some of the exposures do not meet the *conditio sine qua non* requirement, for example because the disease was already unknowingly contracted. Still every exposure is a factual cause.¹⁰⁹⁴

¹⁰⁹¹ “When an actor’s tortious conduct is not a factual cause of physical harm under the standard in § 26 only because another causal set exists that is also sufficient to cause the physical harm at the same time, the actor’s tortious conduct is a factual cause of the harm.” Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012. (Accessed on April 19, 2013).

¹⁰⁹² Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012. (Accessed on April 19, 2013).

¹⁰⁹³ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012, (g).

¹⁰⁹⁴ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012, (g).

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In the Restatement (Third) of Tort it is clearly advised to solve these issues with multiple causes through the test of multiple sufficient causal sets, a test in line with the NESS developed by Wright. But how does this translate into practice? Restatements are followed by the majority of courts.¹⁰⁹⁵ Is this also the case for this matter? In the following paragraph some court cases are analysed as examples of the practical application of the concept of multiple causal sets.

b) What can we learn from court cases?

Courts have since the beginning allowed that asbestos victims recover from all defendants to whose asbestos they were exposed.¹⁰⁹⁶ In the Borel case it was impossible to determine with absolute certainty which particular exposure resulted in the injury.¹⁰⁹⁷ Based on the undisputed fact that Borel contracted his disease from asbestos dust, the court found the circumstantial evidence strong enough to find that each defendant was a cause in fact.¹⁰⁹⁸ Similar approaches were used in cases concerning other chemicals.¹⁰⁹⁹ In James versus Chevron the plaintiff brought a wrongful death action against multiple defendants. The deceased husband of the plaintiff was during his working life exposed to different toxic chemicals (e.g. benzene, PaHs) and developed liver and stomach cancer allegedly caused by the exposure. The plaintiff had to prove that the injuries of her husband were proximately caused by exposure to the defendants' chemicals. Providing evidence that the exposure was sufficiently frequent, regular and proximate is enough to prove the causal link between all defendants and the disease.¹¹⁰⁰

In June versus Union Carbide a resident of a former uranium and vanadium mining town brought action asserting claims for personal injury caused by the

¹⁰⁹⁵ Information gathered during an interview with Professor McLaughlin on March 1, 2013.

¹⁰⁹⁶ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, current through August 2012, comment (g).

¹⁰⁹⁷ See Borel versus Fibreboard Paper Products Corp., 493 F.2d 176 (1973), p. 1094; Rutherford et al. versus Owens-Illinois Inc., 941 P.2d 1203 (Supreme Court of California October 22, 1997); Hollingsworth & Vose Co. versus Connor, 764 A.2d 318 (Court of Special Appeals of Maryland December 28, 2000).

¹⁰⁹⁸ Borel versus Fibreboard Paper Products Corp., 493 F.2d 176 (1973).

¹⁰⁹⁹ Hollingsworth & Vose Co. versus Connor, 764 A.2d 318 (Court of Special Appeals of Maryland December 28, 2000); James versus Chevron U.S.A., Inc., 301 N.J.Super. 512 (Superior Court of New Jersey, Appellate Division May 27, 1997), p 910; Ingram versus ACandS, Inc., 977 F.2d 1332 (United States Court of Appeals, Ninth Circuit October 21, 1992); Eagle-Picher Industries, Inc. versus Balbos, 604 A.2d 445 (Court of Appeals of Maryland April 10, 1992).

¹¹⁰⁰ Borel versus Fibreboard Paper Products Corp., 493 F.2d 176 (1973). pp; 912-914.

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radio-active substances mined in their region. The court decided that the defendants were not liable, because the plaintiffs failed to prove that either their exposure to radioactive and non-radioactive toxic substances was a *conditio sine qua non* for their diseases, or that the exposure was a 'necessary element of a causal set' that would have caused these conditions.¹¹⁰¹

Courts go even further than that. They assign liability when a tortfeasor's act was not necessary for the damage. Liability was attributed when a tortfeasor's act would have been a factual cause if the other competing cause had not existed.¹¹⁰² Or, when a person develops (for example) cancer after exposure to chemicals of several sources, then some of these exposures might not have been necessary for the contraction of the disease. With the NESS test each exposure is a factual cause of the disease.¹¹⁰³

In the case of James versus Chevron the court concluded that:

"Where there is "unitary injury caused by concurrent negligence, the plaintiff is naturally relieved of this burden [of proving apportionment] because of the joint liability which is the usual concomitant of concurrent negligence."¹¹⁰⁴

The conduct of one of the defendants would also have caused the harm in the absence of the competing cause.

But what if each individual tortious conduct is not sufficient, like in the case of the polluting mill owners? Then the NESS construction brings solace. If an actor's conduct is necessary to at least one causal set, then that act is a factual cause, although his act is only sufficient in combination with the conduct of others. Or as it is written in the Restatement (Third) of Torts:

"When an actor's tortious conduct is not a factual cause of harm under the standard in § 26 only because one or more other causal sets exist

¹¹⁰¹ June versus. Union Carbide Corp, 577 F.3d 1234 (United States Court of Appeals, Tenth Circuit August 21, 2009).

¹¹⁰² Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, comment (a), current through August 2012, (accessed on April 16, 2013).

¹¹⁰³ James versus Chevron U.S.A., Inc., 714 A.2d 898 (Supreme Court of New Jersey July 27, 1998) applying the 'Borel principle' from Borel versus Fibreboard Paper Products Corp., 493 F2d 176 (United States Court of Appeals, Fifth Circuit September 10, 1973).

¹¹⁰⁴ James versus Chevron U.S.A., Inc., 694 A.2d 270 (Superior Court of New Jersey, Appellate Division May 27, 1997).

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that are also sufficient to cause the harm at the same time, the actor's tortious conduct is a factual cause of the harm."¹¹⁰⁵

Again an example should clarify: a person suffering from bladder cancer was exposed to benzene on several occasions and from several sources. The total amount of exposure was undoubtedly enough to cause the disease. But an exposure to all sources minus one could still be sufficient. One source is not a *conditio sine qua non*, since the sources could individually not have caused the cancer. On the other hand that source may be a factual cause if it was a necessary component of a causal set that probably has caused the injury.

The plaintiff consequently has to show that the exposure would have caused the disease; proving that the exposure could have caused the cancer is not sufficient. There are always many possible causes of a particular cancer, but according to the court in *June versus Union Carbide Corporation* a plaintiff does not have an action based on each substance he was exposed to, only the substance that probably caused the cancer is a factual cause without being a *conditio sine qua non*.¹¹⁰⁶

In another case it was stated that:

"when the conduct of two or more persons is so related to an event that their combined conduct, viewed as a whole, is a but-for cause of the event, and application of the but-for rule to them individually would absolve all of them, the conduct of each is a cause in fact of the event."¹¹⁰⁷

Several courts have adopted an approach whereby it is not required that each of multiple concurring contributing causes should be sufficient in itself to bring about the plaintiff's harm.¹¹⁰⁸ Consequently, low exposure to toxic substances that only cause damage beyond a certain threshold, could also be considered a factual cause when they are part of multiple exposures. If the total exposure from all allegedly tortious exposures exceeds that threshold, it may well be that the damage also had happened without exposure to source X. This source X is

¹¹⁰⁵ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, comment (k), current through August 2012, (accessed on April 16, 2013).

¹¹⁰⁶ *June versus Union Carbide Corp*, 577 F.3d 1234 (United States Court of Appeals, Tenth Circuit August 21, 2009), p. 1243.

¹¹⁰⁷ *Eagle-Picher Industries, Inc. versus Balbos*, 604 A.2d 445 (April 10, 1992), p. 459.

¹¹⁰⁸ *Spaur versus Owens-Corning Fiberglas Corp.*, 510 N.W.2d 854 (January 19, 1994), p. 858.

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not a *conditio sine qua non* cause, but it is a factual cause if it was a necessary element of a sufficient set of causes.¹¹⁰⁹

Multiple sufficient causal sets as a remedy to the insufficiency of each individual cause, occur most frequently in cases concerning exposure to multiple doses of toxic chemicals.¹¹¹⁰ When a threshold limit for the chemical concerned is known, the distinction between sufficient and insufficient individual contributions to the damage is possible¹¹¹¹, at least if the amount of exposure can be established. Anyhow, under the newly accepted judicial approach, each of the exposures is considered a factual cause of the damage. The court can however still decide that some individual contribution is *de minimis*, but this is a matter of legal cause and thus a policy/fairness decision.¹¹¹²

In reality, courts frequently do not hold alleged tortfeasors liable for reasons of *de minimis*, or when the tortfeasor was the first to be negligent, or the absence of the specific tortious act would not have prevented the damage... Such decisions are not captured in the rule that each of multiple sufficient sets of conditions to bring about an injury is treated as a factual cause. It seems that these decisions are based on intuitive notion that one of the tortfeasors has pre-empted the other.¹¹¹³ Although, would it be correct to pre-empt such factual causes? Would it be correct to not hold a tortfeasor liable for poisoning the fish you eat, because you died in a car accident before the poison worked?

¹¹⁰⁹ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 28: Burden Of Proof, REST 3d TORTS-PEH § 28, comment c (5), current through August 2012, (accessed on May 6, 2013).

¹¹¹⁰ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012; Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, (g), current through August 2012, (accessed on April 16, 2013).

¹¹¹¹ Golden versus Lerch Bros, 281 N.W. 249 (Supreme Court of Minnesota July 8, 1938); Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, (g) current through August 2012. (Accessed on April 16, 2013).

¹¹¹² Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 36: Trivial Contributions to Multiple Sufficient Causes, REST 3d TORTS-PEH § 36, current through August 2012, (accessed on April 16, 2013).

¹¹¹³ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, (i), current through August 2012, (accessed on April 19, 2013).

And what about situations where the plaintiff was already suffering the damage before the *multiple sufficient causal set* occurred?¹¹¹⁴ This is not an unlikely situation in chemical liability. Imagine an individual who was exposed to a toxic chemical causing cancer. Medical evidence however proves that the cancer originated before the exposure to the chemical, but just was not diagnosed. The causal link between the chemical and the harm is void. An act or omission cannot be the factual cause of something that already occurred.¹¹¹⁵

This is a difficulty that also arises in cases where omissions are the cause. Some of those decisions involve common sense in order to get to a solution. A bottle containing a toxic substance with inadequate information on its label does not make any difference to the occurrence of the harm since the plaintiff did not read this warning. The fact that the information was useless is not causal in such a case, if one follows Wright. The formula of necessary element of a sufficient set does not capture such a situation. Following the reasoning in the test the later factor pre-empted the first. This does not seem right; the plaintiff would have been harmed even when he would have read the inadequate label. It is like the case with the defective brakes: the rental company failed to repair the brakes of a car and the driver, who rented the car, forgot to brake and a collision occurred.¹¹¹⁶ The failure to attempt to brake pre-empted the failure to repair and all other non-instantiated conditions.¹¹¹⁷ The case was solved by the court through making an intuitive decision.¹¹¹⁸

Common sense remains important in such cases, as it is confirmed by the following citation from the Restatement (Third) of Torts:

“Thus, this Restatement does not provide a set of rules to resolve these cases. Instead, it highlights the disagreements that these cases raise,

¹¹¹⁴ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (c), REST 3d TORTS-PEH § 26, current through August 2012; Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, (i), current through August 2012, (accessed on April 16, 2013).

¹¹¹⁵ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 26: Factual Cause (k) and comment (k), REST 3d TORTS-PEH § 26, current through August 2012, (accessed on May 9, 2013).

¹¹¹⁶ *Saunders System Birmingham Co. versus Adams*, 117 So. 72 (Supreme Court of Alabama May 31, 1928).

¹¹¹⁷ STAPLETON, J. (2008, Spring). Choosing what we mean by "causation" in the law. *Missouri Law Review*, p. 478.

¹¹¹⁸ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, (i), current through August 2012, (accessed on April 16, 2013).

and leaves their resolution to further case-law development of rules or to case-by-case resolution under specific factual settings.”¹¹¹⁹

The NESS is useful to give insight in complex causation cases. It however does not help with formulating an answer on the liability question. Fischer believes these cases cannot be solved without making a decision on policy or intuition, a matter whereby the NESS test does not help us.¹¹²⁰ Flexibility is provided by combining the NESS test with other doctrines, like the proximate cause. A court can use proximity to exonerate parties who made minimal contributions although there is causation in fact.¹¹²¹

3.2.3.3 NESS in the UK

Although it is not always immediately observable, the approach of legal issues is quite similar in the US and the UK. The two legal systems cross reference a lot and on some topics it is frequently difficult to find specific theories or opinions. On the other hand there is also the impact of a quite different culture and societal view. Despite the fact that Lord Hoffmann, with his extensive experience of many years, declares that no judges heard of the NESS test, an attempt is made to compare the NESS standard to the tools used in the UK Common Law system. Some academics, like Miller¹¹²², now recognize the value of the test, but practising lawyers and court still find it too complex.¹¹²³

What is their alternative? In 2002 the House of Lords addressed the question of multiple causes in the case *Fairchild versus Glenhaven*.¹¹²⁴ An employee was exposed to asbestos during his employment with several companies. He later developed mesothelioma. It appeared impossible to prove which exposure during which period of employment was the actual cause or, in other words, the *conditio sine qua non* requirement could not be met. Their Lordships found it unfair and unjust to leave the plaintiff without recourse and attributed liability to

¹¹¹⁹ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, (i), current through August 2012, (accessed on April 16, 2013).

¹¹²⁰ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p 289.

¹¹²¹ FISCHER, D. (2005-2006, Vol. 94). Insufficient causes. *Kentucky Law Journal*, p 289.

¹¹²² MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing.

¹¹²³ HOGG, M. (2011). Developing Causal Doctrine. In R. GOLDBERG, *Perspectives on causation* (pp. 41-56). Oxford and Portland, Oregon: Hart Publishing, p. 47.

¹¹²⁴ *Fairchild versus Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002).

those employers who materially contributed to the risk. The case could have been approached with the NESS standard, equalling each negligent act to a “necessary for the sufficiency of a sufficient set”. Chris Miller agrees with this conclusion.¹¹²⁵ More, he regrets that their Lordships did not take the opportunity: the test could have been used as a “principle justification for the application of joint and several liabilities”.¹¹²⁶ Lord Hoffman has however also a point when he states that the Fairchild case would not have passed the NESS test. Indeed, concerning mesothelioma, being an indivisible harm caused by potentially one fibre, only one defendant could have factually caused the damage. A fact that was not proved. But if Fairchild would have been about lung cancer or asbestosis, both subject to the amount of exposure to asbestos, the material contribution can, in my opinion, be compared with the NESS standard. The former makes me think that the UK courts could be more inclined to officially use the NESS standard if they were not “obstinately”¹¹²⁷ refusing to apply the two step approach of cause-in-fact and legal cause. But it is also a reality that the English courts are not afraid to use arguments like fairness and justice whilst ‘adjusting’ causal links. Anyhow, the outcomes in both Common Law systems are, despite their different approaches, quite similar.¹¹²⁸

Lord Hoffman’s solution is to divide the causation process into three stages: (1) establishment of the facts; (2) decision on whether these facts are a cause-in-fact, for example with the NESS test (*dixit* Lord Hofmann); (3) the decision if legal causation exists.¹¹²⁹ This proposal makes the process clearer, but probably it is sufficient to keep it in mind when analysing causation. The process is complex enough and delineating stages is very difficult in view of the many borderline categorisation that should then take place without little added value. The question is then of course what the value is of the two phases, namely cause-in-fact and legal cause. There the difference is more substantial since the policy and value decisions on causation change and should be acceptable to the

¹¹²⁵ MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing, p. 337.

¹¹²⁶ MILLER, C. (2011). NESS for beginners. In R. GOLDBERG, *Perspectives on Causation* (pp. 323-337). Oxford and Portland, Oregon: Hart Publishing, p. 337.

¹¹²⁷ HOFFMANN, L. (2011). Causation. In R. GOLDBERG, *Perspectives on Causation* (pp. 3-9). Oxford and Portland, Oregon: Hart Publishing, p. 3.

¹¹²⁸ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing.

¹¹²⁹ HOFFMANN, L. (2011). Causation. In R. GOLDBERG, *Perspectives on Causation* (pp. 3-9). Oxford and Portland, Oregon: Hart Publishing, p. 5.

societal situation the court is active in. Concluding, I see little reason to bring another step into the causation process.

Another UK method found, was the 'combined effect rule'. The combined effect rule is very old; it was already used in 1873 in the case of *Thorpe versus Brumfitt*.¹¹³⁰ And the rule was also used in 1887 for a decision concerning the pollution of a stream.¹¹³¹ However it seems on the basis of the information found, that this rule is used for nuisance cases¹¹³² and will thus not be discussed any further.

3.2.3.4 NESS in the Continental legal system

First a brief explanation on terminology. Multiple causation as discussed here includes what is called in European academic essays 'concurrent causes', i.e. causes which take place at the same time and which would have caused the entire damage absent the other causes.¹¹³³ Although in such situation the *conditio sine qua non* standard is not met, France and the Netherlands hold the tortfeasors jointly and severally liable. Causes occurring simultaneously or in sequence, that are insufficient, but together cause the damage lead however to different liabilities in the Netherlands and France.¹¹³⁴ These causes lead in France to joint and several liability of the tortfeasors, whilst in the Netherlands the resulting liability depends on the fact whether the damage is indivisible or not.

a) Pragmatic flexibility in France

In France a condition can only be a cause of the damage if the *conditio sine qua non* is fulfilled.¹¹³⁵ Consequently in cases with multiple causes, that have to be

¹¹³⁰ *Thorpe versus Brumfitt*, (1872-73) L.R. 8 Ch. App. 650 (Court of Appeal in Chancery May 1, 1873).

¹¹³¹ HOWARTH, D. (2002, Spring). Muddying the waters: Tort law and the environment from an English perspective. *Washburn Law Journal*, p. 486; *Thorpe versus Brumfitt*, (1872-73) L.R. 8 Ch. App. 650 (Court of Appeal in Chancery May 1, 1873).

¹¹³² HOWARTH, D. (2002, Spring). Muddying the waters: Tort law and the environment from an English perspective. *Washburn Law Journal*, p.485.

¹¹³³ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 146.

¹¹³⁴ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 146.

¹¹³⁵ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 120.

combined to create damage, a defendant is liable if his act was a *conditio sine qua non*.¹¹³⁶ It makes for example no difference if in multiple causes' situations each cause is sufficient on its own or if the concurrence of the different causes was necessary to produce the damage and thus not each cause was sufficient on its own.¹¹³⁷ It seems that in such cases further testing than the *conditio sine qua non* is neither needed nor accepted.

Concerning uncertain causation, the Court of Cassation in France has frequently ruled that no damages can be awarded if causation is not established, but is hypothetical, doubtful or uncertain. In practice however, judges have used this rule in a quite flexible manner.¹¹³⁸ The theory of the common fault (*faute commune*) of a group is used in cases of multiple potential tortfeasors when the specific tortfeasor cannot be identified. The judge can then hold every member of that group fully liable on the basis that the members of the group together were acting dangerously and encouraging each other to commit dangerous acts.¹¹³⁹ The *conditio sine qua non* is precluded.¹¹⁴⁰ In most cases it is however sure that not all the members of a group are at the origin of the damage. Consequently, each group member is allowed to prove his innocence and will then escape liability.¹¹⁴¹ This solution will most probably not work in toxic tort cases, although the concept of a 'group' is applied in a very broad manner.

Any event that resulted in damage is not to be characterized as a cause for liability, the event should also 'explain' the damage.¹¹⁴² The negligent conduct of the defendant should be the efficient and generating cause for the damage, what is *de facto* adequate causation applied in court.¹¹⁴³ This approach has been used in situations like (1) in liability cases for objects where the object played an active role in the damage; (2) when a cause nearer in time to the occurrence of

¹¹³⁶ SPIER, J., & HAAZEN, O. (2000). Comparative conclusions on causation. In J. SPIER, *Unification of Tort Law: causation* (pp. 127-154). Netherlands: Kluwer Law International, p. 120.

¹¹³⁷ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 60.

¹¹³⁸ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 60

¹¹³⁹ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 61.

¹¹⁴⁰ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: *Dalloz*, 1728.

¹¹⁴¹ Cassation Civile (2e chambre), 11 February 1966, *Dalloz* 1966/228.

¹¹⁴² VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 419.

¹¹⁴³ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 420.

the damage played a greater role in that result; (3) when many faults differing in significance have contributed, the most significant one absorbs the others.¹¹⁴⁴

Clearly there is little room for the NESS test. Mountain climber P is hurt by a falling rock. At the same time a second rock nearly hits him. The falling of the rocks is caused, on the one hand, by negligence of D, and on the other hand, by a mountain goat. It is unknown which rock hit P. Both events are factual causes, both sufficient to result in the damage. Under the rule for multiple sufficient causes in the US, the rock coming down by the negligence of D would be regarded as a factual cause because, absent the other factual cause (the goat and the rock), the stone falling by the act of D would have caused the damage.¹¹⁴⁵ This approach is followed regardless of (1) whether the competing cause involves tortious conduct or consists only of innocent conduct¹¹⁴⁶, (2) their individual significance and (3) their place in the sequence of occurrences.¹¹⁴⁷ Referring to the example of the falling rock, under normal French rules nobody would be held liable, because causation is not proved.¹¹⁴⁸ There has to be a direct relation¹¹⁴⁹ between the act (fault) and the damage and this link needs to be certain.¹¹⁵⁰

But French courts have judged that there existed a direct causal link even when the damage was but an ulterior consequence of the behaviour of the defendant.¹¹⁵¹ The concept of co-actors causing a single damage makes it possible to find liability. It is irrelevant whether the acts occurred simultaneously or in sequence, whether the act was intentional or not, whether the individual act was a substantial part of the cause or only a small one, whether it was an

¹¹⁴⁴ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 420.

¹¹⁴⁵ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, comment (a), current through August 2012, (accessed on May 6, 2013).

¹¹⁴⁶ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, § 27: Multiple Sufficient Causes, REST 3d TORTS-PEH § 27, comment (a), current through August 2012, (accessed on May 6, 2013).

¹¹⁴⁷ Please note that this reasoning is about factual causation and not about attributing liability. Finding the cause-in-fact is however the first step to take in the process.

¹¹⁴⁸ GALAND-CARVAL, S. (2000). Causation under French law. In J. SPIER, *Unification of Tort Law: Causation* (pp. 53-61). Amsterdam: Kluwer Law International, p. 61.

¹¹⁴⁹ Cour de Cassation (2e Chambre) 3 October 1990, *Bulletin Civile* 1990.II.184.

¹¹⁵⁰ SARGOS, P. (2008). La certitude du lien de causalité en matière de responsabilité est-elle un leurre dans le contexte d'incertitude de la médecine? *Recueil Dalloz*, pp. 1935-1947, p. 1935.

¹¹⁵¹ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 423.

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act *stricto sensu* or an omission.¹¹⁵² It is however mandatory that the co-actors are identified.¹¹⁵³ The former is contrary to the concept of a group, whereby an actor can remain unknown, for example it is unclear who shot the fatal bullet.

b) The Netherlands

i) Multiple causes each originating in an act of another actor

Article 6:99 of the Dutch Civil Code deals with multiple causes. It states that if damage could be caused by two or more factors while for each of these factors another actor is allegedly responsible, and thereby it is certain that the damage is caused by at least one of these factors, then each defendant has to pay for the damage unless he can prove he did not cause it.¹¹⁵⁴

Liability is thus attributed to all defendants despite the fact that there could be innocent defendants. It is however unclear who these innocent defendants are. Is this similar to the NESS test? Wright's test still requires at least some factual causal link between the damage and each of the alleged tortfeasors. This is similar to the requirement in the article that each factor could cause the damage and each factor originates in the act of an alleged tortfeasor. The difference and advantage of the NESS test is that all causes, regardless their specific significance, are considered and evaluated before liability is decided upon. Article 6:99 Civil Code deals with this issue by reversing the proof: the defendant has to prove he did not cause the damage.

ii) Different kinds of causes: co-operative, separate or alternative

Co-operating causes are another concept in the Dutch legal system. Such causes lead together to damage, whilst individually they are not sufficient.¹¹⁵⁵ For example, three causes result in skin irritation. It was not inconceivable that the same damage would not have materialized in the absence of one of the three, but all three will be considered for the attribution of liability. This is typically a

¹¹⁵² LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, 1740, 1741, 1743.

¹¹⁵³ LE TOURNEAU, P. (2012). *Droit de la responsabilité et des contrats*. Paris: Dalloz, 1740.

¹¹⁵⁴ Art. 6:99 Burgerlijk wetboek: Kan de schade een gevolg zijn van twee of meer gebeurtenissen voor elk waarvan een andere persoon aansprakelijk is, en staat vast dat de schade door te minste één van deze gebeurtenissen is ontstaan, dan rust de verplichting om de schade te vergoeden op ieder van deze personen, tenzij hij bewijst dat deze niet het gevolg is van een gebeurtenis waarvoor hijzelf aansprakelijk is.

¹¹⁵⁵ Hoge Raad 24 December 1999, *Nederlandse Jurisprudentie* 2000, 351, with note of Akkermans.

situation that could be handled with the NESS formula: two or more causes combine into a sufficient set that causes the injury, whilst each individual cause would be insufficient for the result. All three would be held liable, since their individual acts are a factual cause of the damage.

The difference when applying the Dutch rule would be that the defendants could prove that they did not cause the injury and subsequently escape liability. Would proof of an insufficient contribution be sufficient? Will that defendant then be exonerated completely or will it depend on the nature of the injury: divisible or not, what on its turn will impact the apportionment of liability and damages. Probably this will be decided by the judge, who will use his authority as defined in article 6:98 Civil Code, namely reasonable contribution. Actually this is a question relating to liability and compensation and not strictly to causation. Everything is however linked in liability and the standard and methodology of proof of causation will influence the resulting liability and compensation.

Separate causes refer to a situation whereby each cause could have resulted in the damage.

When the causal events happened in sequence and the damage caused by the first event happens before the second cause, which also could have caused the same damage, the first cause is not pre-empted by the second. There is no change to the liability the first cause created.¹¹⁵⁶ Remember the situation with the defective brakes? The car rental company forgot to repair the brakes of the car they rented to Mr. X. Mr. X forgets to brake when approaching a crossroad and injures a pedestrian. In the NESS test only the failure of Mr. X will be retained as a factual cause. The negligence of the car rental company is disregarded.

This would not happen in the Netherlands. There the first event would be considered a cause.

Concerning these sequential events, the time between the two causes should however be more than minimal.¹¹⁵⁷ Otherwise the events would be regarded as happening simultaneously.

¹¹⁵⁶ Hoge Raad 7 December 2001, *Nederlandse Jurisprudentie* 2002, 576, conclusion of Advocate-general Huydecoppe.

¹¹⁵⁷ Hoge Raad 7 December 2001, *Nederlandse Jurisprudentie* 2002, 576, conclusion of Advocate-general Huydecoppe, par. 8.

It is clear that in a situation with alternative¹¹⁵⁸ causes, an increase in damage caused by a second cause following the first one should be attributed to the second tortfeasor/cause. (For example.) Somebody gets injured and the injurer was held liable for the injury leading to partial disability, two months later the same person is again injured and his condition is aggravated to complete disability. The first tortfeasor is liable as it was already decided. The second tortfeasor is liable for the damage he caused.

A more difficult question is to be answered when the second cause, also happening well after the first one, does not change the damage. For example: the fire in the Frieslandhallen.¹¹⁵⁹ The owner of the café in the hall terminated the rent before the fire demolished the building. Consequently the fire was not at the basis of the end of the activity of the tenant. The principle is that the second cause (the fire) does not take away the liability based on the first cause (the termination of the rent).¹¹⁶⁰ Thus normally the owner is still liable for the damage to the plaintiff occurring after the fire. For example if the notice period lasted still another two years after the demolition. However if a third party caused the fire, this party could be held liable for the remaining part of the notice period.¹¹⁶¹

The issue of multiple causation is in the Netherlands rather seen as an issue of attributing liability than of causation.

3.2.4 Concluding observations across the different countries

In an attempt to solve issues with the *conditio sine qua non* requirement when proving causation, all legal systems have made some exceptions to the general principles of proving cause. These exceptions are often motivated, but they are best elaborated in the US, most probably due to a culture encouraging to seek legal or other redress for harm done. This leads sometimes to outrageous claims, but also to lots of attention for finding and proving causation.

¹¹⁵⁸ The word alternative is here used in its normal sense and does not refer to or connect with alternative causation.

¹¹⁵⁹ Hoge Raad 7 December 2001, *Nederlandse Jurisprudentie* 2002, 576, conclusion of Advocate-general Huydecoppe.

¹¹⁶⁰ The Dutch call the second cause a hypothetical cause. See: TJONG TJIN TAI, T. (2012). *Bedrijfsjuridische berichten: Burgerlijk procesrecht. Nederlands Juristenblad*, p. 44 and A-G in arrest Hoge Raad 7 December 2001, *Nederlandse Jurisprudentie* 2002, 576, LJN AB27, conclusion of Advocate-general Huydecoppe, par. 17.

¹¹⁶¹ Hoge Raad 7 December 2001, *Nederlandse Jurisprudentie* 2002, 576, conclusion of Advocate-general Huydecoppe, par. 20.

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On the basis of the former, it was perhaps inevitable that the theories most suited for the subject of this research were found in the US. Having used those findings as a structure for discovery in the other countries, it became quickly clear that all systems have their ways to deal with difficult causation.

The US being organised in their analysis and focussed on a structured approach and the UK leaving ample room for more soft argumentation like the thinking of the ordinary man, fairness, equity and the like. The former elements are in complex cases repeatedly the starting point from which evidence of causation is sought after.¹¹⁶²

The legal system of the Netherlands is profoundly organised, mainly in Book 6 of the Civil Code.¹¹⁶³ Motivating decisions is important and there is ample room for policy and value elements. The former was made formally possible through the rule on (reasonable) attribution.

France is peculiar. Swearing to follow the theory of equivalence and nothing else, practice shows different. Many creative solutions cover up exceptions to that theory of equivalence and the Court of Cassation¹¹⁶⁴ turns a blind eye, arguing that they cannot decide on facts or accepting the application of constructions like presumption and virtual groups.

One common factor in all four countries studied is the presence of common sense. It may seem odd that common sense is accepted in court. In fact it seems that there is no way around. The concept is useful when explained, for motivating difficult decisions in the legal phase of causation, but it also frequently helps to understand causal links. For example, when it cannot be proved, scientifically or factual that the fumes of a chemical cause vomiting, the observation of the exposure immediately followed by the vomiting is admitted as proof of the causal link. Common sense is used in such a case.

¹¹⁶² For example: *Fairchild versus. Glenhaven Funeral Services Ltd and others*, [2003] A.C. 32 (House of Lords June 20, 2002); *Wilsher versus Essex Area Health Authority*, [1988] A.C. 1074 (House of Lords March 10, 1988); *McGhee versus National Coal Board*, 1973 S.L.T. 14 (House of Lords November 15, 1972).

¹¹⁶³ The main articles are from 6:97-6:110, although some articles in other parts of the Civil Code are also used in liability cases.

¹¹⁶⁴ The French Court of Cassation has the task to verify the judgments of last resort on their conformity with the law and on the application of the law. The court will not appreciate the facts of a case, it controls the correct application of the legislation. www.courdecassation.fr (last accessed on 14 July 2013).

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The US is the country focussing most on scientific evidence, however also there traces are found of the application of 'the thinking of the ordinary man'.

In the UK we find common sense as an argument to deviate from standard causation rules, like in Fairchild and Sienkowich. In the Netherlands, the article on attribution does not mention the word 'reasonable', but reasonability is generally used as a method to decide on attribution following causation, France has but one objective: the protection of the victim of tort. Following this many creativity is used to attain that target. I dare to say sometimes even against common sense.

The objective of this conclusion is not to repeat the lengthily analysis of the substantial factor formula and the NESS test, but it is still worthwhile mentioning that these structured approaches provide solutions for situations with multiple factual causes. Although it is claimed that both tests are part of the factual cause, they inherently need interpretation and evaluation when selecting the relevant substantial or sufficient causes. Still they fill the gap that is left by the inability of the *conditio sine qua non* principle.

Assessing both the NESS test is the most suitable for complex causation in toxic tort. Up to now the test is perceived as quite complex and not many courts are using it.

In the UK the NESS test is up to the spring of 2014 not applied, although things are changing. Some academics and even Lord Hoffman promote this test as a very useful method for analysis of the causal link.

The Dutch courts know the concepts of reasonable attribution and presumptions and they can get a long way with those.

Again France is different. There exists a discrepancy between the claimed adherence to the theory of equivalence and the pragmatic, empirical interpretation of causation. Examples are the application of the adequate cause or the cause tended to be followed by a certain result, the use of presumption, the theory of the common fault and the requirement that an event should not only cause the damage, but also explain it. The former could be seen as the beginning of a substantial factor-NESS-like approach: all the events that could have caused the damage are identified and then the cause(s) that explains the damage are withheld.

The comparison is difficult, due to the differences in culture and legal thinking. In order to visualize the different approaches, a hypothetical example is worked out in the next chapter.

3.3. A hypothetical example as a comparative overview

The difficulties with complex chemical liability is particularly located in causation and the proof thereof. The alleged causal links in chemical liability frequently cannot meet the *conditio sine qua non* requirement, whilst an assessment of the factual circumstances of the case is still primordial for a conclusion on a claim.

After the analysis of the difficulties relating to such complex liability in the previous chapters, the hypothetical example in the following paragraphs is made to guide the reader through a practical application of the analysed solutions.¹¹⁶⁵ Before describing the case, a few remarks have to be made.

It is assumed that it is scientifically proved that the chemical substances present in the accident can cause conditions like vomiting, dizziness, and headache and can lead to severe disease like liver infection and cancer.

The questions concerning liability and negligence are not discussed in detail. Furthermore the analysis of the hypothetical case will only make a suggestion on the attribution of liability. After all liability litigation is more an art than an exact science...¹¹⁶⁶ Issues concerning compensation for damages are also not discussed?

If some injury could be caused by personal behaviour of the plaintiff will not be taken into account. The fact that a person by himself also could be held responsible for his injury is a matter of attribution and compensation and thus not discussed here.

Abstraction is made of any specific legislation or rules concerning transport, railroad services, fire brigades, authorities of the village and the country, employment and public services. The potential impact of the fact that this was an international transport is also disregarded.

¹¹⁶⁵ The case is not an accident that really happened. All facts and damages are created and do not in any way refer to what actually happened in similar accidents.

¹¹⁶⁶ LAMBERT-FAIVRE, Y. (1992). De la poursuite à la contribution: quelques arcanes de la causalité. *Recueil Dalloz*, pp. 311-319, 331.

3.3.1 A train involved in an accident lost toxic chemicals

On a Saturday a train was on its way from the harbour of Rotterdam to London via Calais. It was a sunny, dry but windy day. The three last wagons of the train were loaded with a toxic chemical powder.

3.3.1.1 The chemical and its hazards

That chemical powder has dangerous and toxic properties.¹¹⁶⁷ It is combustible and explosive, highly flammable in the presence of open flames or sparks, flammable as a result of shocks, explosive in presence of mechanical impact (like a collision), soluble in water. The substance forms explosive mixtures with air. When in contact with water, the substance forms another toxic chemical in the form of gas or fumes.

The substance is toxic to humans. It can be inhaled and is absorbed through the skin. Acute injuries through inhalation may affect behaviour and the central nervous system with symptoms including seizures, weakness in the limbs, dizziness, impaired judgement, irritability, apprehension, weakness, headache, anxiety, agitation, confusion, and coma. Chronic damage relates to carcinogenic, mutagenic and teratogenic effects. It may cause harm to blood, the kidneys, the liver, the cardiovascular system and the central nervous system. It may also cause adverse effects on male fertility. Individuals that have been exposed should have periodic medical examinations.

Safety management advises are of course important when dealing with such a hazardous substance. In this case attention is drawn to the fact that the transported substances react with water into a second gaseous substance that is even more toxic. It is thus primordial to follow the rules for extinguishing a fire: dry chemical powder should be used if the fire is small and alcohol foam or CO₂ if the fire is large. Entry of firewater into sewers should be prevented, as well as entry in basements or confined areas.

The gas resulting from the reaction of the powder with water is well absorbed via the skin and rapidly absorbed through inhalation.¹¹⁶⁸ Once absorbed it is rapidly and ubiquitously distributed throughout the body, although the highest

¹¹⁶⁷ Inspiration was found in the Safety Data Sheets of acrylonitrile, but, reading the example, it should always be kept in mind that data and consequences are altered to serve the objective of this exercise. Just one example: acrylonitrile is a liquid and not a powder.

¹¹⁶⁸ As mentioned in fn. 2, this is a hypothetical situation.

levels are typically found in the liver, lungs, blood, and brain. Especially a high acute toxicity exists, with a very steep and rate-dependent dose-effect curve. Its main acute effect is that the substance disables cells to utilize oxygen causing coma and cardiac arrest. Death follows in a matter of minutes.

When the dose is below the threshold limit for acute injuries, chronic damage may occur, including weakness, paralysis, nervous lesions, miscarriages. Mild liver and kidney damage are also possible.

3.3.1.2 The accident

Somewhere during the trip the train conductor ignored a stop signal, i.e. a red light. As soon as he realised this, he braked sharply. Unfortunately this happened in a turn and the three wagons toppled. Two wagons showed severe cracks, the third one was still intact. The accident happened nearby a village with approximately 3 500 inhabitants.

The first houses of the village were located only 80 meters from the railroad infrastructure. Because the accident happened with a lot of noise, most citizens heard that something occurred. Some of them were very curious and came close to the wagons to have a good look. Others continued doing whatever they were doing. Still others were afraid and locked themselves in their home.

The two broken wagons lost a big part of their cargo and the powder was spread in thick layers across the rails and even in the neighbouring field. Soon after the accident the middle wagon caught fire. The fire brigade arrived and started immediately with putting out the fire and with the cooling of the intact wagon. They used water for this purpose. A toxic gas originated from the reaction between the powder and the water. The firewater was drained into the sewerage of the village. Several person saw fumes arising from the sewers.

Most of the people, who came to watch the havoc, soon felt sick. They showed symptoms like nausea, headache and weak legs. All were evacuated from the location immediately. They went to the doctor for medical advice.

Not long after the facts a few of these people filed liability claims against the railroad company and the fire brigade.

Seven years later three individuals (A, B and C) developed serious diseases, one had liver insufficiencies and the two other had cancer. It is not abnormal that within a period of seven years some people develop serious diseases like the

ones at hand; sadly this is the normal course of events. However those three people blamed their condition on their exposure to the chemicals freed by the accident. They filed liability claims.

3.3.2 Going to court

3.3.2.1 General judicial aspects

The train conductor made a disastrous mistake ignoring the red sign and then braking heavily. Consequently the toxic cargo was set free. The conduct of the driver is an alleged factual cause of the accident, and the accident is a factual cause of freeing the chemical, exposing thereby the citizens and the rescue teams.

The fire brigade tried to extinguish the fire with water, thereby initiating a chemical reaction between the water and the chemical cargo of the train. This led to the formation of a very toxic gaseous substance allegedly inhaled by the local citizens. This is also a factual cause that can be proved.¹¹⁶⁹ However it is unclear how far the gas dispersed and by what means: the sewage system and/or the air. This has to be proved, since it is relevant for the establishment of exposure. Only after evidence of exposure the causal link between the chemical and the harm can be proved.

3.3.2.2 Liability claims are filed

a) Immediate contact with both the powder and the gas

X wants to help the fire brigade with the accident. He runs to the train and comes into contact with the powder from the broken wagon. Meanwhile the poisonous gas is also formed. On his arm vesicles appear. After one hour X feels sick; he is vomiting and has a severe headache.

In the hospital, the medical doctors cannot establish with certainty if X's condition is caused by the exposure to the powder or by the inhalation of the gas. However when damage shortly after or during exposure is observable, testimonies of laypersons can be accepted. The causal link is then considered clear by the close timely connection.

Multiple causes are present and the *conditio sine qua non* cannot be used to specify the actual cause amongst the two potential causes.

¹¹⁶⁹ For the methodology and the standard of proof, see the next part.

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In the UK common sense could point the court to the most likely cause of the damage. In concreto, the symptoms of X are such that these are more likely caused by a combination of the exposure to the powder and to the gas. After all X was standing nearby the train, nearly with his feet in the powder and next to the fire brigade spraying water.

In the Netherlands the court could on the basis of reasonable attribution accept a causal link between the chemicals and the sickness. The judge has a lot of freedom when applying the concept: he can take into account that the exposure to the powder and to the gas is both necessary for the damage to result. On the other hand, the judge can decide that the harm is rather caused by one substance than by the other, for as long as the judgment is well motivated.

In view of the importance the French put on protecting and compensating a victim, it is probable that the plaintiff would also win his case. A presumption of a causal link would be acceptable, since the conditions for presumptions are met:

- Serious: the powder is spread, the gas is formed and emitted in the air, the waste water of the fire brigade, being the source of the toxic gas, spreads it through the sewerage;
- Precise: it is known with certainty that the powder and the gas can cause the symptoms and damage the victims are suffering from, the source of powder and the gas is known;
- Concurrent: all facts happen at a time and in such a way that the results could originate as they did.

The combination of the former with the extensive power of the French judge to select and accept the evidence that supports their presumptions, makes it very likely that the plaintiff's claim will be granted. A clear motivation for the final judgment is not obliged. It will thus remain unsure – at least to a certain extent – on what basis the decision is made.

X could also decide to file a complaint solely against the railroad company, because he believes that it will be easier to get compensated by this private company. Then the court can and most probably will hold this company liable in full, although it is possible that the fire brigade contributed to the harm.

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If on the basis of acceptable and relevant scientific evidence it is probable that the damage to X was caused by the chemical substances, a US court would accept the existence of a causal link between the exposure and the injury. At trial level common sense would also have an impact. There the jurors have the final word. Too much common sense is however frequently overruled at higher courts, especially in chemical liability cases. In this case, the damage occurred immediately after the contact with the powder and the gas. Standards of proof are for such immediate reaction lowered in some cases. Lay testimony, typically based on common sense, is then acceptable as a causal link. Since plenty of witnesses saw him at the place of the accident and some even saw that he was covered with the powder, the causal link between the exposure and the condition of plaintiff X can be considered as proved. X will probably win his case. If a judgment is pronounced on proof of causation by lay testimonies, then it will not differentiate between harm caused by the powder and harm caused by the gas. If experts are involved, then this distinction between the two chemicals will most probably be taken into account.

It is clear that the legal systems differ in their approaches. However, in all four courts it is very likely that the plaintiff will win his case, in whole or in part. The difference between the procedures makes this easier in some than in others.

b) No observable contact with either of the chemicals

Plaintiff Y was sitting in his garden on the afternoon of the accident. In the evening he feels sick and has to be hospitalized with impaired judgment, seizures, partial paralysis and dyspnoea. Some symptoms can be caused by the powder or the gas, others by both chemicals. He was also sunbathing, so that could also have caused some.

In the UK it would be considered to be unfair to leave Y without recourse and liability would most probably be attributed to those who materially contributed to the risk.

The US court recognizes that the *conditio sine qua non* standard is not the exclusive method to the determination of factual cause. The factual cause, *id est* the exposure to gas, powder and sun will together be held as factual causes. This includes the exposure to the sun, since in this stage of analysis the court will take all potential causes into account, regardless if they are tortious or not.

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The set of causes (thus all three) is assessed on its sufficiency. The aggregated effect of these is decisive. If the result is that the set of causes has most probably caused the harm, all will be held liable. However, non-tortious causes or causes that are *de minimis* will be left out when apportioning compensation. In concreto the damage will be attributed to the railroad company and the fire brigade.

But, if the exposure to the powder proved to be *de minimis*, the railroad company could escape liability.

In case of multiple causation (or concurrent causes) the tortfeasors would both in France and the Netherlands be held liable, even when the *conditio sine qua non* is not proved for each separate exposure.

In France the liability could be based on the appreciation that the damage is caused by a common fault of a group, the combination of the causes should be sufficient. Every member of that group is held liable in full. When the concept of a 'group' is considered not realistic, the concept of co-actors could be used. The railroad company and the fire brigade would then be presumed liable on the basis that they caused a single damage, although they did not work in concert.

The Dutch court will decide on the basis of article 6:99 of the Civil Code. When the court decides that the damage is certainly caused by the powder and/or by the gas, both the railroad company and the fire brigade are held liable, unless they prove that they did not cause the damage.

c) Hospitalised with symptoms that might result from exposure to either substance, alone or together

A, B and C are hospitalised years after the accident with different injuries or diseases allegedly caused by their exposure to the powder and/or the gas coming from two sources, namely the wagons and the drainage of the firewater. It is not abnormal that within a period of seven years some people develop serious diseases like the ones at hand.

Liability claims are filed.

In the former paragraph the harm was quickly observable. Exposure and damage occurred nearly simultaneously. This is the main difference with the cases of A, B and C. The time period between the alleged cause of the damage and the occurrence of that harm is long and influence the possibility to prove the

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link. Standards of proof are regularly stricter in such cases, since many other elements probably have interfered. This is especially so when chemicals are involved.

In France both the exposure to the powder and to the gas would be regarded as a cause. Similar to the occurrence of acute damage, a presumption can be used. Thereby judges are allowed to select and accept evidence that support their presumptions. For example, if plaintiff A was sitting on a terrace in the middle of the village, the judge could reason by means of common sense that the gas is the actual cause, since the powder, despite the wind, would not have come so far. A presumption of a causal link between the gas and the disease is established. A similar reasoning can be used *mutatis mutandis* for the other plaintiffs. Another approach is based on the fact that in France a defendant cannot be partly relieved from liability on the basis of another cause that contributed to the damage. It happens that liability was attributed to a tortfeasor, although evidence showed that he only caused part of the damage. In our case it could also be held that the exposure to the gas is a substantial presumption in the absence of the powder reaching the location where the plaintiff was.

In the Netherlands courts can evaluate acts on the basis of the substantiality of their contribution to the result. If an act contributes so little to a result, then that act can be considered as not causally linked to the damage. In this case it is unlikely that the powder was transported into the middle of the village, let alone in sufficient quantities and thus the railroad company would not have caused the injury of plaintiff C.

All systems studied accept exceptions to causal requirements to the benefit of the plaintiff, if the situation warrants it. We can conclude that despite some differences in approach a causal link would be accepted by the courts in the UK, the Netherlands and France. The US victim will have the hardest time to prove his claim.

3.4 A few thoughts to conclude with

Causation is an important element that supports the objectives of liability. Both law and economics and corrective justice accept the need for a causal link, and provide viewpoints for assessing cause. The causal theories in this part of the study, are flexible enough to incorporate objectives from both doctrines.

Without a causal link between the act of the alleged tortfeasor and the victim no claim on compensation for damages can be granted. Causation is however not the same as liability. Equating causation with responsibility mingles cause-in-fact with normative elements. Once the factual causal links are established a decision from the court is still necessary to make the tortfeasor liable.

An analysis of the pure factual circumstances of a link between an event and a result has proved insufficient, especially in complex cases concerning damages caused by chemical substances. Thus a solution had to be found. The additional step used to satisfy the causal requirements is called the legal cause.¹¹⁷⁰

The factual quest for causation and the legal interpretative cause together form the two step process. This process is useful to make the finding causation more structured and transparent. The difficulties that occur due to the blurred borderline between the two stages do not outweigh the benefits. Advantages are for example that the influence of policies, value and culture become more transparent. Acceptability and correctness of judgments are also increased, since the reasons and arguments for a decision become clear.

A two-step process will however not solve all the difficulties with causation. And difficulties do exist. Many theorists and especially legal philosophers have tried to find all inclusive solutions. Without success, but from the wealth of alternative theories it was possible to choose three that are particularly interesting for chemical liability. These are: common sense as a methodology since it is ubiquitous; the substantial factor since it is quite simple and helps to pick the most 'suitable' and significant cause; the NESS test since it is up to now the most comprehensive solution for multiple and uncertain causation.

¹¹⁷⁰ In the US the second stage is often called the proximate cause. In this dissertation only the term legal cause is used in order to avoid confusion with the condition of proximity.

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Some of these tests claim to be in the cause-in-fact stage, but in reality they demonstrate the synergy between cause-in-fact and legal cause and their interdependence.

Following the study of the three alternatives, a comparison was made between the four countries studied. Particularly interesting were following elements:

- Common sense is everywhere and is frequently used, although not always explicitly. This methodology (if we can call it that in view of its spontaneous use by every human being) has its benefits, but should above all be brought into the open and dealt with consciously in order to avoid the pitfalls it has.
- The substantial factor test is interesting, but by no means comparable to the NESS test.
It is however still used and it is the most close to the Continental law system.
- The NESS is the queen of the theories. The downside is that it is experienced as very complex, what in fact it is not. But perception cannot be ignored, thus NESS should be translated into practical language and then – as some notorious academic people suggest – be promoted. The question is if its very structured approach is suitable for the UK and France, two countries that have as the main objective to get where they want, even in litigation.
- The Dutch concept of reasonable attribution is also very interesting. Despite the structured and organized approach of liability, cfr. the elaborated legislation concerning liability, the concept offers flexibility and opportunity to incorporate policies, values (i.e. the legal cause) in judgments when duly motivated.
- The other solutions, like presumptions, liability of (virtual) groups, the theory of adequate causation, common fault cannot be ignored, but are not new and despite their historical experience have not proved to be the excellent solution for complex liability cases.

So far the theories of causation. There is however an important aspect that is up to now not discussed in full: the proof of causation and the standard of proof

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thereof. In the next part the standard of proof and in particular the role of science, experts, information sharing, etc. are analysed.

Part IV – Risk versus damage

Chemicals have brought and continue to bring important benefits to man, but can also have negative impacts. Meanwhile an increase in health problems that is attributed to the use of chemicals is noticeable.¹¹⁷¹ This is partly due to the ubiquitous presence of chemical substances and to the evolution of scientific knowledge and detection methods. More and more is known on the effects of exposure to chemicals, although there is still a lot to learn. The increase in knowledge however not yet results in a situation where all damages caused by chemical substances will be immediately observable¹¹⁷² or that the long latency periods will no longer hinder adequate recourse to action at the moment the damage factually occurs. Notorious examples are the injuries caused by asbestos, PCBs or dioxins, where first damage over time can grow into a fatal condition.¹¹⁷³ Not surprisingly people are worried, fear diseases and sue the alleged source.

Lord Salmon observed already a few decades ago that:

“In the circumstances of the present case, the possibility of a distinction existing between (a) having materially increased the risk of contracting the disease, and (b) having materially contributed to causing the disease may no doubt be a fruitful source of interesting academic discussions between students of philosophy. Such a distinction is, however, far too unreal to be recognised by the common law”.¹¹⁷⁴

However, he proved wrong. The issue of risk cannot be ignored when dealing with damage allegedly caused by chemicals, whereby the proof of a causal link is a challenge. The following paragraphs explain the concept of risk and its relation to physical damage, followed by creative solutions courts applied in risk cases.

¹¹⁷¹ http://ec.europa.eu/environment/chemicals/index_en.htm

¹¹⁷² The role of risk in cases where it is impossible to prove what exactly caused the damage is analysed in the chapter on the ‘but for’ test.

¹¹⁷³ Diethylstilbestrol (DES) is an oestrogen prescribed to pregnant women to prevent miscarriages and avoid other pregnancy problems. All DES-exposed persons are at an increased risk for developing some health problems. Source:

<http://www.cdc.gov/DES/consumers/about/history.html> (accessed on 29 May 2012)

¹¹⁷⁴ *McGhee versus National Coal Board*, 1973 S.L.T. 14 (House of Lords November 15, 1972), Lord Salmon.

4.1. Risk, a concept leading to discussions

What is 'risk' and, in the context of liability what does it mean to impose risk on another?

The exact meaning of the concept depends on various factors that continuously change. Roderick Smith said at the Royal Academy of Engineering:

“Several factors can influence the different perceptions and interpretations of risk. These may include: personal experience of the adverse effect/event, social, cultural background and beliefs, the ability to exercise control over a particular risk, the extent to which information is gained from different sources e.g. from the media and so on.”¹¹⁷⁵

4.1.1 Risk in our society

Overall the increase of knowledge and the availability of information together with more scientific and technological capabilities, lead to the discovery of more dangers in more situations. Consequently it seems that risks are increasing to unprecedented levels. However, also the complexity of our society makes the world less understandable. People worry over what they cannot apprehend. Provisions like insurances, safety measures, etc. people make for eventualities, create an illusion of safety in an era of chemical, genetic, and atomic risks.¹¹⁷⁶

Research shows that public reactions reflect different understandings about risk-related facts compared to the comprehension of the same risks by experts.¹¹⁷⁷ Non-expert people qualitatively distinguish risks, whilst experts are more focussed on facts and figures.¹¹⁷⁸ For example: many individuals dread airplane crashes, while experts see these risks as less threatening. Perception has an important role in the impact of risk on people. People tend to assess risk on the basis of their experience and common sense.¹¹⁷⁹ Media and their presentation of news influence those people. Indeed, it is more likely that a person will rather recall an air crash than the less spectacular road accident leading to the death of

¹¹⁷⁵ Thompson versus Smiths Shiprepairers (North Shields) Ltd., [1984] Q.B. 405 (Queen's Bench Division November 14, 1983), p. 4.

¹¹⁷⁶ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 27.

¹¹⁷⁷ PERSAD, G. C. (2010, May 63 Stan.L.Rev.1445). Risk, everyday intuitions and the institutional value of tort law. *Stanford Law Review*, p. 1452.

¹¹⁷⁸ PERSAD, G. C. (2010, May 63 Stan.L.Rev.1445). Risk, everyday intuitions and the institutional value of tort law. *Stanford Law Review*, p. 5.

¹¹⁷⁹ HILSON, C. (2008, Vol. 21). Let's get physical: civil liability and the perception of risk. *Journal of Environmental Law*, p. 34.

the driver. The aversion for (potential) loss or damage leads laypersons into failure to appropriately weigh risks.¹¹⁸⁰ Overestimation is frequently the result. On the basis of the foregoing, we can conclude that concerns about risk play an increasingly prominent role in the development and implementation of policies and legislation.¹¹⁸¹ Modern law, contrary to the former passive approach, enhances protection against risks and obliges safe or at least cautious behaviour. This includes respect and protection for the environment and human health. A good example of active risk management is the new chemical legislation of the European Union. Europe was first to implement an extensive regulation on chemical substances, namely the regulation concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).¹¹⁸² The objectives of REACH are ambitious: to provide a high level of protection of human health and environment, to enhance the competitiveness of the EU chemicals industry, and to foster innovation. In the past chemicals were regarded as being harmless until someone or something proved the opposite. In practice this meant that an accident had to occur before a chemical was restricted on the basis of its hazardous characteristics. This is no longer the case: producers, importers and distributors have to prove that their chemicals are safe or at least manageable in a safe manner.¹¹⁸³

Meanwhile the US initiate proposals to change their chemical legislation in line with the concept of REACH. Changes to the Toxic Substances Control Act (TSCA) were approved by the US Senate Environment and Public Works Committee on 25 July 2012.¹¹⁸⁴ The approved version differs considerably from the first one introduced on April 14, 2011 by Senator Lautenberg. The actual version shifts

¹¹⁸⁰ PERSAD, G. C. (2009-2010, May). Risk, everyday intuitions and the institutional value of tort law. *Stanford Law Review*, p. 1450.

¹¹⁸¹ For example: safety rules in the workplace, consumer protection, environmental safety, etc.

¹¹⁸² Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC, *O.J. L.* 30 December 2006, 396.

¹¹⁸³ HOPPENBROUWERS, M. (2007, March). Who is responsible? The legal basis for the burden of proof in REACH and TSCA. *Institute of Environmental and Energy Law*. Leuven: (not published).

¹¹⁸⁴ Now the bill still has to pass the full Senate and the House.

the burden of demonstrating chemical safety to the manufacturers of chemicals and requires them to develop and submit health and safety data for their chemicals.¹¹⁸⁵ On 31 July 2013 the Senate Committee on Environment and Public Works held a hearing which lent new urgency to the need for advancing the reform of TSCA.¹¹⁸⁶ The support for the Chemical Safety Improvement Act is growing. Recently the National Hispanic Medical Association, five unions and the Environmental Defense Fund formally declared to support the initiative.¹¹⁸⁷

These changes breach with the past and actively deal with risks as they are or should be known in our society. This evolution will undoubtedly have an impact on toxic tort. Already the risk calculation implemented by REACH is used in a US toxic tort case.¹¹⁸⁸

4.1.2 Risk and liability

Toxic tort is nowadays recognized as having other features than the traditional tort system. One of the major issues is the proof of causal relationships, leading to barriers for tort victims and undermining the deterrent effect of tort.¹¹⁸⁹ Another important aspect is the fact that exposure to chemicals could lead to damage, but there is no certainty on the occurrence of that damage, neither on the moment when it will materialise. Consequently claims for exposure and an alleged increased risk following such an exposure are pursued. These claims for increased risk depend on the likelihood of damage that not yet materialised or never will materialise. It is also frequently very difficult to assess before harm is done if the risk creation is wrongful.¹¹⁹⁰ Liability is judged ex post and such an

¹¹⁸⁵ *S. 847: Safe Chemicals Act of 2011*. (n.d.). Retrieved July 30, 2012, from Govtrack.us: http://www.govtrack.us/congress/bills/112/s847?utm_campaign=govtrack_email_update&utm_source=govtrack/email_update&utm_medium=email.

¹¹⁸⁶ www.epw.senate.gov/public/index.cfm?FuseAction=Hearings.Hearing&Hearing_id=15d8775e-f02a-6ab7-1973-8ea6ce1196c7

¹¹⁸⁷ US Senate Committee on Environment & Public Works, April 15, 2014, www.epw.senate.gov/public/index.cfm?FuseAction=Home.Home.

¹¹⁸⁸ *Milward versus Acuity Specialty Products Group, Inc.*, 639 F.3d 11 (United States Court of Appeals, First Circuit March 22, 2011); *Milward versus Acuity Specialty Products Group, Inc.*, 664 F. Supp. 2d at 137 (United States District Court, D. Massachusetts July 31, 2009).

¹¹⁸⁹ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, p. 1678.

¹¹⁹⁰ DIJKSHOORN, W. (2012, December 7). Het privaatrecht is niet geschikt om het algemeen belang te dienen. *Nou en? Nederlands Juristenblad*, pp. 2467-2473.

assessment is not possible for as long that there is no damage.¹¹⁹¹ Risk evaluation is based on the future probability of it materialising. Consequently risk claims have the speculative quality of an unquantified claim.¹¹⁹² On the other hand denying such risk claims may have the effect that some victims will not be able to receive compensation.¹¹⁹³

On the other hand, exposure to toxic chemicals cannot be completely excluded and the question if risk can, should or cannot be the basis of a claim in tort became a pertinent question. 'Risk' is then also understood as referring to the 'chance', the 'probability', the 'likelihood' that some event will occur in the future.

Standard negligence is the imposition of unreasonable risk that has materialised.¹¹⁹⁴ But what if risk has not or not fully materialised? What if the risk leads to anomalous consequences, like fear? In some cases the answer is quite obvious, for example when risk leads with certainty to harm or when the risk partly materialised. Equally risk that forces people to take steps that might harm them, just to avoid the consequences of that risk, can be subject of a tort claim.¹¹⁹⁵

But risk is per definition not material. It is an abstract concept that can be categorized on a scale from leading to no actual damage up to fully materialised damage. Risk in itself is unquantifiable.

The concept thus leads to discussions. Opinions differ on the question if risk should be compensatable¹¹⁹⁶ and in what circumstance that should be the case. In this chapter two theories of risk are analysed, since the appreciation of risk frequently depends on the preferred objectives of tort. The second chapter describes risk in litigation and is thus more focussed on pragmatic solutions. The

¹¹⁹¹ *Ayers versus Jackson Township*, 525 A.2d 287 (Supreme Court of New Jersey May 07, 1987), pp. 597-598.

¹¹⁹² *Ayers versus Jackson Township*, 525 A.2d 287 (Supreme Court of New Jersey May 07, 1987), p. 598.

¹¹⁹³ *Ayers versus Jackson Township*, 525 A.2d 287 (Supreme Court of New Jersey May 07, 1987), pp. 597-598.

¹¹⁹⁴ CANE, P. (1997). *The anatomy of tort law*. Oxford: Hart Publishing, p 37

¹¹⁹⁵ OBERDIEK, J. (2012). *The moral significance of risking*. *Legal Theory*, p. 339.

¹¹⁹⁶ The Principles, Definitions and Model Rules of European Private Law (the DCFR) are not in agreement what term should be used: 'compensable' or 'compensatable' to describe a type of harm or condition for which compensation could be obtained. I opt for compensatable.

third chapter of this part analyses risk in relation to probability. The analysis is linked to the objectives of tort.

4.2. The theories of risk

Risk imposition is not necessarily wrong. Some risk impositions are permissible. The conclusion that a risk leads to liability is for the court to make. In daily life it is, for example, hard to understand that an action without material impact, *id est* the creation of a risk, could be tortious.¹¹⁹⁷ As well is it difficult to understand that some risky behaviour is not tortious, like emitting chemicals as allowed by a valid permit, but, despite the adherence to the limit of the permit, neighbours are harmed by the emissions.

However the role of risk leads to differences in opinion and discussions amongst scholars and legal practitioners.

Some academics argue that the creation of a risk should be a basis for liability. They claim that accepting pure risk claims supports the objectives of tort law. These objectives as defined by corrective justice and law and economics would be better served if toxic tort would be based on risk rather than on physical harm.¹¹⁹⁸ Since some quantification or observation of the risk is necessary before the court can assess it, the imposition of a significant risk of disease is then considered an invasion of the personal autonomy.¹¹⁹⁹

On the other hand, some use similar arguments against risk as damage. Tort is about personal injury and more particularly about physical damage.¹²⁰⁰ If someone created a danger he should be liable if that danger materialises and not for the creation of the risk. Another theory claims that one who benefits

¹¹⁹⁷ OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, p. 342.

¹¹⁹⁸ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, p. 1681; SCHROEDER, C. (1990, February). Corrective justice and liability for increasing risks. *UCLA Law Review*, pp. 451-469; ROBINSON, G. (1985, Vol. 14). Probabilistic causation and compensation for tortious risk. *Journal of Legal Studies*, pp. 779-800; LANDES, W., & POSNER, R. (1984, Vol. 13). Tort law as a regulatory regime for catastrophic personal injuries. *Journal of Legal Studies*, pp. 417-436.

¹¹⁹⁹ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, p. 1681.

¹²⁰⁰ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, p. 1681-1682; PROSSER, W., KEETON, R., DOBBS, D., & OWEN, D. (1984). *Prosser and Keeton on the law of torts*. St. Paul: West Publishing Co., p. 360; WEINRIB, E. (1983, April). Toward a Moral Theory of Negligence Law. *Law and Philosophy*, pp. 37-62.

from an activity should bear the risk. Roughly the first approach is oriented on economic aspects (deterrence and cost efficiency), whilst the second is more linked to corrective justice and individual fairness.

4.2.1 Law and economics: the *ex ante* risk appreciation

In essence the question to be answered is if risk exposure should be recognized as legal harm (in certain types of cases).¹²⁰¹ Accepting risk as a cause of action in tort fits the economic theory on the basis that liability should be put on the party who is best situated to avoid risk creation.¹²⁰² Risks are subject to liability if they breach an applicable written rule or a 'customary *ex ante* standard'.¹²⁰³ Imposing liability on risk creators gives them an incentive to reduce the creation of risk in a cost efficient manner.¹²⁰⁴ The risk creator is then held liable for failing to take efficient precautions. The *ex ante* standards of fault liability protect against unacceptable risks.¹²⁰⁵ Being held liable for risk creation would thus support the deterrence objective.¹²⁰⁶ Risk creation per definition occurs before the materialisation and precautions have to be taken in an early phase.

From the foregoing it is already apparent that wrongfulness in tort claims based on risk is appreciated *ex ante*, namely before the occurrence of damage. This is different in standard tort, where the damage is assessed after its materialisation. Clearly the *ex ante* appreciation of risk creates some challenges: how to observe, quantify and assess the potential damage. Risk is abstract and is not wrongful in itself. Since claims in tort aim at restoring the plaintiff in his former state, risk should have materialised before it can be classified as wrong

¹²⁰¹ WRIGHT, R. (1987). The Efficiency Theory of causation and responsibility: unscientific formalism and false semantics. *Chicago-Kent Law Review*, pp. 553-578.

¹²⁰² CANE, P. (2013). *Atiyah's Accidents, Compensation and the Law*. Cambridge: Cambridge University Press, p. 414.

¹²⁰³ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 278.

¹²⁰⁴ LANDES, W., & POSNER, R. (1987). *The economic structure of tort law*. Cambridge, Massachusetts and London: Harvard University Press.

¹²⁰⁵ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 368.

¹²⁰⁶ SCHEUERMAN, S. (2012, Spring). Against liability for private risk-exposure. *Harvard Journal of Law & Public Policy*, p. 729.

or acceptable.¹²⁰⁷ The evaluation of risks happens *ex post*.¹²⁰⁸ Risk creation can be qualified as tortious, depending on the materialisation of the risk resulting in legal harm.¹²⁰⁹

Even if material harm occurred, it is not always clear if that damage occurred because of the defendant's negligent creation of a risk. Or, as regularly is the case in toxic tort, it is impossible to determine whether the damage is the result of the creation of the risk. Economic theorists solve this issue by using probabilistic causation, namely risk assessment based on probability. They also argue that when mere exposure to risk, thus without tangible harm, leads to fear, this fear is a welfare cost to society. Consequently liability for such fear can be granted, even when the damage is caused by the personal risk perception of the plaintiff.

Not everybody agrees with the requirement that risk should in one way or another materialise. It is argued that a negligent actor makes an unjust gain when he fails to prevent an unreasonable risk. Under the economic doctrine of law all cost-justified precautions should be taken.¹²¹⁰ Failing to meet to do so a defendant is liable for creating the risk whether or not the risk results in harm.¹²¹¹

In line with the objective of efficiency again probabilistic causation is used to assign liability.¹²¹² When the act of the defendant did not increase *ex ante* the

¹²⁰⁷ PERRY, S. (2001). Responsibility for Outcomes, Risk, and the Law of Torts. In G. J. POSTEMA, *Philosophy and the Law of Torts* (pp. 72-130). Cambridge: Cambridge University Press, p. 119.

¹²⁰⁸ BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, p. 278.

¹²⁰⁹ PERRY, S. (2001). Responsibility for Outcomes, Risk, and the Law of Torts. In G. J. POSTEMA, *Philosophy and the Law of Torts* (pp. 72-130). Cambridge: Cambridge University Press, p. 119.

¹²¹⁰ KRESS, K. (2001). The seriousness of harm thesis for abnormally dangerous activities. In D. OWEN, *Philosophical foundations of tort law* (pp. 277-298). Oxford: Oxford University Press, p. 281.

¹²¹¹ WEINRIB, E. (1987, Vol. 63). Causation and wrongdoing. *Chicago-Kent Law Review*, p. 516; COLEMAN, J. (1982, Vol. 11). Corrective justice and wrongful gain. *Journal of Legal Studies*, p. 421.

¹²¹² SCHWARTZ, A. (1987, Vol. 63). Causation in private tort law: a comment on Kelman. *Chicago-Kent Law Review*, pp. 644-647; LANDES, W., & POSNER, R. (1983, January). Causation in tort law: an economic approach. *Journal of Legal Studies*, pp. 121-124.

probability of that harm, the economic theory would not hold this defendant liable.¹²¹³

Liability results in the obligation to compensate the plaintiff, but how to calculate the value of a risk exposure? The economic theory suggests that the value of the created risk is the sum of the cost of the prevention and the expected harm. Thereby the harm is to be understood as the magnitude of the expected damage multiplied by the probability that the damage occurs.¹²¹⁴

4.2.2 Moral responsibility and risk

Another attempt to clarify the connection between the objectives of tort and the role of risk in tort is the Kantian social contract theory. Following that doctrine free and equal persons cooperate in such a way that freedom and equality are safeguarded, whilst also recognizing the diversity in conceptions of the good.¹²¹⁵ Tort law supports this ideal. The creation of risks is consequently a by-product of beneficial activities.¹²¹⁶ Tort law per definition focuses on the negative side of risk, namely those (aspects of) risks that threaten wellbeing. In view of the equality of people, everyone is entitled to create some risk, and should at the same time accept to have some risk imposed on him if he wants the benefit from the imposition of the risk.¹²¹⁷ When that balance is distorted, and the wellbeing of the persons on whom the risk was imposed is in peril, fairness is lost. The former leads to the conclusion that interpersonal risk is fundamentally a matter of fairness, not a matter of efficiency.¹²¹⁸

¹²¹³ LANDES, W., & POSNER, R. (1987). *The economic structure of tort law*. Cambridge, Massachusetts and London: Harvard University Press, p. 119.

¹²¹⁴ GRADY, M. (1983, April). A new positive economic theory of negligence. *Yale Law Journal*, p. 372.

¹²¹⁵ KEATING, G. (2001). A social contract conception of the tort law of accidents. In G. POSTEMA, *Philosophy and the law of torts* (pp. 22-71). New York: Cambridge University Press, p. 27.

¹²¹⁶ KEATING, G. (2001). A social contract conception of the tort law of accidents. In G. POSTEMA, *Philosophy and the law of torts* (pp. 22-71). New York: Cambridge University Press, p. 27.

¹²¹⁷ KEATING, G. (2001). A social contract conception of the tort law of accidents. In G. POSTEMA, *Philosophy and the law of torts* (pp. 22-71). New York: Cambridge University Press, p. 27-30.

¹²¹⁸ KEATING, G. (2008, Vol. 37). The heroic enterprise of the asbestos cases. *Southwestern University Law Review*, p. 30.

But are all risks equal or similar? How to assess risk, which is in essence abstract and unquantifiable? The distinction between objective and epistemic risk is a method to answer the former question.

4.2.2.1 Objective risk and epistemic risk

By now it is clear that risk is an important topic in toxic tort law. Thereby it is, according to corrective justice scholars, important to distinguish two conceptions of risk.¹²¹⁹ These two concepts are (1) objective and (2) epistemic risk.

Objective risk is based on the standard relative frequency account of probability. It exists regardless of knowing if the risk will materialise or not. Liability for damage that is caused by the creation of an objective risk is independent of foreseeability.¹²²⁰ The fact that one caused the harm is sufficient. Objective risks lead to absolute liability.

Objective risk cannot be directly observed. It cannot be proved that it exists. Thus epistemic risk assessment is necessary in order to gain a best estimate of objective risk. Epistemic risk is the basis of evidence whereupon judgements of relative frequency can be made.¹²²¹

Moral responsibility for the consequences of creating risk is responsibility for the physical harm, if any, that materialises. It is not responsibility for the creation of the risk in itself.¹²²² Attribution of the responsibility is only possible if the damage resulting from the risk creation was foreseeable. Foreseeability is based on knowledge of the probability that a risk creation will lead to harm. One should have known that creating the risk could lead to damage for the victim. The fact that we can only assess the consequences of risk as a probability, is another argument that objective risk is not knowable. Indeed the sample group with which the damage in an individual case is compared is never exactly the

¹²¹⁹ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, p. 345.

¹²²⁰ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, p. 340.

¹²²¹ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, pp. 332-333.

¹²²² PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, p. 345.

same.¹²²³ A best estimate of the objective risk is what we have to rely on. That estimate is epistemic risk.¹²²⁴

The case of *Hotson*¹²²⁵ can be used as an example. The plaintiff suffered an injury, which the health authority misdiagnosed. Five days later the diagnosis was corrected and the plaintiff was treated. However the plaintiff developed a serious disabling condition, which could have been caused by the injury or by the misdiagnosis leading to a delay of five days before starting treatment. At the time of arrival at the hospital there was a 75 % risk that the disabling condition would not have been avoided despite proper treatment. The misdiagnosis brought the probability of damage up to 100 %, because at the end of the five day period without treatment, the occurrence of the condition was inevitable.

Thus the misdiagnosis counted for 25% increase in risk (loss of chance). Meaning that when the damage materializes it is 25 % probable that it was caused by the misdiagnosis. In such cases it is important to know what the antecedent risk was. The additional risk created by the negligent act is independent of the fact whether the physical damage materialized. In some situations a tort claim could then be filed regardless the absence or presence of physical harm, on condition the risk has not ended (through its materialisation or disappearance).¹²²⁶ In the *Hotson* case the increase in risk caused by the misdiagnosis was in itself damage.

The probabilities are objective in relation to the sample group they are based on. However, transferring the probabilities to an individual case they becomes relative, since there exist always differences between the individual and the average person representing the sample group. On the basis of this reasoning, the conclusion follows that risk damage `cannot constitute an interest of the kind

¹²²³ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press p. 333-334.

¹²²⁴ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press pp. 332-333.

¹²²⁵ *Hotson versus East Berkshire Health Authority*, [1987] A.C. 750 (House of Lords July 2, 1987).

¹²²⁶ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press p. 331

tort law is concerned to protect.¹²²⁷ There is only one situation where risk liability is acceptable, namely if the causal process is deterministic.¹²²⁸

Risk is an estimation and is epistemic, not objective. The inability to observe objective risk is an issue in tort, because only objective risk can be 'thought to constitute a form of damage'.¹²²⁹ Consequently risk as we can know it, is not damage and tort is about damage.

4.2.2.2 Categories of risk

When studying the morality of risk imposition, some categories can be detected.¹²³⁰ One category concerns subjecting another person to risk that will materialise into harm. Quite similar is the situation whereby a person has to take disruptive steps in order to avoid the risk to materialise. Another class of risks are those that cause damage different from the one that normally would follow, such as fear, depression, emotional disturbance. In reality these risks cause some observable harm or damage and can in principle be the subject of a liability claim. These situations call for moral evaluation and justification, since their relation with the imposition of risk is only indirect.¹²³¹

The third category consists of 'pure' risk. These risk impositions do not result in harm. Do these risks then bear any moral significance? The fact that an action creates a risk might not be a morally relevant feature. If creating a risk is morally significant in itself it can be a wrong.¹²³² According to Schroeder, holding a defendant liable for risk exposure is not against the theory of corrective justice. A person can be held liable if he was able to control and predict *ex ante* whether his acts will subject him to liability.¹²³³ Then liability is linked to the risk

¹²²⁷ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press p. 330-336.

¹²²⁸ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press p. 336-339.

¹²²⁹ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, pp. 332-333.

¹²³⁰ OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, pp. 339-340.

¹²³¹ OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, pp. 339-340.

¹²³² OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, p. 341.

¹²³³ SCHROEDER, C. (1990, February). Corrective justice and liability for increasing risks. *UCLA Law Review*, p. 154.

exposure rather than to the damage, since it must be proven that the risk the defendant created is the origin of the manifested harm.¹²³⁴

Wrongful risk creation is a breach of the duty of care, when it resulted in harm to the plaintiff.¹²³⁵ Materialisation of the risk is necessary. One should not make the mistake to confuse causation (as the link between the risk creation and the harm), with the pure creation of an increased risk.¹²³⁶

4.3. Risk in practice

One might now ask the question, why the possibility of risk as a specific basis for action in tort should *überhaupt* be discussed. All activity creates some risk. Not all of these risks are unacceptable. Therefore it is important to note that the concept of 'risk' in this text refers to risk on top of the normal risks of daily life. But still, is such (increased) risk a cause of action in tort?

Before going further into concrete cases it seems useful to repeat briefly the difference between risk and hazard as it is relevant in relation to exposure.¹²³⁷

Risk is the likelihood of harm, whilst hazard is the potential to cause harm. Thus a chemical can be hazardous without causing a risk. The hazardousness of a chemical is a characteristic or property of the substance. A chemical only creates a risk when it is in a situation that could lead to damage. Liability is related to risk, not to hazard. Legislation on the other hand focuses on both, but is mainly implemented for hazardous substances.

Another remark concerns strict liability versus standard toxic tort.

The risk chemicals pose is frequently dealt with through strict liability.¹²³⁸ Strict liability is frequently called risk liability, because of its focus on risk.¹²³⁹ The

¹²³⁴ WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1073.

¹²³⁵ WEINRIB, E. (1989, Vol. 23). Understanding tort law. *Valparaiso University Law Review*, p 520.

¹²³⁶ WRIGHT, R. (1987). The Efficiency Theory of causation and responsibility: unscientific formalism and false semantics. *Chicago-Kent Law Review*, p. 558.

¹²³⁷ See also paragraph 1.1.5 of the introduction.

¹²³⁸ See chapter 2.4.

¹²³⁹ For example: RIJNHOUT, R., ENGELHARD, E., GIESEN, I., & e.a. (2013, April 8). *Beweging in het aansprakelijkheidsrecht. Nederlands Tijdschrift voor Burgerlijk Recht*, pp. 20-41; BERGKAMP, L. (2001). *Liability and Environment: Private and Public Law Aspects of Civil Liability for Environmental Harm in an International Context*. The Hague: Kluwer Law International, pp.119 & 122.

main difference with standard liability is the absence of the fault requirement. Strict liability is based on damage, on a causal link between the act of the alleged tortfeasor and the damage, and on the responsibility of the custodian/user of the substances/products to prevent damages. It is thus not a liability for risk.¹²⁴⁰

The following paragraphs are valid for standard toxic tort and various strict liabilities. The different aspects of liability involving risk are related to the presence or absence of physical damage, the emotional consequences of exposure and the creative solutions plaintiffs and courts have found to address the difficulties related to risk and the objectives of tort.

4.3.1 Risk and physical injury

Traditionally courts only award compensation for harm that actually occurred.¹²⁴¹ Risk does not meet these requirements. First it is an abstract concept that can materialise or not.¹²⁴² Secondly, risk alone does not create any damage; it does not place the exposed person in a worse position.¹²⁴³

Chemical liability, more often than other tort, leads to claims for risk. Victims of exposure to toxic substances sue for damage even when they do not have symptoms, but expect a disease or an injury to occur (many) years later.¹²⁴⁴

Courts have conditionally accepted cause of action for risk. Claims for medical monitoring, for mental distress and/or for increased risk with or without the presence of physical harm are used to get recovery from exposure to toxic

¹²⁴⁰ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 7694.

¹²⁴¹ HANDFIELD, T., & PISCIOTTA, T. (2005, Vol. 11 Issue 4). Is the Risk-Liability Theory compatible with negligence law? *Legal Theory*, p. 391; LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1413; HARTKAMP, A., & SIEBURGH, C. (2012). Asser 6-II De verbintenissen in het algemeen: 142 Art. 6:106 limitatief aantal gevallen. Kluwer; MARTIN-CASALS, M. (2009). Introduction to the Annotations to Johnston v. NEI International Combustion Ltd. *European Review of Private Law*, pp. 177-247.

¹²⁴² PERRY, S. (1992, Vol. 42). Protected interests and undertakings in the law of negligence. *University of Toronto Law Review*.

¹²⁴³ SCHEUERMAN, S. (2012, Spring). Against liability for private risk-exposure. *Harvard Journal of Law & Public Policy*, pp. 717-718.

¹²⁴⁴ CHURCHILL, M. (2013, November). Toxic Torts: Proof of Medical Monitoring Damages for Exposure to Toxic Substances. *American Jurisprudence Proof of Facts*. Proof of Facts, § 3. Law of toxic torts—Present and future disease claims.

substances.¹²⁴⁵

4.3.1.1 'Innocent' physical changes after exposure

Some light or 'harmless' bodily changes can be present after exposure to a noxious substance. These changes can be the onset of a future disease or an injury, but is that a sufficient basis for a claim in tort?

a) The Common Law countries

In the 1980s UK judges accepted that asbestos passing through the lungs of the plaintiff and causing pleural plaques was damage.¹²⁴⁶ Judge Otten expressed it as follows:

"there has been a definite change in the structure of the pleura due to the presence of the asbestos. In my judgment that amounts to a significant and definite degree of damage which entitled the Plaintiff to compensation as he has established actual damage ... he is entitled to be compensated not only for the physical damage ... but also for the aspect of anxiety which seems to me to have a connection with physical damage, to be entirely genuine and thoroughly understandable in a person who has worked in such conditions and has known his workmates to die in the circumstances that he has described. I have also come to the conclusion that he is entitled to be compensated for the risks of lung cancer and mesothelioma."¹²⁴⁷

In 1987 the court dealing with *Patterson versus Ministry of Defence* concluded that neither the presence of pleural plaques, neither the anxiety caused by this presence were actionable by themselves, but together they were.¹²⁴⁸ After these decisions, pleural plaques were regularly accepted as actionable injuries.

¹²⁴⁵ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, fn. 19; ABRAHAM, K. (2002, December). Liability for medical monitoring and the problem of limits. *Virginia Law Review*, pp. 1975-194.

¹²⁴⁶ *Patterson versus Ministry of Defence*, [1987] C.L.Y. 1194 (Queens Bench Division July 29, 1986); *Sykes versus Ministry of Defense*, 134 N.L.J. 623 (Queen's Bench Division March 19, 1984); *Church versus Ministry of Defence*, 134 N.L.J. 623 (Queens Bench Division February 23, 1984).

¹²⁴⁷ *Sykes versus Ministry of Defense*, 134 N.L.J. 623 (Queen's Bench Division March 19, 1984).

¹²⁴⁸ *Patterson versus Ministry of Defence*, [1987] C.L.Y. 1194 (Queens Bench Division July 29, 1986).

Then in 2007 the House of Lords changed the approach. Four cases¹²⁴⁹ were brought together for analysis by their Lordships. Their final conclusion was: when there is no damage, a claim for liability cannot be granted.¹²⁵⁰ A victim should suffer damage and damage equals being worse off. Pleural plaques are fibrous thickening of the lung membrane and they cause no symptoms.¹²⁵¹ Neither will they ever be at the basis of any other diseases related to asbestos. The plaques do prove the exposure to asbestos, but 'damage' *stricto sensu* is not present. In *Grieves* the House of Lords stated that a claim in tort is incomplete without proof of damage¹²⁵² and damage is the abstract concept of being worse off.¹²⁵³ Lord Hoffmann described as follows:

"It was not merely that the plaques caused no immediate symptoms. ... The important point was that, save in the most exceptional case, the plaques would never cause any symptoms, did not increase the susceptibility of the claimants to other diseases or shorten their expectation of life. They had no effect upon their health at all."¹²⁵⁴

There should be damage before a claim can be granted. The discussion is not about the principle, but about the classification of what should be regarded as damage and when a victim is 'worse off'.

Also in the US the inhalation of asbestos fibres and the mere possibility of developing a malign disease thereafter is not sufficient.

¹²⁴⁹ The four cases were: *Grieves versus FT Everard & Sons*; *Johnston versus NEI International combustion Limited*; *Rothwell versus Chemical and Insulating Company Limited*; *Topping versus Benchtown Limited*. Further referred to as '*Grieves*'.

¹²⁵⁰ Lord Hoffmann in *Grieves and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007).

¹²⁵¹ Except in rare cases, psychiatric illness does constitute damage for the purpose of founding an action in negligence: *Grieves and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007); *Group B Plaintiffs versus Medical Research Council*, 1997 WL 1105445 (Queen's Bench Division December 18, 1997); *Page versus Smith*, [1996] 2 W.L.R. 644 (House of Lords May 11, 1995).

¹²⁵² *Rothwell v Chemical & Insulating Co Ltd. and another*, [2008] 1 A.C. 281 (House of Lords June 25, 2007).

¹²⁵³ Damage is in the UK physical or economical. In the US compensation for economic loss is dealt with separately.

¹²⁵⁴ *Rothwell v Chemical & Insulating Co Ltd. and another*, [2008] 1 A.C. 281 (House of Lords June 25, 2007).

“[A] person who is placed in peril by the negligence of another, but who escapes without injury, may not recover damages simply because he has been placed in a perilous position.”¹²⁵⁵

If there is no physical injury, recovery is not granted.¹²⁵⁶

The US courts motivate the requirement for physical injury being that what puts the plaintiff in a worse situation than before, with three reasons: (1) it is especially difficult for courts to separate valid, important claims from those that are invalid or ‘trivial’; (2) granting claims without physical injury leads to a threat of ‘unlimited and unpredictable liability’; (3) the ‘potential for a flood of trivial claims’ is present.¹²⁵⁷

However, there are courts that have granted exceptions to the principle that risk should have materialised. This happened in cases where a substantial and unreasonable risk of death or personal injury was created.¹²⁵⁸ The motivation for such an exception can be (for example) the willingness to correct dangerous situations before tragedy results.¹²⁵⁹

b) Continental law in the Netherlands and France

i) The Netherlands

Like in the Common Law system, the general rule in the Continental Law countries is that a claim cannot be submitted before the subject of the claim is real.¹²⁶⁰

In the Netherlands a risk should have materialised before a liability claim can be made. Innocent bodily changes are not sufficient.¹²⁶¹ However, when a victim

¹²⁵⁵ Temple-Inland Products Corporation versus Martin Reeves Carter, 993 S.W.2d 88 (Supreme Court of Texas April 29, 1999) , p 91; City of Tyler versus Likes, 962 S.W.2d 489 (Supreme Court of Texas December 11, 1997),p. 500.

¹²⁵⁶ Metro-North Commuter R. Co. versus Buckley, 521 U.S. 424 (Supreme Court of the United States June 23, 1997), p. 2119.

¹²⁵⁷ Metro-North Commuter R. Co. versus Buckley, 521 U.S. 424 (Supreme Court of the United States June 23, 1997), p. 2119.

¹²⁵⁸ Kumho Tire Co., Ltd. versus Carmichael, 526 U.S. 137 (Supreme Court of the United States December 6, 1999); U.S. Gypsum Co. versus Mayor and City Council of Baltimore, 647 A.2d 405 (Court of Appeals of Maryland September 12, 1994).

¹²⁵⁹ Lloyd versus General Motors Corp., 916 A.2d 257 (Court of Appeals of Maryland February 8, 2007); Ayers versus Jackson Township, 525 A.2d 287 (Supreme Court of New Jersey May 07, 1987).

¹²⁶⁰ DE KEZEL, E. (2013). *Asbest, gezondheid en veiligheid*. Antwerpen, Cambridge: Intersentia, p. 352.

immediately goes to court, the possibility exists to safeguard a right on compensation when damage after exposure has not yet materialised. The defendant is then held liable for future damage.¹²⁶²

ii) France

In France, it is equally clear that a risk in itself can never be a recoverable damage (*préjudice réparable*).¹²⁶³ The former is regularly confirmed by the Court of Cassation.¹²⁶⁴

The question whether risk is a cause of action, is considered only relevant when the risk is such that, if the damage materialises, it will be serious. The concept of serious risk is thereby interpreted in a flexible manner. For example if a professional fails to subscribe the legally required insurance, and consequently the plaintiff is required to take on an insurance by himself, paying for that insurance is considered damage regardless of the fact if the risk materialised or not.¹²⁶⁵

Moreover, a distinction is made between virtual damage and potential damage. Virtual damage in fact already exists because all conditions for materialisation of the risk are present.¹²⁶⁶ For example: an infection with a virus is considered damage. Even if the virus is not yet active, it is certain that at a certain time physical damage will occur.¹²⁶⁷ The risk is in such situations certain enough to require actions to be taken.

Potential damage, on the contrary, still needs to come true. It is not certain that it will materialise and the evaluation is depending on probability.¹²⁶⁸ The judge

¹²⁶¹ SOBCZAK, F., TOWNEND, D., & VAN MAANEN, G. (2009). Introduction to the Annotations to Johnston versus NEI International Combustion Ltd - Dutch case note. *European Review of Private Law*, pp. 207-217.

¹²⁶² "Bindende verklaring van aansprakelijkheid" in DE KEZEL, E. (2013). *Asbest, gezondheid en veiligheid*. Antwerpen, Cambridge: Intersentia, p. 353. See also Hoge Raad, 30 March 1951, *Nederlandse Jurisprudentie* 1952/29.

¹²⁶³ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1413.

¹²⁶⁴ Cour de Cassation Civile (1re chambre), 27 March 2001, *Juris-Classeur Périodique* 2002.II.10089 ; Cour de Cassation Civile (1re chambre), 16 June 1998, *Bulletin Civile* 1998.I.216.

¹²⁶⁵ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1413.

¹²⁶⁶ PRIGENT, S. (2005, July 11). Prévention d'un risque d'incendie et réparation d'une gêne esthétique. *L'Actualité juridique: Droit immobilier*, p. 593 ff.

¹²⁶⁷ Cour de Cassation 9 July 1996, *Bulletin Civile*.I.106.

¹²⁶⁸ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1414.

will have to decide on the basis of the factual situation. The Court of Cassation can audit the certainty of the materialisation of the risk and has used this authority to squash cases where the damage was uncertain.¹²⁶⁹

The aspect of risk without physical damage is discussed in the following paragraph.

4.3.1.2 Nothing but risk

If risk should be considered a valid cause of action in tort, then it could be defined as:

“[a]n increased or enhanced risk of future disease claim seeks damages because the plaintiff contends that the unquantified injury to health and life expectancy should be presently compensatable, even though no evidence of disease is present.”¹²⁷⁰

Notwithstanding the former, opinions continue to differ whether risk should in itself be considered harm. A number of scholars argue that risk of physical harm is in itself a form of damage.¹²⁷¹ Some argue that risk should be compensatable in the absence of physical harm.¹²⁷² Still, in principle neither the risk for future damage nor the anxiety for future disease are a basis for tortious liability.¹²⁷³ The duty of care is to avoid causing harm and not a duty to avoid conduct that could or will increase risk of causing harm.¹²⁷⁴ Given the fact that tort law compensates only if the plaintiff is materially worse off than it would have been

¹²⁶⁹ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1416.

¹²⁷⁰ PENOFKY, D. J. (2012, May). Asbestos Injury Litigation. *American Jurisprudence*, AMJUR trials, p. 73.

¹²⁷¹ LANDES, W., & POSNER, R. (1987). *The economic structure of tort law*. Cambridge, Massachusetts and London: Harvard University Press, p. 263; WRIGHT, R. (1985, Vol. 73). Causation in tort law. *California Law Review*, pp. 1814-1816; Hotson versus East Berkshire Health Authority, [1987] A.C. 750 (House of Lords July 2, 1987); Herskovits versus Group Health Cooperative of Puget Sound, 664 P.2d 474 (Supreme Court of Washington, En Banc May 26, 1983).

¹²⁷² SCHROEDER, C. (1990, February). Corrective justice and liability for increasing risks. *UCLA Law Review*, pp. 439-474; SIMONS, K. (1990, October). Corrective justice and liability for risk creation. *UCLA Law Review*, pp. 113-138.

¹²⁷³ Gregg versus Scott, [2005] WL 62248 (House of Lords January 27, 2005).

¹²⁷⁴ DESAI, P. (2011, vol. 38). Donovan versus Philip Morris USA, Inc.: the best approach to satisfying the injury requirement in medical monitoring claims. *Boston College Environmental Affairs Law Review*, p. 101-102.

in the absence of tortious behaviour, tort law cannot deal with (pure) risk as damage.¹²⁷⁵

Still liability for pure risk creation, as assessed post-exposure without resulting in certainty about the damage to occur, is not without debate. Risky conduct diminishes the autonomy of those exposed to it, because it forecloses available options.¹²⁷⁶ Consequently imposing risk can be wrongful, if the risk is morally impermissible.¹²⁷⁷

As said before, risk has a number of characteristics that makes it difficult to pursue liability. Since it is rare that a causal link between an exposure to a toxic chemical and harm is at once or directly observable, even when that chemical is knowingly hazardous, an action in tort is difficult when risk claims are excluded.¹²⁷⁸ Long latency periods, problems with establishing toxicity and lack or slow gathering of (scientific) knowledge about the aetiology of the related diseases make many of the toxic tort cases a real challenge.

The abstractness of risk makes it physically unobservable and difficult to quantify. Thereby it is not even sure that a risk will materialise; most risks never do. Still, in view of the frequent exposure of people to toxic substances, the risks created by these toxins call for increased prevention and early detection of damage and of potential diseases.

a) The Common Law

After Hagerty was drenched with dripolene, a chemical containing benzene, toluene and xyolene, he filed a claim for damages including pain and suffering, mental anguish due to fear of developing cancer, and medical expenses of regular check-ups to monitor against that disease.¹²⁷⁹ The US court stated that:

“A tortious cause of action accrues when the victim suffers harm caused by the defendant's wrong. The injury or harm may occur simultaneously with the tortious conduct in the case of a traumatic event or the injury

¹²⁷⁵ OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, pp. 349-350.

¹²⁷⁶ OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, p. 356.

¹²⁷⁷ OBERDIEK, J. (2012). The moral significance of risking. *Legal Theory*, p. 356.

¹²⁷⁸ Some actions are possible: see the exceptions mentioned in paragraph 4.3.1.1 (seriousness of the risk and certainty that damage will occur) and paragraph 4.3.3 (medical monitoring and the like).

¹²⁷⁹ *Hagerty versus L & L Marine Services, Inc.*, 788 F.2d 315 (United States Court of Appeals, Fifth Circuit April 30, 1986).

may be latent and not manifested and discovered until some later date.”¹²⁸⁰

Hagerty presented sufficient indicia supporting his mental distress caused by his fear for cancer. Consequently reasonable costs for medical check-ups were granted. The claim for increased risk was denied.¹²⁸¹

If it is uncertain that the risk will materialise and what the magnitude of the future damage will be, tort remains difficult.¹²⁸² But, when submitting a claim for personal injury is the only available method for compensation, denying this recourse equals requiring plaintiffs to run the risk on materialisation and to potentially suffer serious harm.¹²⁸³ Considering the former, some courts believe that granting recovery for risk is correct both from an economic and a corrective justice viewpoint. A person acts efficiently and fair when attempting to avoid risks of injury to others, rather than waiting for an injury to develop.¹²⁸⁴ Omitting to act with care is wrongful. Additionally, the damages, if incurred, and their related costs would in most cases be higher than the costs of an action based on risk.¹²⁸⁵ In other words a plaintiff should not have to wait for a harm to materialise in order to recover.¹²⁸⁶

Two young American women whose mothers had taken DES filed a tort claim. Neither had developed cancer or any precancerous conditions at that time, but both alleged that they were entitled to damages as a result of their fear of developing cancer in the future. It was not proved that the disease was reasonably certain to develop, but the court ruled for the plaintiffs with following

¹²⁸⁰ Hagerty versus L & L Marine Services, Inc., 788 F.2d 315 (United States Court of Appeals, Fifth Circuit April 30, 1986).

¹²⁸¹ Hagerty versus L & L Marine Services, Inc., 788 F.2d 315 (United States Court of Appeals, Fifth Circuit April 30, 1986).

¹²⁸² VANDALL, F., WERTHEIMER, E., & RAHDERT, M. (2003). *Torts: cases and problems*. Newark: LexisNexis.

¹²⁸³ U.S. Gypsum Co. versus Mayor and City Council of Baltimore, 647 A.2d 405 (Court of Appeals of Maryland September 12, 1994); 80 South Eighth Street Ltd. Partnership versus Carey-Canada, Inc., 486 N.W.2d 393 (Supreme Court of Minnesota September 11, 1992).

¹²⁸⁴ 80 South Eighth Street Ltd. Partnership versus Carey-Canada, Inc., 486 N.W.2d 393 (Supreme Court of Minnesota September 11, 1992).

¹²⁸⁵ Lloyd versus General Motors Corp., 916 A.2d 257 (Court of Appeals of Maryland February 8, 2007); Council of Co-Owners Atlantis Condominium, Inc. versus Whiting-Turner Contracting Co., 517 A.2d at 343 (Court of Appeals of Maryland November 14, 1986).

¹²⁸⁶ Lloyd versus General Motors Corp., 916 A.2d 257 (Court of Appeals of Maryland February 8, 2007); 80 South Eighth Street Ltd. Partnership versus Carey-Canada, Inc., 486 N.W.2d 393 (Supreme Court of Minnesota September 11, 1992).

arguments:

“Neither reasonable certainty nor present injury is required. As for ‘reasonable certainty,’ such a stringent requirement would distort traditional notions of proximate cause. That concept's touchstone - reasonable foreseeability of the claimed injury (in this case emotional distress) - merely demands a reasonable fear, not a high degree of likelihood, that the feared contingency be likely to occur ... [F]ears of future injury can be reasonable even where the likelihood of such injury is relatively low.”¹²⁸⁷

The fact that a disease may be invisible to the naked eye or undetectable using traditional techniques, does not exclude the possibility that harm is present and ongoing. The damage is related to the risk, but is different from what would be expected, namely a physical injury. The topic of emotional damage is further elaborated in paragraph 4.3.2.

The evolution of scientific knowledge, particularly on the molecular level, continuously increases the ability to detect bodily changes. Consequently more and more physical changes after exposure to toxic substances can be observed. However, unless they are considered damage, these changes are not sufficient to grant a liability claim. Neither is the exposure in itself sufficient to support a claim for mental distress. Even the fact that the exposure was to a known carcinogenic does not make a difference.¹²⁸⁸ Recovery for mental anguish is only permitted if the event was so shocking and disturbing that the anxiety was foreseeable.¹²⁸⁹ In those situations the argument that a physical impact was required to ensure that the mental injury was not feigned, was abandoned.

Ingestion of a chemical is an event that meets the criteria of shocking or disturbing. The case of the Laxton family is an example. The defendant (Orkin Exterminating Company) sprayed the ground surrounding plaintiffs' house with chlordane and heptachlor against termites. Subsequently the plaintiffs observed that their water had a foul smell and taste. When samples were analysed it

¹²⁸⁷ *Wetherill versus University of Chicago*, 565 F. Supp. 1553 (United States District Court, N.D. Illinois, Eastern Division June 17, 1983).

¹²⁸⁸ *Temple-Inland Products Corporation versus Martin Reeves Carter*, 993 S.W.2d 88 (Supreme Court of Texas April 29, 1999), p 90-93.

¹²⁸⁹ *City of Tyler versus Likes*, 962 S.W.2d 489 (Supreme Court of Texas December 11, 1997); *Metro-North Commuter R. Co. versus Buckley*, 521 U.S. 424 (Supreme Court of the United States June 23, 1997)

became clear that the water was contaminated with said chemicals. The plaintiffs were advised to cease using it. After a period, a bit longer than a month, the water was declared safe. But approximately one year later, it again contained chlordane above the safety limits. The plaintiffs became very worried about their health and the health of their children. The anxiety did however not evidence in any physical manner. Despite the general rule that compensation is not granted for mental disturbance without physical harm, an exception was made. The fact that the plaintiffs ingested polluted water was considered a physical injury and thus sufficient to award recovery, although no physical harm was found after medical examination.¹²⁹⁰

In line with the reasoning in *Laxton versus Orkin (supra)*, courts also have accepted subcellular damage (like chromosome damage or to the immune system) as harm.¹²⁹¹ On the other hand, other courts have rejected this approach.¹²⁹²

The conclusion is thus that fear of future disease or injury can be sustained in court when certain factors are proved: (1) the exposure to the toxic substance, (2) the tortfeasor being legally responsible for the exposure, (3) the pain and suffering from emotional distress caused by the fear, (4) the proximity of the cause and (5) the reasonableness of the fear.¹²⁹³ As such, these cases are not about risk. They are deciding on the consequence of the tortious act that resulted in concrete damage. The fact that the damage is beyond the normal expectations on the effects of that tortious act is not relevant.

¹²⁹⁰ *Laxton versus Orkin Exterminating Company Inc.*, 639 S.W.2d 431 (Supreme Court of Tennessee September 13, 1982)

¹²⁹¹ *Donovan versus Philip Morris USA, Inc.*, 268 F.R.D. 1 (US District Court, D. Massachusetts June 24, 2010); *Barth versus Firestone Tire and Rubber Corporation*, 673 F.Supp. 1466 (United States District Court September 1, 1987)

¹²⁹² *Paz versus Brush Engineered Materials, Inc.*, 555 F.3d 383 (US Court of Appeals, Fifth Circuit January 13, 2009).

¹²⁹³ CHURCHILL, M. (2013, November). Toxic Torts: Proof of Medical Monitoring Damages for Exposure to Toxic Substances. *American Jurisprudence Proof of Facts*. Proof of Facts, § 3. Law of toxic torts—Present and future disease claims; *Parker versus Wellman*, 230 Fed. Appx. 878 (United States Court of Appeals, Eleventh Circuit April 18, 2007)

b) The Continental Law: the Netherlands and France

i) Netherlands

Damage has to be present. Risk alone is not sufficient.¹²⁹⁴ But in special circumstances extreme fear can lead to harm and that harm can be considered as damaging the person concerned.¹²⁹⁵ However the risk causing the fear needs to be substantial, reducing the uncertainty of the future damage. The actual damage is then the emotional harm as it is related to the chance for getting a disease.¹²⁹⁶ Damage can thus also be immaterial.

However, if the impact is innocuous, like with pleural plaques, there is no actual harm in the meaning of tort law. Consequently there is nothing to claim.¹²⁹⁷

When the potential damage is not certain or even not known, the sources of the risk should at least be managed following the existing norms as laid down in rules, permits, as well as the norms recognized as the 'state of industry'.¹²⁹⁸ *In concreto* an actor is obliged to respect the terms of his environmental permit, the common practices in his industry, etc. Omitting to take precautions can lead to liability once damage occurs. On the basis of article 6:106 of the Dutch Civil Code, attribution of the liability to the defendant is possible. Van Boom concludes that not only known risks should be taken into account. Defendants are also assessed on their pro-active stance. They should also actively investigate and gather knowledge, as well as research for safer, and better processes.¹²⁹⁹

Article 6:105 provides the opportunity to postpone the evaluation of damage which has not yet occurred.¹³⁰⁰ Meanwhile a defendant can be obliged to pay

¹²⁹⁴ HARTKAMP, A., & SIEBURGH, C. (2012). *Asser 6-II De verbintenis in het algemeen: 142 Art. 6:106 limitatief aantal gevallen*. Kluwer.

¹²⁹⁵ LINDENBERGH, S. (2013). Uiteenlopende oorzaken van geestelijk letsel. In GROENE SERIE, *Schadevergoeding* (p. § 27.2.3.). Den Haag: Kluwer.

¹²⁹⁶ SOBCZAK, F., TOWNEND, D., & VAN MAANEN, G. (2009). Introduction to the Annotations to Johnston versus NEI International Combustion Ltd - Dutch case note. *European Review of Private Law*, p. 214.

¹²⁹⁷ SOBCZAK, F., TOWNEND, D., & VAN MAANEN, G. (2009). Introduction to the Annotations to Johnston versus NEI International Combustion Ltd - Dutch case note. *European Review of Private Law*, p. 213.

¹²⁹⁸ VAN BOOM, W. (2001). Anticiperen op nieuwe gezondheidsrisico's. *Aansprakelijkheid, verzekering & risico*, p. 6-.

¹²⁹⁹ VAN BOOM, W. (2001). Anticiperen op nieuwe gezondheidsrisico's. *Aansprakelijkheid, verzekering & risico*, p. 3.

¹³⁰⁰ Art. 6:105 BW:

instalments. The decision can later on still be adjusted when circumstances arise that affect the liability and were not yet taken into account at the time of the trial.

ii) France

The existence of a risk can in itself lead to a determined, inalterable damage. To avoid the harm the potential victim will have some costs, regardless of the fact if the risk is physical or emotional.¹³⁰¹

Risk that most likely will lead to damage can in France be considered as actual economic or emotional damage.¹³⁰² This reasoning is used by trial courts in cases concerning serious risk. Le Tourneau doubts if this approach is correct, although he thinks it is defensible.¹³⁰³ However, it is clear that risk is never *per se* damage.¹³⁰⁴ There are risks in between the two extremes of certain and hypothetical. Courts believe that such risks, if very serious, cannot be ignored.

Le Tourneau concludes that, although the court decisions are still 'confused', the exposure to a serious risk likely leading to damage can be considered as actual economic or emotional damage to be evaluated by the judge.¹³⁰⁵

1. De begroting van nog niet ingetreden schade kan door de rechter geheel of gedeeltelijk worden uitgesteld of na afweging van goede en kwade kansen bij voorbaat geschieden. In het laatste geval kan de rechter de schuldenaar veroordelen, hetzij tot betaling van een bedrag ineens, hetzij tot betaling van periodiek uit te keren bedragen, al of niet met verplichting tot zekerheidstelling; deze veroordeling kan geschieden onder door de rechter te stellen voorwaarden. *The judge is allowed to postpone or do immediately the calculation of the damage that not yet materialised after he has assessed the probability. In such situation the judge can hold the defendant liable for the payment of a one-time lump sum or for periodical instalments.*

2. Voor zover de rechter de schuldenaar veroordeelt tot betaling van periodiek uit te keren bedragen, kan hij in zijn uitspraak bepalen dat deze op verzoek van elk van de partijen door de rechter die in eerste aanleg van de vordering tot schadevergoeding heeft kennis genomen, kan worden gewijzigd, indien zich na de uitspraak omstandigheden voordoen, die voor de omvang van de vergoedingsplicht van belang zijn en met de mogelijkheid van het intreden waarvan bij de vaststelling der bedragen geen rekening is gehouden. *If the judge has decided for periodic instalments, then he can put in his judgment the possibility that on demand of either party the arrangement can be altered, on condition the situation has changed in such a manner that there is an impact on the compensation for liability which was not taken into account when deciding on the amount of compensation.*

¹³⁰¹ LASSERRE, V. (2011). Le risque. *Recueil Dalloz*, p. 1632.

¹³⁰² For more information on risk that considered equal to damage, see paragraph 4.3.1.1, b), ii).

¹³⁰³ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1413.

¹³⁰⁴ Cour de Cassation (1re chambre) 27 March 2001, *Juris-Classeur périodique* 2002.II.100089; Cour de Cassation (1re chambre) 16 June 1998, *Dalloz* 1998/180.

¹³⁰⁵ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1413.

4.3.1.3 Subcellular damage

One of these scientific evolutions impacting toxic tort is the increased knowledge of the molecular level of life. Subcellular damage can be considered as physical changes to a body's cellular or molecular system.¹³⁰⁶ The injury can be caused by toxic exposure¹³⁰⁷ and the changes can be the precursors of a disease.¹³⁰⁸

Personal injury claims on the basis of alleged subcellular changes have been submitted, mostly in conjunction with claims for mental distress, increased risk or medical monitoring.¹³⁰⁹ Exceptionally some claims have been submitted solely based on subcellular damage.¹³¹⁰ Courts however differ in their appreciation of the evidence. Some accept it, whilst others do not.¹³¹¹

In *Brafford versus Susquehanna* the plaintiffs lived near a uranium milling facility. None of them had any symptoms of physical injury. Their claim was based on, *inter alia*, chromosome damage and an increased risk for developing

¹³⁰⁶ d'ENTREMONT, J. (2006, Vol. 58). Fear factor: the future of cancerphobia and fear of future disease claims in the toxicogenomic age. *Loyola Law Review*, p. 808.

¹³⁰⁷ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, p. 1711.

¹³⁰⁸ GOLD, S. C. (2010, Vol. 34). The more we know, the less intelligent we are? How genomic information should and should not, change toxic tort causation doctrine. *Harvard Environmental Law Review*, p. 419.

¹³⁰⁹ *Wood versus Wyeth-Ayers St. Laboratories*, 82 S.W.3d 849 (Supreme Court of Kentucky August 22, 2002); *Buckley versus Metro-North Commuter R.R.*, 79 F.3d 1337 (United States Court of Appeals, Second Circuit April 1, 1996); *Capital Holding Corp. versus Bailey*, 873 S.W.2d 187 (Supreme Court of Kentucky March 24, 1994); *Caputo versus Boston Edison Co.*, 1990 WL 98694 (United States District Court, D. Massachusetts July 9, 1990); *Payton versus Abbott Labs*, 437 N.E.2d 171 (Supreme Judicial Court of Massachusetts, Suffolk June 22, 1982).

¹³¹⁰ *Donovan versus Philip Morris USA, Inc.*, 268 F.R.D. 1 (US District Court, D. Massachusetts June 24, 2010); *Rainer versus Union Carbide Corp.*, 402 F.3d 608 (United States Court of Appeals, Sixth Circuit March 8, 2005); *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005); *Wood versus Wyeth-Ayers St. Laboratories*, 82 S.W.3d 849 (Supreme Court of Kentucky August 22, 2002); *Werlein versus U.S.*, 746 F.Supp. 887 (United States District Court, D. Minnesota September 4, 1990); *Brafford versus Susquehanna Corp.*, 586 F.Supp. 14 (United States District Court, D. Colorado March 19, 1984).

¹³¹¹ Accepting subcellular evidence: *Bryson versus Pillsbury Co.*, 573 N.W.2d 718 (Court of Appeals of Minnesota February 3, 1998); *Werlein versus U.S.*, 746 F.Supp. 887 (United States District Court, D. Minnesota September 4, 1990); *Sterling versus Velsicol Chemical Corporation*, 855 F.2d 1188 (US Court of Appeals August 29, 1988); *Brafford versus Susquehanna Corp.*, 586 F.Supp. 14 (United States District Court, D. Colorado March 19, 1984).

Excluding subcellular evidence: *Parker versus Brush Wellman, Inc.*, 377 F.Supp.2d 1290 (United States District Court, N.D. Georgia March 29, 2005); *Caputo versus Boston Edison Co.*, 1990 WL 98694 (United States District Court, D. Massachusetts July 9, 1990).

cancer.¹³¹² The court concluded that there was a question of fact with respect to whether the chromosome damage was a result of the plaintiffs' exposure to the radiation emitted from the mill.¹³¹³ According to this court subcellular injury can be a cause of action. It is however unclear if the court would have decided the same if they plaintiff had not added that their chromosome damage increased the risk of cancer.¹³¹⁴ After all, substantial exposure to radio-active substances nearly certain leads to disease and injury.

Whilst some subcellular damage was present, the exposed persons showed no symptoms or would not get sick in the short term, there was no damage on which a claim could be based. However it justified the granting of a claim for medical monitoring.¹³¹⁵

In 2009 the court in *Donovan versus Philip Morris* did not require physical symptoms or a recognizable illness in order to meet the standard for filing a claim. It was sufficient that the plaintiffs proved physiological changes caused by smoking, as well as expert medical testimony that, because of those physiological changes, they were at a substantially greater risk of cancer due to manufacturer's alleged negligence:

"[s]ubcellular or other physiological changes may occur which, in themselves, are not symptoms of any illness or disease, but are warning signs [. . .] that the patient has developed a condition that indicates a substantial increase in risk of contracting a serious illness [. . .] and thus the patient will require periodic monitoring. Since the plaintiffs alleged that such changes resulted from defendant's negligence, the SJC determined that they could proceed past the threshold stages of litigation and proffer proof of their claims through expert testimony and factual evidence."¹³¹⁶ (Citations omitted)

¹³¹² *Brafford versus Susquehanna Corp.*, 586 F.Supp. 14 (United States District Court, D. Colorado March 19, 1984).

¹³¹³ *Brafford versus Susquehanna Corp.*, 586 F.Supp. 14 (United States District Court, D. Colorado March 19, 1984).

¹³¹⁴ SEN, M. (2005-2006, Vol. 58). Defining the boundaries of 'personal injury': *Rainer versus Union Carbide Corp.* *Standard Law Review*, p. 1256.

¹³¹⁵ *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005).

¹³¹⁶ *Donovan versus Philip Morris USA, Inc.*, 268 F.R.D. 1 (US District Court, D. Massachusetts June 24, 2010 *Donovan versus Philip Morris USA, Inc.*, 455 Mass. 215 (Supreme Judicial Court of Massachusetts, Suffolk October 19, 2009).

In another case the plaintiffs were exposed to water contaminated with trichloroethylene. They claimed chromosomal damage and damage to the cardiovascular and immune system. Additionally they demanded medical monitoring because of their (alleged) risk on developing cancer. The court recognized that organic volatile substances have subtle and complex effects and that it is consequently the trier of fact, assisted by experts, who should determine if the plaintiffs are harmed.¹³¹⁷ It is noteworthy that also in this case plaintiffs referred to an increased risk on future damage.

Not all courts accept subcellular evidence. Some denied claims on the basis that subcellular damage that does not 'rise to the level of' physical damage and consequently physical symptoms are lacking.¹³¹⁸ Grodsky believes that the refusal is correct. Compensatory damages are meant to compensate for actual loss.¹³¹⁹ Losses should have an impact on the quality of life of the plaintiff. A claim for subcellular damage is premature since subcellular injuries do not have such an impact.¹³²⁰

After their home was treated with pesticides against termites, the plaintiffs' children had elevated levels of the used chemicals in their blood. Following the directed verdict of the Supreme Court, the Court of Appeals held that elevated levels of pesticides in children's' blood was not sufficient as proof, because the health of those children was otherwise normal. Additionally the court found that there was no evidence that their future risk for cancer had increased.¹³²¹

¹³¹⁷ Werlein versus U.S., 746 F.Supp. 887 (United States District Court, D. Minnesota September 4, 1990)

¹³¹⁸ Parker versus Wellman, 230 Fed. Appx. 878 (United States Court of Appeals, Eleventh Circuit April 18, 2007); Rainer versus Union Carbide Corp., 402 F.3d 608 (United States Court of Appeals, Sixth Circuit March 8, 2005); Bryson versus Pillsbury Co., 573 N.W.2d 718 (Court of Appeals of Minnesota February 3, 1998); Caputo versus Boston Edison Co., 1990 WL 98694 (United States District Court, D. Massachusetts July 9, 1990); Askey versus Occidental Chemical Corporation, 477 N.Y.S.2d 242 (Supreme Court, Fourth Department New York May 25, 1984).

¹³¹⁹ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, p. 1678.

¹³²⁰ Schweitzer versus Consolidated Rail Corporation et al., 758 F.2d 936 (US Court of Appeals, Third Circuit April 26, 1985); Amendola versus Kansas City Southern Ry. Co., 699 F.Supp. 1401 (United States District Court, W.D. Missouri, Western Division November 14, 1988).

¹³²¹ Boyd versus Orkin Exterminating Co., Inc., 381 S.E.2d 295 (Court of Appeals of Georgia March 6, 1989).

4.3.2 Emotional distress and fear for future disease after exposure to toxins

Emotional harm is distinct from physical harm. It refers to various mental states, like fright, fear, anxiety, depression and other mental illnesses and conditions.¹³²² The aspect of emotional harm has already been discussed in relation to the existence of pure risk. (See paragraph 4.3.1.2) In this paragraph the status and value of emotional distress is analysed as damage in itself. How is tort dealing with emotions? Do special requirements exist before an emotional condition can be the basis of a tortious claim?

In mental distress cases, the legally cognizable harm is the victim's actual suffering due to fear of developing some serious disease in the future.¹³²³ Whilst physical harm can be objectively verified, this is often not the case with emotional injuries.¹³²⁴

Consequently such claims are prone to exaggeration or they can be feigned. Recovery is only allowed for serious and immediate emotional distress when traumatic or caused by violent conduct.¹³²⁵ Physical damage is frequently required or at least it should be likely that physical damage will materialise. Recovery for emotional distress is more easily allowed for serious and immediate emotional distress when traumatic or if caused by violent conduct.¹³²⁶ Exceptions are equally granted for recognized psychiatric illnesses.

Individuals who were exposed to toxic substances are frequently concerned. They worry about developing a serious disease from the exposure. When the worry turns into fear, anxiety or another psychiatric illness are they then entitled to compensation, even before the physical damage is observable?

Each country studied deals differently with such situations. In following

¹³²² Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 8. Liability for Emotional Harm, (October 2013), § 45 Emotional Harm.

¹³²³ GRODSKY, J. (2007, April). Genomics and toxic torts: dismantling the risk-injury divide. *Stanford Law Review*, pp. 1679-1680.

¹³²⁴ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 8. Liability for Emotional Harm, (October 2013), § 45 Emotional Harm.

¹³²⁵ HENDERSON, J., & TWERSKI, A. (2002, Summer). Asbestos litigation gone mad: exposure-based recovery for increased risk, mental distress, and medical monitoring. *South Carolina Review*, p. 827.

¹³²⁶ HENDERSON, J., & TWERSKI, A. (2002, Summer). Asbestos litigation gone mad: exposure-based recovery for increased risk, mental distress, and medical monitoring. *South Carolina Review*, p. 827.

paragraphs, the role of physical injury when evaluating mental distress is discussed followed by an analysis of reasonableness requirement used when dealing with emotional harm.

4.3.2.1 The United Kingdom

In the UK cases on liability for fear are rather exceptional. But if a claim is submitted, the courts require that a plaintiff establishes an associated physical injury before he successfully can claim damage for fear.¹³²⁷

In the extensive case of October 2007 the House of Lords was firm and unanimous: claims for emotional distress fail unless there is also an actionable injury.¹³²⁸ Lord Hoffman was of the opinion that without physical damage, risk is not a sufficient basis for liability:

“Proof of damage is an essential element in a claim in negligence [...] Neither do the risk of future illness or anxiety about the possibility of that risk materialising amount to damage for the purpose of creating a cause of action, although the law allows both to be taken into account in computing the loss suffered by someone who has actually suffered some compensatable physical injury and therefore has a cause of action. In the absence of such compensatable injury, however, there is no cause of action under which damages may be claimed and therefore no computation of loss in which the risk and anxiety may be taken into account.”¹³²⁹

Referring to the asbestos cases, the question is if the fear caused by presence of the asbestos fibres as demonstrated by the pleural plaques can be the basis for a claim. A significant physical injury related to asbestos might very well never develop.

Contrary to claims for fear or anxiety, actions based on depression have more chance in succeeding. When a plaintiff suffers from a recognised psychiatric illness rather than just from fear, courts have decided that the plaintiff is

¹³²⁷ *Grieves and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007); *Gregg versus Scott*, [2005] WL 62248 (House of Lords January 27, 2005).

¹³²⁸ *Johnston v NEI International Combustion Ltd as joint in the case of Grieves and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007).

¹³²⁹ Lord Hoffmann in *Grieves and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007), § 2.

entitled to recovery.¹³³⁰ A psychiatric illness is damage on which an action in negligence is possible.¹³³¹ The success of such a claim then depends on the fulfilment of the standard requirements concerning negligence cases.¹³³²

Anxiety can however be based on a perceived risk for a fatal disease caused by, for example, asbestos fibres, dioxin emission, or through medical products as in the Creutzfeldt-Jakob disease litigation. The seriousness of those diseases made the courts rethink their approach. In cases where the claim was about a dread disease, the known evil nature of Creutzfeldt - Jakob motivated the court to accept the risk as the harm. The judge additionally argued that the amplification of that dreadful characteristic by the public media supported his acceptance of the fear as damage.¹³³³ These exceptions were however not the beginning of a new approach. Recent cases still refer to the requirement of physical injury or at least a recognized psychiatric illness.

“Emotional reactions of that kind do not, on their own, sound in damages. But taken in combination, they say, these various elements when added together do add up to an injury caused by the wrongful exposure to asbestos which is more than negligible.”¹³³⁴

Back to the innocent pleural plaques that are not sufficient to base on a cause of action. As said before, pleural plaques are normally symptomless and do not develop into serious or fatal diseases. On the other hand they confirm the exposure to asbestos and thus support the observation that an independent risk on mesothelioma or any other dangerous asbestos-related disease exists. The House of Lords elaborated on this situation. They decided that the pleural plaques were not actionable physical damage and neither was the risk for developing a serious disease in the future because of the presence of asbestos

¹³³⁰ See *Page versus Smith*, [1996] 1 W.L.R. 855 (Court of Appeal March 11, 1996); *Creutzfeldt - Jakob disease Litigation (No.5)* (alias CJD litigation), 41 B.M.L.R. 157 (Queen's Bench Division December 18, 1997).

¹³³¹ *Grievés and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007), § 23.

¹³³² E.g. the duty of care, foreseeability, proximity.

¹³³³ See *Creutzfeldt - Jakob disease Litigation (No.5)* (alias CJD litigation), 41 B.M.L.R. 157 (Queen's Bench Division December 18, 1997).

¹³³⁴ *Grievés and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007).

fibres, even when that resulted in fear.¹³³⁵ Anxiety at the risk of future harm is not in itself actionable. A plaintiff should have sustained actionable physical damage and then the risk of a future deterioration in his condition is compensatable.¹³³⁶ In *Grieves versus Everard*, the plaintiff developed a clinical depression, which is a recognized psychiatric illness, and, as seen above, such is actionable. His depression has been caused by apprehension that a serious disease may occur. Such an event has not occurred. And since the creation of a risk is not in itself actionable, anxiety or a psychiatric disease caused by the knowledge of this risk does not found a claim.¹³³⁷

4.3.2.2 The United States

In the US emotional disturbance without physical injury¹³³⁸ was likewise not accepted as a basis for personal injury claims.¹³³⁹ Actions for mental distress were only recognized if fear was based in an immediate personal injury.¹³⁴⁰

The court in the 1965 *Falzone* case ruled that where negligence caused fright of immediate injury, and the fright resulted in substantial physical injury or sickness, the plaintiff may claim liability if the emotional damage:

“would be regarded as proper elements of damage had they occurred as a consequence of direct physical injury rather than fright”.¹³⁴¹

And the judge continued:

“where fright does not cause substantial bodily injury or sickness, it should be regarded as too lacking in seriousness and too speculative to warrant the imposition of liability.”¹³⁴²

¹³³⁵ *Rothwell v Chemical & Insulating Co Ltd. and another*, [2008] 1 A.C. 281 (House of Lords June 25, 2007).

¹³³⁶ JONES, M. A. (2008, P.N. 2008, 24(1)). *Liability for fear of future disease? Professional Negligence*, p. 26.

¹³³⁷ *Grieves and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007).

¹³³⁸ “Physical harm means the physical impairment of the human body (“bodily harm”) or of real property or tangible personal property (“property damage”). Bodily harm includes physical injury, illness, disease, impairment of bodily function, and death.” In *Restatement (Third) of Torts, Chapter 2. Liability for Physical Harm, § 4 Physical Harm*, October 2013.

¹³³⁹ *Ward versus West Jersey & S.R. Co* (Supreme Court of New Jersey November 12, 1900).

¹³⁴⁰ *Ward versus West Jersey & S.R. Co* (Supreme Court of New Jersey November 12, 1900).

¹³⁴¹ *Falzone versus Busch*, 45 N.J. 559 (Supreme Court of New Jersey October 25, 1965), p. 569.

¹³⁴² *Falzone versus Busch*, 45 N.J. 559 (Supreme Court of New Jersey October 25, 1965), p. 569.

Still the word *bodily* was used, thus physical injury was necessary to be successful in a tort liability claim.

In 2012 several workers were exposed to toxic chemicals. After examining the case, the court decided that the physical and emotional damage was caused by the exposure:

“even though that determination was not supported by air monitoring data, where slop oil contained various levels of chemicals which could cause symptoms ranging from nausea, headache, dizziness, fatigue, drowsiness, and unconsciousness to organ damage, cancer, and death, workers experienced contemporaneous or near-contemporaneous symptoms when exposed to the odours and fumes from the slop oil spill, and workers' experts in toxicology, air dispersion modelling, environmental chemistry, exposure monitoring, odour, industrial hygiene, epidemiology, and occupational and environmental medicine, and workers' treating physicians, agreed that symptoms were consistent with exposure to toxic chemicals contained in the slop oil.”¹³⁴³

Compensation was granted for the injuries and for fear of future injuries to workers.¹³⁴⁴

As from 2013 on, a defendant can be held liable for both physical and emotional damage on condition that the physical harm developed out of emotional damage caused by the tortfeasor.¹³⁴⁵ The sequence of occurrence of the physical and emotional damage is thus not important.

a) Why require physical damage?

Nowadays US courts are more accustomed to liability actions based on chemical exposure. The increase in toxic tort cases however leads to a new worry, namely

¹³⁴³ *Arabie versus Citgo Petroleum Corp.*, 89 So.3d 307 (Supreme Court of Louisiana. May 4, 2012).

¹³⁴⁴ *Arabie versus Citgo Petroleum Corp.*, 89 So.3d 307 (Supreme Court of Louisiana. May 4, 2012).

¹³⁴⁵ See for example: *Exxon Mobil Corp. versus Ford*, 204 Md.App. 1 (Court of Special Appeals of Maryland February 9, 2012); *Paz versus Brush Engineered Materials, Inc.*, 555 F.3d 383 (US Court of Appeals, Fifth Circuit January 13, 2009); *Bonnette versus Conoco, Inc.*, 804 So.2d 649 (Supreme Court of Louisiana January 11, 2002); *Metro-North Commuter R. Co. versus Buckley*, 521 U.S. 424 (Supreme Court of the United States June 23, 1997). A contrario: *Norfolk & Western Ry. Co. versus Ayers*, 538 U.S. 135 (Supreme Court of the United States March 10, 2003); *Potter versus Firestone Tire and Rubber Company*, 863 P.2d 795 (Supreme Court of California December 27, 1993). Restatement (Third) of Torts, chapter 8: Liability for Emotional Harm, § 45 Emotional harm, October 2013.

the concern that granting claims for fear would lead to an interminable number of liability cases.¹³⁴⁶ The following citation summarizes it well:¹³⁴⁷

“Having determined that inhalation of asbestos satisfies the impact rule ... we must still determine if and when recovery is available for fear of cancer ... The justification for permitting recovery for "fear of" is that the plaintiff suffers, since "[l]ike the sword of Damocles [plaintiff] knows not when it will fall." [Citations omitted] But, if Damocles supplies the reason for permitting recovery, Pandora supplies the reason for at least limiting recovery.”

The physical injury requirement is considered necessary and fair.¹³⁴⁸ When fear is not caused by (or now also: does not cause) substantial physical injury or sickness, it is classified as not serious and too speculative for causing liability.¹³⁴⁹ Expert testimony to prove physical symptoms suffered from alleged negligent infliction of emotional distress is required in order to ensure that the emotional harm is sufficiently serious to base a claim and causation on.¹³⁵⁰

b) Exceptions

This approach is considered settled¹³⁵¹, although exceptions can be found.¹³⁵²

“An actor whose negligent conduct causes serious emotional harm to another is subject to liability to the other if the conduct:(a) places the other in danger of immediate bodily harm and the emotional harm results from the danger; or (b) occurs in the course of specified

¹³⁴⁶ CARPENTER, M., & WARE, G. (2012, August). Fear of future disease Claims, § 9.6 The physical injury requirement. *Defending Pesticides in Litigation*.

¹³⁴⁷ *Eagle-Picher Industries, Inc. versus Cox*, 481 So. 2d 517 (District Court of Appeal of Florida, Third District December 31, 1985).

¹³⁴⁸ *Eagle-Picher Industries, Inc. versus Cox*, 481 So. 2d 517 (District Court of Appeal of Florida, Third District December 31, 1985).

¹³⁴⁹ *Falzone versus Busch*, 45 N.J. 559 (Supreme Court of New Jersey October 25, 1965).

¹³⁵⁰ *O'Donnell versus HCA Health Services of N.H. Inc.*, 883 A.2d 319 (Supreme Court of New Hampshire September 8, 2005).

¹³⁵¹ *Falzone versus Busch*, 45 N.J. 559 (Supreme Court of New Jersey October 25, 1965), p. 562.

¹³⁵² New Jersey Courts have accepted that fright can be the proximate cause of substantial physical injury: *Sowinski versus Walker*, 198 P.3d 1134 (Supreme Court of Alaska February 18, 2009); *Ryder versus USAA Gen. Indem. Co.*, 938 A.2d 4 (2007). Eighth Circuit September 22, 2000); *Tuttle versus Atlantic City R. Co.*, 49 A. 450 (Court of Errors and Appeals of New Jersey June 17, 1901).

categories of activities, undertakings, or relationships in which negligent conduct is especially likely to cause serious emotional harm.”¹³⁵³

If the defendant’s negligent act placed the plaintiff in risk of bodily harm, but after the risk disappeared it becomes clear that only emotional harm was caused, then a claim can be filed for that emotional harm.¹³⁵⁴ On the contrary recovery for fear of future disease is not granted for as long as the latency period for the physical damage did not pass. Meaning, for as long as the risk that the disease will develop has not expired. However, when the victim is in danger of immediate physical harm but emotional harm results instead, for example when there is a particular short latency period, a claim based on emotional distress is possible.¹³⁵⁵ This is called the ‘zone of danger’ rule.¹³⁵⁶

Overall, the rule in the Restatement only applies when the person seeking recovery has suffered serious emotional harm. In addition, the actor's conduct must be such that would cause a reasonable person to suffer serious emotional harm.

Another exception is applied when an actor who by extreme and outrageous conduct intentionally or recklessly causes severe emotional harm to another. That actor is held liable for the emotional harm caused.¹³⁵⁷

Last but not least when the conduct falls within certain categories of activities, undertakings and relationships where it is especially likely to cause serious

¹³⁵³ Exxon Mobil Corp. versus Ford, 204 Md.App. 1 (Court of Special Appeals of Maryland February 9, 2012); Norfolk & Western Ry. Co. versus Ayers, 538 U.S. 135 (Supreme Court of the United States March 10, 2003); Restatement (Third) of Torts, chapter 8: Liability for Emotional Harm, § 46 Intentional (or Reckless) Infliction of Emotional Harm, October 2013.

¹³⁵⁴ Restatement (Third) of Torts, chapter 8 Liability for Emotional Harm, § 47 Negligent Conduct Directly Inflicting Emotional Harm on Another, October 2013.

¹³⁵⁵ Restatement (Third) of torts: Physical and Emotional Harm, Chapter 8: Liability for Emotional Harm, § 47 Negligent Conduct Directly Inflicting Emotional Harm on Another, (2013).

¹³⁵⁶ The zone of danger rule led to the ‘bystander rule’ under which a bystander can recover for emotional harm caused by contemporaneously observing bodily harm to a close relative, even though the bystander is not in the zone of danger. This is a different role and not an extension of the ‘zone of danger’ and will not be discussed further.

¹³⁵⁷ Restatement (Third) of Torts, chapter 8: Liability for Emotional Harm, § 46 Intentional (or Reckless) Infliction of Emotional Harm, October 2013.

emotional harm, however without physical harm, then physical damage is also not required.¹³⁵⁸

4.3.2.3 The Netherlands

The Dutch Courts are also confronted with the challenge of new risks and the role of immaterial 'damage' in liability.

In the Netherlands emotional harm is recognized as a valid claim in tort if there is some patrimonial or physical loss.¹³⁵⁹ For example the trial court of Utrecht decided that emotional distress caused by the contamination of the soil under the plaintiffs' houses was not sufficient to qualify as emotional harm. Although the remediation of the soil was cumbersome and difficult, the worries of the plaintiffs about their personal and their children's health were unwanted and alarming, these elements did not qualify as emotional harm. The argument for the decision was that medical examination did not reveal any injury or diseases.¹³⁶⁰

On the other hand, anxiety for developing a disease after exposure to chemicals can lead to liability on behalf of the tortfeasor.¹³⁶¹ Following Dutch legislation a plaintiff can only sue for emotional distress in situations that are specifically regulated by statute.¹³⁶² The Dutch courts remain however reluctant to grant claims based on fear for future disease, like mesothelioma. The Supreme Court stated that recovery for emotional damage requires that this harm can be legally established.¹³⁶³ The fear should be genuine and so severe that some damage is noticeable.¹³⁶⁴ Generally this is the case when the plaintiff suffers from a recognized psychiatric injury.¹³⁶⁵

¹³⁵⁸ Restatement (Third) of torts: Physical and Emotional Harm, Chapter 8: Liability for Emotional Harm, § 47 Negligent Conduct Directly Inflicting Emotional Harm on Another, (2013).

¹³⁵⁹ Hoge Raad 9 October 2009, *Nederlandse Jurisprudentie* 2010/387, with note of J.B.M. Vranken; Art. 6:95 of the Dutch Civil Code: states that compensation for tortious acts should only be granted if there is patrimonial loss (vermogensschade), unless the law states otherwise.

¹³⁶⁰ Rechtbank Utrecht 29 June 1999, *Kort Geding* 1999/219.

¹³⁶¹ LINDENBERGH, S. (2013). Uiteenlopende oorzaken van geestelijk letsel. In GROENE SERIE, *Schadevergoeding* (p. § 27.2.3.). Den Haag: Kluwer.

¹³⁶² Art. 6:106 of the Dutch Civil Code.

¹³⁶³ Hoge Raad 10 April 2007, LJN AZ5670, *Nederlandse Jurisprudentie* 2007/409.

¹³⁶⁴ See for example: Rechtbank 's-Gravenhage 30 December 2003, AO4405, *Tijdschrift voor Ambtenarenrecht* 2004/34.

¹³⁶⁵ Hoge Raad 9 oktober 2009, *Nederlandse Jurisprudentie* 2010/387, note of J.B.M. Vranken.

Fear for future disease is not assessed by the probability of the risk materializing, but according to the impact the fear has on the plaintiff.¹³⁶⁶ It is thereby sufficient that the plaintiff proves he was exposed and that an expert confirms that the plaintiff is suffering from emotional distress.

4.3.2.4 France

France recognizes emotional distress as damage to be compensated by the tortious defendant.¹³⁶⁷ Emotional distress following the awareness of a serious risk leads to compensation for anxiety. This is particularly the case for fear for a future serious disease, like cancer. This fear led to the creation by the courts of '*le préjudice spécifique de contamination*'. The concept was first applied in HIV cases. Thereafter it is extended to all diseases that are incurable and likely to evolve (*incurables susceptibles d'évoluer*), like some diseases following exposure to toxic chemicals.¹³⁶⁸ In concreto employees exposed to asbestos¹³⁶⁹ and fearing to develop a serious disease at any time in the future, are considered to have suffered damage by anxiety before the onset of the illness and are entitled to recovery for this harm.¹³⁷⁰

Another creative solution was developed in a case of mobile telephone antennas. The French court judged it on the basis of *trouble de voisinage* (trouble caused by neighbours).¹³⁷¹ The court considered the situation 'abnormal' despite the fact that the claim was based on pure risk. It was scientifically uncertain that damage would follow, but the risk was such that concerns about safety were reasonable and serious.

¹³⁶⁶ Hoge Raad 6 May 2008, HD 103.003.179, www.rechtspraak.nl.

¹³⁶⁷ Cour de Cassation (Civile) 9 July 1996, *Bulletin Civile* 1996.I.306.

¹³⁶⁸ LE TOURNEAU, P. (2012-2013). *Droit de la responsabilité et des contrats*. Paris: Dalloz, nr. 1413; BEAUGENDRE, S. (2009). *Regard d'outre-manche sur un arrêt de la Chambre des Lords*. *European Review of Private Law*, pp. 197-199, 203.

¹³⁶⁹ Note: this cases are mentioned with the sole purpose of demonstrating the position taken towards exposure to risk and emotional distress. They concern the relation employer-employee (white collar) and take into account the particular situation of asbestos victims in France (whereby employees exposed to asbestos can stop working at 60).

¹³⁷⁰ Cour de Cassation (chambre sociale) 25 September 2013, nr. 12-20.157, www.legifrance.gouv.fr; Cour de Cassation (chambre sociale) 25 September 2013, nr. 11-20.948.

¹³⁷¹ Cour d'Appel de Versailles, 4 February 2009, Dalloz 2009/819, note of Boutonnet.

Equally an entrepreneur can be held liable for the abnormal trouble he is or was causing to his (former) neighbours.¹³⁷² Using that concept the abnormality of the risk is based in the seriousness of the possible consequences for human health.¹³⁷³ However, the difficulties related to liability for pure risk remain, as was clear in the decision of the Court of Cassation stating that the uncertainty was just too big.¹³⁷⁴ The concept of virtual damage can however also be applied in this situation. (See paragraph 4.3.1.1, b), ii).

The advantage of the 'trouble caused by neighbours' is that it is sufficient that the trouble was abnormal. Wrongfulness does not have to be proved.¹³⁷⁵

4.3.3 Medical monitoring

Medical monitoring consists of periodic medical check-ups with the objective to discover the onset of a disease. Medical professionals describe medical monitoring in more detail as follows:

“a form of surveillance based on repetitive use of the same test ... to detect a specified change in the patient indicating a ... need for treatment or a change in his treatment.”¹³⁷⁶

The expression 'medical monitoring' used in tort litigation refers to a claim seeking compensation for the costs of medical testing which a victim is willing to assume after toxic exposure.¹³⁷⁷ An enhanced risk caused by a sufficient exposure to toxic substances is necessary.¹³⁷⁸

¹³⁷² PRIGENT, S. (2009). Le trouble anormal de voisinage appartient au droit de la responsabilité. *L'Actualité juridique*, p. 13ff.

¹³⁷³ Cour d'appel de Versailles, 4 February 2009, *Dalloz* 2009/819. For more information on this topic: STOFFELS-MUNCK, P. (2009). La théorie des troubles du voisinage à l'épreuve du principe de précaution: observations sur le cas des antennes relais. *Recueil Dalloz*, p. 2817.

¹³⁷⁴ Cour de Cassation (3^e Chambre Civile), 18 May 2011, no 10-17.645.

¹³⁷⁵ DEMEESTER, M.-L., & NEYRET, L. (2014, January). Environnement. Répertoire de droit civil, nrs. 82-90.

¹³⁷⁶ SCHWARTZ, V., LORBER, L., & LAIRD, E. (2005, spring). Medical monitoring: the right way and the wrong way. *Missouri Law Review*, p. 351.

¹³⁷⁷ DESAI, P. (2011, vol. 38). Donovan versus Philip Morris USA, Inc.: the best approach to satisfying the injury requirement in medical monitoring claims. *Boston College Environmental Affairs Law Review*, p. 95.

¹³⁷⁸ Exxon Mobil Corp. versus Ford, 204 Md.App. 1 (Court of Special Appeals of Maryland February 9, 2012); Sheridan versus NGK Metals Corp., 609 F.3d 239 (United States Court of Appeals, Third Circuit January 11, 2010); Bourgeois versus A.P. Green Industries, 841 So.2d 902 (Court of Appeal of Louisiana, Fifth Circuit February 25, 2003)

Granting claims for medical monitoring supports several objectives of tort. It deters unwanted/negligent behaviour. It is economically efficient because it reduces the costs by preventing future disease. It is just and fair, because without granting the claim the victim would have to pay himself for costs caused by the defendant.¹³⁷⁹

Claims for medical monitoring are frequently submitted in the US.¹³⁸⁰

In the Netherlands the presence of pleural plaques is some kind of physical injury and thus an actionable damage.¹³⁸¹ Consequently it is logic that these individuals want regular medical monitoring. Although no claims for medical monitoring have been pleaded yet, Dutch scholars see no reason for the denial of a claim for medical monitoring in such situations. The exposure of asbestos, hence the plaques, is proved and this is sufficient for a cause of action on the condition there is anxiety or psychiatric illness.¹³⁸²

In view of its importance as a solution to some difficulties encountered in toxic tort, the concept of medical monitoring is described in the following paragraphs. Firstly the difference between a claim for compensation of future damage and a claim for monitoring is explained. The second paragraph deals with the issue of medical monitoring as a cause of action on its own.

4.3.3.1 Medical monitoring is no action for risk of future harm

First, a distinction should be made between an action for medical monitoring and an action for increased risk of future harm. These are two different things. In

¹³⁷⁹ DESAI, P. (2011, vol. 38); *Donovan versus Philip Morris USA, Inc.*: the best approach to satisfying the injury requirement in medical monitoring claims. *Boston College Environmental Affairs Law Review*, p. 109. *Bower versus Westinghouse Elec. Corp.*, 522 S.E.2d 424 (Supreme Court of Appeals of West Virginia September 20, 1999); *Brown versus South-eastern Pennsylvania Transportation Authority ("SEPTA") e.a.* (In re: Paoli Railroad Yard PCB Litigation), 113 F.3d 444 (United States Court of Appeals, Third Circuit May 12, 1997); *Potter versus Firestone Tire and Rubber Company*, 863 P.2d 795 (Supreme Court of California December 27, 1993).

¹³⁸⁰ *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005); *Petito versus A.H. Robins Co., Inc.*, 750 So. 2d 103 (District Court of Appeal of Florida, Third District February 19, 2000) (medical monitoring granted in absence of physical injury); *Metro-North Commuter R. Co. versus Buckley*, 521 U.S. 424 (Supreme Court of the United States June 23, 1997); *Ayers versus Jackson Township*, 525 A.2d 287 (Supreme Court of New Jersey May 07, 1987).

¹³⁸¹ MARTIN-CASALS, M. (2009). Introduction to the Annotations to *Johnston versus NEI International Combustion Ltd.*, *European Review of Private Law*, p. 184.

¹³⁸² SOBCZAK, F., TOWNEND, D., & VAN MAANEN, G. (2009). Introduction to the Annotations to *Johnston versus NEI International Combustion Ltd* - Dutch case note. *European Review of Private Law*, p. 213.

fact a claim filed by a victim to recover quantifiable costs for medical examinations aiming at an early detection of the onset of a disease or injury caused by the defendant's negligent behaviour, is for damage occurring in the present.¹³⁸³ A claim for medical monitoring is an action that requests reimbursements of costs for the necessary examinations and not for expenses or damages related to a future disease. Medical monitoring is also not a recovery for fear of a future disease. It is fact in a claim for preventing the future disease. Necessarily the cause of action has to be based on significant exposure to a proven hazardous substance that will more than probably lead to the alleged disease.¹³⁸⁴ The increased risk to physical injury should exist when the action for liability is started and should be proved.¹³⁸⁵ Some risks dissolve or disappear with time; these risks cannot be subject of a claim when they have expired.

But it is not always easy to successfully claim medical monitoring. The proof of risk of future harm can be difficult to deliver, as was experienced by residents living near a beryllium processing plant. They claimed to have a significantly increased risk of contracting Chronic Beryllium Disease (CBD) and wanted medical monitoring. The disease causes scarring of the lung tissue. At present there is no cure for it, however further lung damage can be slowed down by immunosuppressive drugs and oxygen therapy. The final recourse is lung transplant.¹³⁸⁶ In first instance the claim of the residents was rejected.

An appeal was filed. The plaintiffs had to prove that they were exposed to a higher level than the general population (or background level), that the exposure was caused by the defendant's negligence and that as a proximate result of the exposure, a significantly increased risk of contracting a serious disease occurred. Additionally they should demonstrate that the requested medical monitoring is able to detect the onset of the disease and that

¹³⁸³ PENOFSKY, D. J. (2012, May). Asbestos Injury Litigation. *American Jurisprudence*, 60 AMJUR TRIALS 73, § 38.

¹³⁸⁴ *Bourgeois versus A.P. Green Industries*, 841 So.2d 902 (Court of Appeal of Louisiana, Fifth Circuit February 25, 2003), p. 915; *Glenn Gates, et al. versus Rohm and Haas Company, et al.*, 618 F. Supp. 2d (United States District Court, E.D. Pennsylvania July 26, 2007), pp. 365-366.

¹³⁸⁵ *Gates, et al. versus Rohm and Haas Company, et al.*, 618 F. Supp. 2d (United States District Court, E.D. Pennsylvania July 26, 2007), pp. 365-366.

¹³⁸⁶ UNIVERSITY OF SAN FRANCISCO. (n.d.). Retrieved September 19, 2012, from UCSF Medical Center:

http://www.ucsfhealth.org/conditions/chronic_beryllium_disease/index.html.

contemporary scientific principles support the need for a monitoring regime.¹³⁸⁷ The plaintiffs lost their case, because CBD can only develop if a person was previously sensitized to beryllium. They were not. Thus medical monitoring had no added value.

Although the requirements mentioned are widely used in decisions on medical monitoring, the outcome is not always as clear cut as with beryllium. Some commentators disagree with the practice of using strict standards.¹³⁸⁸ They state that a victim who suffers from an increased risk should be heard, even when the materialisation of the risk is not probable.¹³⁸⁹

4.3.3.2 Medical monitoring as a standalone claim

A claim for medical monitoring is not in all US states recognized as a standalone cause of action.¹³⁹⁰ Some courts decline compensation for medical monitoring when plaintiffs cannot prove a present physical injury.¹³⁹¹ Some judges accept these claims without that requirement. Such was the case of *Henry versus Dow Chemical*. As explained in the text below, the acceptance of 'so called' standalone cases for medical monitoring depends highly on the definition of damage/harm.¹³⁹²

The Dow Chemical Company had a plant on the banks of the Tittabawassee River in Midland for over a century. The plant produced several products,

¹³⁸⁷ *Abbatiello versus Monsanto Co.*, 522 F. Supp. 2d 524 (United States District Court, S.D. New York November 2, 2007); *Pohl versus NGK Metals Corporation*, 936 A.2d 43 (Superior Court of Pennsylvania October 11, 2007), § 17.

¹³⁸⁸ *Exxon Mobil Corp. versus Albright*, 433 Md. 502 (433 Md. 502 June 25, 2013); *Pohl versus NGK Metals Corporation*, 936 A.2d 43 (Superior Court of Pennsylvania October 11, 2007), § 17; *Meyer ex rel. Coplin versus Fluor Corp.*, 220 S.W.3d 712 (Supreme Court of Missouri March 20, 2007); *Ayers versus Township of Jackson*, 461 A.2d 184 (Superior Court of New Jersey April 5, 1983); *Bower versus Westinghouse Elec. Corp.*, 522 S.E.2d 424 (Supreme Court of Appeals of West Virginia September 20, 1999); *Brown versus Monsanto e.a. (In re: Paoli Railroad Yard PCB litigation)*, 113 F.3d 444 (United States Court of Appeals, Third Circuit May 12, 1997); *Potter versus Firestone Tire and Rubber Company*, 863 P.2d 795 (Supreme Court of California December 27, 1993).

¹³⁸⁹ HANDFIELD, T., & PISCIOTTA, T. (2005, Vol. 11 Issue 4). Is the Risk-Liability Theory compatible with negligence law? *Legal Theory*; AM JUR Toxic Torts: Proof of Medical Monitoring Damages for Exposure to Toxic Substances § 9. *Enhanced risk claims*, Westlaw.

¹³⁹⁰ E.g. it can be considered a remedy and not a separate claim in Maryland, Delaware

¹³⁹¹ DESAI, P. (2011, vol. 38). *Donovan versus Philip Morris USA, Inc.*: the best approach to satisfying the injury requirement in medical monitoring claims. *Boston College Environmental Affairs Law Review*, p. 96.

¹³⁹² For the UK see: *Cartledge and Others versus Jopling & Sons Ltd*, [1963] 2 W.L.R. 210 (House of Lords January 17, 1963), later followed in *Grievs and others versus F.T. Everard & Sons Ltd and others*, [2008] P.I.Q.R. P6 (House of Lords October 17, 2007).

including, e.g. styrene, butadiene, picric acid, mustard gas, Saran Wrap, Styrofoam, Agent Orange, and various pesticides.¹³⁹³ These operations had a 'deleterious effect' on the local environment.¹³⁹⁴ The soil of the plant was equally contaminated, but with dioxin, which is a hazardous chemical causing cancer, liver disease and birth defects, to name a few.¹³⁹⁵ Plaintiffs requested a medical monitoring program especially focussing on the exposure to dioxin. Following normal procedures the plaintiffs had to prove that they suffered damage.¹³⁹⁶ The plaintiffs admitted that they did not have any present physical injuries. The court found for the defendants, except for one judge who was dissenting.¹³⁹⁷

That judge believed that the plaintiffs had suffered actual harm, namely the exposure to very high concentrations of dioxin. The exposure and the need for medical monitoring constituted the injury.¹³⁹⁸ This judge would have granted the claim.

Rewarding compensation for medical examinations is consistent with the principle to allow a victim to recover costs, even when no physical injury is observable. The motivation for such an approach lies in the public interest in diagnosing diseases in an early stage, as well as in the deterrent effect and the distribution of costs, but also in the fairness of having the tortfeasor pay.¹³⁹⁹

A case with a clear public interest is *Donovan versus Philip Morris*. In this class action smoking plaintiffs without symptoms filed a claim for medical monitoring on the basis of their increased risk of contracting lung disease.¹⁴⁰⁰ At the moment of the claim they had not contracted cancer, and they did not claim that they were likely to contract cancer in the immediate future as a result of the

¹³⁹³ *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005).

¹³⁹⁴ According to some published reports. See *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005).

¹³⁹⁵ *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005), p. 707.

¹³⁹⁶ *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005), p. 688.

¹³⁹⁷ Michael Cavanagh (dissenting) in *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005), p. 706.

¹³⁹⁸ Judge Michael Cavanagh (dissenting) in *Henry versus Dow Chemical Co*, 701 N.W.2d 684 (Supreme Court of Michigan July 13, 2005), p. 707.

¹³⁹⁹ *Potter versus Firestone Tire and Rubber Company*, 863 P.2d 795 (Supreme Court of California December 27, 1993); *Hathaway versus Tascosa Country Club, Inc.*, 846 S.W.2d 614 (Court of Appeals of Texas, Amarillo March 1, 1993).

¹⁴⁰⁰ RECENT CASES. (2010, May). Tort law - proof of harm in tobacco cases - Supreme Judicial Court of Massachusetts recognizes cause of action for medical monitoring of tobacco users. *Harvard Law Review*, pp. 1771-1780.

alleged negligence of Philip Morris. Neither did the plaintiffs seek monetary compensation. They wanted an injunction creating a medical monitoring program under the supervision of the court.¹⁴⁰¹ That program would require the hiring of personnel, the establishment of notification and informed consent procedures, the purchase of equipment, the implementation of quality control practices, the rendering of medical advice, and record-keeping plus follow-up policies. The court decided that each plaintiff had to prove that:

“(1) The defendant's negligence (2) caused (3) the plaintiff to become exposed to a hazardous substance that produced, at least, subcellular changes that substantially increased the risk of serious disease, illness, or injury (4) for which an effective medical test for reliable early detection exists, (5) and early detection, combined with prompt and effective treatment, will significantly decrease the risk of death or the severity of the disease, illness or injury, and (6) such diagnostic medical examinations are reasonably (and periodically) necessary, conformably with the standard of care, and (7) the present value of the reasonable cost of such tests and care, as of the date of the filing of the complaint.”¹⁴⁰²

The conclusion was that the plaintiffs' allegations of subclinical effects on lung tissue constituted a legally cognizable injury on which their medical monitoring claim could be based.¹⁴⁰³

“Subcellular or other physiological changes may occur which, in themselves, are not symptoms of any illness or disease, but are warning signs to a trained physician that the patient has developed a condition that indicates a substantial increase in risk of contracting a serious illness or disease and thus the patient will require periodic monitoring.”¹⁴⁰⁴

¹⁴⁰¹ Donovan versus Philip Morris USA, Inc., 455 Mass. 215 (Supreme Judicial Court of Massachusetts, Suffolk October 19, 2009).

¹⁴⁰² Donovan versus Philip Morris USA, Inc., 455 Mass. 215 (Supreme Judicial Court of Massachusetts, Suffolk October 19, 2009).

¹⁴⁰³ Donovan versus Philip Morris USA, Inc., 455 Mass. 215 (Supreme Judicial Court of Massachusetts, Suffolk October 19, 2009).

¹⁴⁰⁴ Donovan versus Philip Morris USA, Inc., 455 Mass. 215 (Supreme Judicial Court of Massachusetts, Suffolk October 19, 2009), p. 901.

In some US jurisdictions medical monitoring claims are now indeed allowed to proceed in cases where no physical harm *sensu stricto* is present, but when subcellular changes are observed. Diagnostic procedures enabling the detection of the potential disease should however exist.¹⁴⁰⁵

But in all these decisions the probability of the materialisation of the incurred risk is also important. Besides the scientific aspect of statistics, the use of probability in litigation has a doctrinal and legal practice aspect. The following paragraph will discuss some doctrinal aspects of the relation between risk and probability.

4.4. Risk and probability

Two types of probability can be distinguished: (1) forward looking compensation for the risk of future injury and (2) backward looking compensation based on the probability of causation.

A tortious exposure to a risk, like e.g. exposure to dioxin, cadmium, etc., may lead to injury or not. The magnitude of the risk can be expressed as the probability that the tortfeasor's act will inflict damage.¹⁴⁰⁶ When the plaintiff actually sustained injury following the tortious act, an *ex post* assessment of the probability that the wrongdoer caused the damage can be necessary.¹⁴⁰⁷ Both situations lead to a different calculation of probability.

In this paragraph the focus is on the first type of probability. The second category will be discussed in the part on science.

Our knowledge is incomplete, thus causal generalisations are used that list some of the antecedent conditions that lead to an event, whilst assuming that all the conditions have instantiated.¹⁴⁰⁸ These generalisations are based on inferences drawn from the sufficiently high probability that a particular causal observation is applicable in the specific circumstances and the sufficiently low probability that

¹⁴⁰⁵ *Donovan versus Philip Morris USA, Inc.*, 268 F.R.D. 1 (US District Court, D. Massachusetts June 24, 2010).

¹⁴⁰⁶ PORAT, A., & STEIN, A. (2003, Vol. 23, issue 4). Indeterminate causation and apportionment of damages: an essay on Holtby, Allen and Fairchild. *Oxford Journal of Legal Studies*, p. 684.

¹⁴⁰⁷ PORAT, A., & STEIN, A. (2003, Vol. 23, issue 4). Indeterminate causation and apportionment of damages: an essay on Holtby, Allen and Fairchild. *Oxford Journal of Legal Studies*, p. 684.

¹⁴⁰⁸ See also paragraph on NESS.

any competing causal explanation would be applicable.¹⁴⁰⁹ Necessarily, if one wants to predict occurrences then these causal generalisations, formed on past experience, are transposed into predictions of damage in the future. Alternative causes are thereby not excluded¹⁴¹⁰, and frequently reference is made to 'unknown causes' instead of to other specific risk factors.¹⁴¹¹

Clearly, an assessment of damages that will or will not happen in the future is different from the usual judgment of determining what has happened.¹⁴¹²

In toxic tort a causal generalisation is often difficult or even not possible. Risk of future damage is not observable and cause-in-fact cannot be determined.¹⁴¹³

Consequently, statistical risk is used as proof and is considered a causal generalisation with an instantiation through the exposure.¹⁴¹⁴

The question is thus if statistical information on the likelihood that a risk will materialise helps to make risk claims heard in court.

First a distinction has to be made between two concepts of risk. An objective risk concept is based in the standard relative frequency account of probability. An epistemic risk concept is concerned with the evidentiary basis for judgements or estimations of relative frequency, in other words is based on what we know and belief to be true.¹⁴¹⁵ When there is no other way then to prove the causal link by statistics, then probabilistic causal contribution to the damage is the best solution.¹⁴¹⁶

¹⁴⁰⁹ WRIGHT, R. (1987). The Efficiency Theory of causation and responsibility: unscientific formalism and false semantics. *Chicago-Kent Law Review*, p. 559.

¹⁴¹⁰ *Stubbs versus City of Rochester*, 124 N.E. 137 (Court of Appeals of New York July 15, 1919).

¹⁴¹¹ *Henricksen versus Conocophillips company*, 605 F.Supp.2d 1142 (United States District Court, E.D. Washington February 11, 2009).

¹⁴¹² *Hotson versus East Berkshire Health Authority*, [1987] A.C. 750 (House of Lords July 2, 1987); *Herskovits versus Group Health Cooperative of Puget Sound*, 664 P.2d 474 (Supreme Court of Washington, En Banc May 26, 1983).

¹⁴¹³, PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, pp. 328-329; GOLD, S. (2013, Vol. 70). When certainty dissolves into probability: a legal vision of toxic causation for the post-genomic era. *Washington and Lee Law Review*, pp. 238-343, fn. 387.

¹⁴¹⁴ WRIGHT, R. (2011). Proving causation: probability versus belief. In R. GOLDBERG, *Perspectives on causation* (pp. 195-220). Oxford and Portland: Hart Publishing, p. 210.

¹⁴¹⁵ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, p. 345.

¹⁴¹⁶ PERRY, S. (2001). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, p. 334.

4.4.1 Common Law, or the US and the UK

Accepting statistics as a basis of proving causation can result in the liability of the defendant who most probably caused the harm, even when that defendant still could be innocent. Failing absolute certainty on the causal link the alternative is to hold nobody liable. This was considered unacceptable. In the US holding a defendant liable on the basis of probability is generally accepted in toxic tort. The liability is however softened by a proportional compensation. Courts however wanted to attribute liability on a faire basis. The concept of market share liability was developed. Each defendant is then held liable in line with his market share.¹⁴¹⁷

In fact attributing liability and related duty to compensate on the basis of market share is normatively grounded in the fact that each defendant created a risk on harm equal to his market share. However, this is *sensu stricto* not liability for pure risk, since the risk materialised. It is only unclear who exactly provided the causing agent.

The House of Lords has used the same solution in asbestos cases, but was later overruled by the Parliament re-installing joint and several liability for such cases.¹⁴¹⁸

4.4.2 The Netherlands

The Netherlands has its proponents and adversaries of market share liability. Proportional liability is recognized. The creation of the risk leading to the harm is thereby of major importance. Article 6:99¹⁴¹⁹ of the Dutch Civil Code assumes that each of the potential tortfeasors can have caused the total damage. It is impossible to know who actually caused the harm, but it is certain that one of the defendants actually caused it. Consequently each of the defendants is liable for the compensation of the victim, unless he can prove that he did not cause the harm. In cases of mass harm, and multiple defendants the total damage is

¹⁴¹⁷ WRIGHT, R. (2011). Proving causation: probability versus belief. In R. GOLDBERG, *Perspectives on causation* (pp. 195-220). Oxford and Portland: Hart Publishing, p. 214.

¹⁴¹⁸ WRIGHT, R. (2011). Proving causation: probability versus belief. In R. GOLDBERG, *Perspectives on causation* (pp. 195-220). Oxford and Portland: Hart Publishing, pp. 214-215.

¹⁴¹⁹ Kan de schade een gevolg zijn van twee of meer gebeurtenissen voor elk waarvan een andere persoon aansprakelijk is, en staat vast dat de schade door tenminste één van deze gebeurtenissen is ontstaan, dan rust de verplichting om de schade te vergoeden op ieder van deze personen, tenzij hij bewijst dat deze niet het gevolg is van een gebeurtenis waarvoor hijzelf aansprakelijk is.

almost certainly caused by the group of defendants. In other words the probability that the harm was caused by these defendants is nearly 1. Consequently Hartkamp and Sieburgh defend proportionality amongst these tortfeasors in line with their market share.¹⁴²⁰ Market share liability is a refinement of proportional liability on the basis of observable criterion, namely the economic importance of the defendant on the market. The Supreme Court however decided that each defendant can be held liable for the total damage, but has a right to claim excess liability compensation from his fellow defendants.¹⁴²¹ The court considered it unfair that the plaintiff would have to bear the risk that a tortfeasor is not traceable or insolvent.

4.4.3 France

The French situation is different. There a risk should be certain and serious and be the cause of damage before it can be a cause of action. The criterion of certainty excludes the use of probability.¹⁴²² Thus in principle the French courts do not work with the concept of more likely than not. However, the uncertainty on the probability of occurrence of a risk can be offset by the certainty that the damage would be serious and irreversible when materialising.¹⁴²³

On the other hand the uncertainty of risks does not exclude precaution. Precaution has already been used in cases concerning mobile phones. Precaution is then, dixit Lasserre, the economic analysis of subjective probability, namely aiming at minimizing risks as much as possible.¹⁴²⁴ A transition is made from uncertain probability to anticipation of damage when the risks are serious and likely to materialise.

4.5 Conclusion

Risk has become a major issue in our society and is present in policies and legislation. Risk creation is also discussed in the doctrines of tort.

¹⁴²⁰ HARTKAMP, A., & SIEBURGH, C. (2012). Asser 6-II *De verbintenis in het algemeen*: 91 Art. 6:99 BW. Kluwer.

¹⁴²¹ Hoge Raad 9 October 1992, *Nederlandse Jurisprudentie* 1994/535.

¹⁴²² LE TOURNEAU, P. (2009 - update up to September 2013). Répertoire de droit civil: responsabilité (en général). www.dalloz.fr: Dalloz, § 1413.

¹⁴²³ LASSERRE, V. (2011). Le risque. *Recueil Dalloz*, p. 1632.

¹⁴²⁴ LASSERRE, V. (2011). Le risque. *Recueil Dalloz*, p. 1632.

Part IV – Risk versus damage

The economic theory of tort is open to recognise risk as a potential cause of action. The concept fits the theory because it is in line with putting liability on the party who is most able to carry the burden, namely the risk creator. Liability for risk deters risky behaviour and risky activities and it also obliges potential defendants to take precautions.

But it is unclear how risk should be assessed. It is an abstract concept, thus difficult to observe and quantify. According to Law and Economics the value of the created risk is the cost of prevention plus the cost of the expected damage multiplied by its probability.

Following the moral theory of social contract risk creation is a by-product of beneficial activities. Everybody is entitled to create some risk and should also bear some risks created by others. When the balance is distorted fairness is lost. Moral responsibility for the consequence of risk creation is responsibility for the physical harm that results. Thereby an actor should have been able to foresee the result of his risk creation. This requirement is based on the knowledge of risk. Since probability in relation to the materialisation of risk, there is no possibility to know objective risk. Liability is thus based on knowledge (epistemic risk) and not on an objective risk. The latter being impossible to know. Scholars conclude on the former that risk as we know it is not damage and tort is about damage. Thus liability cannot be withheld for risk.

Still courts have to deal with 'risk'. Several approaches exist: risk combined with physical harm, risk and emotional distress and risk in itself.

In general risk can only be a cause of action when linked to physical harm. In the US, the UK and the Netherlands damage should in general be present before a tort claim can be granted. France is more lenient and accepts risk as the basis for a reimbursement of costs made by a potential victim to prevent the risk to materialize.

But, what is damage?

Pure bodily changes without any negative consequences are not accepted as damage, not in Common Law and not in Continental Law. An example of harmless bodily changes that are generally not accepted as damage, are pleural plaques. These plaques are mostly symptomless and they do not lead to any serious disease. They only proved the exposure of the plaintiff to asbestos. Being put in peril is not sufficient.

Part IV – Risk versus damage

The reasons for requiring physical injury is threefold. Firstly, accepting liability for risk without bodily harm could lead to unlimited liability of everybody who creates a risk. Risk creation in itself is not negative or noxious. Furthermore risk is inherent to human life and evolution and is in that sense beneficial.

Secondly, because of the abstract character of pure risk, it is difficult to separate valid claims from non-valid ones. The presence of physical damage supports the existence of the risk.

Thirdly, the court system fears that allowing risk claims would open the floodgates: claims can then be submitted by everybody for all events leading to an overflow of the courts and creating important costs with it.

But tort law is pragmatic and influenced by societal evolution. Also in its approach of risk. Exceptions thus exist.

If a risk is substantial and unreasonable and leads to serious personal injury, including death, then tortious liability can be granted. The US courts motivate their decision referring to the benefit of correcting dangerous situations before tragedy results. In the Netherlands the plaintiff can safeguard a right to compensation when damage materialises. As usual, France interprets the concept of risk more lenient than the other countries. Risk likely to cause serious damage has been accepted by the courts as a basis for a liability claim. The reason behind is that the plaintiff incurs damage when he has to take measures to prevent being worse off; for example when the plaintiff had to take out an insurance. French courts also have the concept of virtual damage, namely a damage that is assumed to exist because all conditions for its materialisation are present, but not yet realised.

Sometimes exposure to risks leads to emotional distress. Fear, depression, anxiety have a negative impact, but these emotions are abstract and as such not observable.

The line between pure risk and risk causing emotional distress is difficult to draw. In Common Law fear in itself cannot be the basis for a tort claim. Physical damage is necessary. Without such physical damage one could say that the approach of emotional distress is similar to the one of pure risk. In most countries emotional damage is indeed only accepted when it materialised into physical damage. However psychiatrically recognized diseases are usually accepted as an actionable damage. Things are no different in the US. Emotional

Part IV – Risk versus damage

damage is compensated if it is accompanied by physical damage. Particular to the US is that the other way around is also possible: the physical damage may result from the fear.

Additionally when fear relies on unknown and /or unlikely association between exposure to a chemical and development of a disease years later, then a US tortfeasor is liable for the emotional harm if his conduct putted the plaintiff in danger of physical harm, but emotional damage is the actual consequence. Probability plays an important role in these decisions.

In the Netherlands extreme fear based on exposure to risk can in itself be considered as damage. The emotional harm should be legally established and some damage should be noticeable. Psychiatrically recognized diseases are considered such damage. The fear is thereby not assessed on the probability that damage will occur, but on the impact it has on the plaintiff.

Although fear is in the UK only a cause of action if physical damage occurred, a claim based on psychiatric illness can succeed without such physical damage. However, confronted with a serious disease like Creutzfeld-Jakob the House of Lords reconsidered its approach and accepted the risk of getting the disease as harm. This case remained an exception. Recent cases still require physical injury or at least a psychiatric disease before a claim can be granted.

Emotional distress following the awareness of a serious risk leads in France to compensation for anxiety. This is particularly the case for fear for a future serious disease, like cancer. France was creative and used the concept of 'trouble caused by neighbours' concerning the creation of a risk and the resulting fear. In the case of the mobile telephone antennas, the court considered the situation 'abnormal' despite the fact that the claim was based on risk. It was scientifically uncertain that damage would follow, but the risk was such that concerns about safety were reasonable and serious. Using the concept of 'trouble caused by neighbours' the abnormality of the risk is based in the seriousness of the possible consequences for human health. However, the difficulties related to liability for pure risk remain, as was clear in the decision of the Court of Cassation stating that the uncertainty was just too big.

The advantage of the 'trouble caused by neighbours' is that it is sufficient that the trouble was abnormal. Wrongfulness does not have to be proved. The

downside is that the requirement of abnormality is too high a standard in cases of toxic tort.

Another 'solution' is the use of medical monitoring claims in situations based on the creation of risk. Medical monitoring serves several objectives of tort: deterrence, economic efficiency, fairness. Regular medical check-ups are not an action for risk of future harm. It is on the contrary a claim for expenses incurred because of the exposure. These costs would not have existed if the exposure would not have taken place.

Significant exposure should be proved as well as a likely risk for future disease. Some courts additionally require actual physical damage, others do not. Rewarding compensation for medical examinations without bodily damage is however consistent with the principle to allow a victim to recover costs, even when no physical injury is observable.

Inherent to risk is the uncertainty surrounding its materialisation. Logically courts try to reduce this uncertainty. They do so by using statistical calculations of the probability that harm will occur. The risk is then defined as the probability that the tortfeasor's risky acts cause damage.

Accepting statistics as proof of causation can however result in the liability of a defendant who in fact is innocent. On the other hand, following standard tort law, uncertainty on causation makes the court unable to find the defendant liable. Such an outcome is deemed unfair. One approach to this issue is the use of market share liability. Each defendant, who has created a risk to the damage, is held liable for a portion equal to his market share. The defendant can still be innocent, but the idea behind market share liability is that each defendant has contributed to the creation of the risk and is thus responsible for the damage, although only in part.

The concept of market share liability is recognized and used in the US. The House of Lords has also used it in asbestos cases, but was overruled by the Parliament installing joint and several liability for such cases. Likewise the Dutch Supreme Court has up to now refused to apply the concept, because it would be unfair to shift the risk of unknown or insolvent defendants to the victim-plaintiff.

Part V –The challenge of proving harm caused by chemicals

*The chief danger is not that a deadly new substance will suddenly be released. A far greater risk is that no one will notice when a substance causes injury years after an exposure.*¹⁴²⁵

If causation is the basis of this research on chemical liability, proving the causation is the knot to disentangle. That proof can in toxic tort seldom be delivered through a simple and direct explanation of a causal process. The biological mechanisms by which diseases and harm are contracted and developed after exposure to toxic substances is yet not fully understood. In the rare cases a substance leads to a signature disease (like methylmercury and the Minamata disease), courts are willing to concede the existence of a causal connection.¹⁴²⁶

But more often, the determination whether an exposure contributed to the harm of the plaintiff is complex. Several questions should be asked when assessing if the act of the defendant led or contributed to the plaintiff's harm. This is certainly relevant when scientific methodologies are used. Recourse is frequently made to statistics for risk estimates and for epidemiological evidence for factual proof. But what do risk estimates based on statistical analysis contribute to the determination whether the defendant's act contributed to the plaintiff's harm? Other scientific areas also contribute to the search for cause, but certainty is seldom obtained. The study with the best fit between its underlying data and the facts of the case should be chosen.¹⁴²⁷ If these conditions are met, the question is still if group data can be used for the proof of specific causation.

This Part of the study analyses that role of science, addressing the subject from different angles. The first paragraph deals with the difference in language between scientists and lawyers as it has an impact on the communication in litigation. However, not all scientific methods are usable or useful in court. A selection of the most popular approaches is discussed in paragraph 5.1.2, whilst

¹⁴²⁵ BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. *Columbia Law Review*, p. 2118.

¹⁴²⁶ BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. *Columbia Law Review*, p. 2121.

¹⁴²⁷ *Stevens versus Secretary of Dept. of Health and Human Services*, 2001 WL 387418 (United States Court of Federal Claims, Office of the Special Masters March 30, 2001).

the procedures that have to be followed when delivering the evidence is the subject of paragraph 5.1.3.

Courts also manage evidence. For the improvement of transparency the proof of causation is split (explicitly or implicitly) between general and specific causation. The additional value this distinction brings to the delivery of proof concerning causation is explained in chapter 5.2.

At the end of the former part, statistics as a way to decide on causation were discussed in relation to their use in assessing risk and damage. That analysis was however performed from another perspective than the one in this part. Now the scientific aspects of probability, and more specifically, the pursuit of quantitative measures is discussed in chapter 3 of this part V.

A lot of different aspects play a role in the delivery of scientific evidence in court. Consequently a summary is useful. Chapter 4 demonstrates the different issues by means of the evolution concerning standards of proof in the US system and chapter 5 will remind the most important points.

5.1. The delivery of science in court

Generally a plaintiff will have to prove in tort the wrongful act, the damage, plus the causal link between the act and the damage.

In Continental law the burden of proof is regulated by law.¹⁴²⁸ In Common law litigation has an important role in the determination and application of evidential standards. The UK have their Civil Evidence Acts for tort, but court decisions have a huge impact on the standard of proof.¹⁴²⁹ In the US, there exist federal

¹⁴²⁸ Art.150 Dutch Code of Civil Procedure: De partij die zich beroept op rechtsgevolgen van door haar gestelde feiten of rechten, draagt de bewijslast van die feiten of rechten, tenzij uit enige bijzondere regel of uit de eisen van redelijkheid en billijkheid een andere verdeling van de bewijslast voortvloeit. *The party who claims legal consequences base on the facts or rights she has, carries the burden of proof, unless a specific rule or on the basis of reasonable and justice another attribution of the burden of proof is decided*; Art. 9 French Code of Civil Procedure: Il incombe à chaque partie de prouver conformément à la loi les faits nécessaires au succès de sa prétention. *Each party should prove, in line with the law, the facts necessary to support its claim.*

¹⁴²⁹ Donoghue versus Stevenson, [1932] A.C. 562 (House of Lords May 26, 1932); McGhee v National Coal Board, 1973 S.L.T. 14 (House of Lords November 15, 1972); Wilsher v Essex Area Health Authority, [1988] A.C. 1074 (House of Lords March 10, 1988); Margerson and Hancock versus J.W. Roberts Limited, [1996] Env. L.R. 304 (Court of Appeal April 2, 1996); Fairchild v. Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002); Gregg v Scott, [2005] WL 62248 (House of Lords January 27, 2005); McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session

rules referring to minimum requirements concerning prove.¹⁴³⁰ Certain states have developed state rules for the exclusion of evidence¹⁴³¹, although the evidence would be admissible in federal court.¹⁴³² Additionally the rules and procedures regarding witnesses show gaps in their texts. This was allegedly done on purpose, in order to enable lawyers and judges to work through these gaps on the basis of their understanding of un-codified common law.¹⁴³³ It is clear that the customary methods of US Common Law did not disappear with the codification of evidence. The law applied in the US includes both statutes and state common law.¹⁴³⁴

In the Netherlands and France, it is accepted that proof can be based on presumptions. In Anglo-American Common Law courts refer to inference as a conclusion based on an assessment of facts without explicit factual basis.¹⁴³⁵ Both concepts, presumption and inference, are important for toxic tort, especially since in such cases it happens regularly that causal links cannot be proved with absolute certainty. Like the case of the Ministry of Defence versus

Outer House May 11, 2005); *Barker versus Corus (UK)*, [2006] UKHL 20 - appeal from [2004] EWCA Civ 545 (House of Lords May 3, 2006); *Sienkiewicz versus Greif (UK) Ltd*, [2011] I.C.R. 391 (Supreme Court March 9, 2011); *B versus Ministry of Defence*, [2012] P.I.Q.R. P13 (Supreme Court March 14, 2012); *Chandler v Cape Plc*, [2012] P.I.Q.R. P17 (Court of Appeal (Civil Division) April 25, 2012).

¹⁴³⁰ Federal Rules of Evidence, relevant for tort are Rule 401, 402, 403 and 702. Federal Rules of Evidence Rule 403, 28 U.S.C.A.

¹⁴³¹ 'State shopping' is not possible, or very difficult to realise after the facts, since the state courts are exclusively competent their residents, except when the parties in the case are residents of different states. In the latter situation the federal courts are competent.

¹⁴³² BONEY, L. (2008). Forum shopping through the Federal Rules of Evidence. *Alabama Law Review*, p. 154.

¹⁴³³ WEISSEBERGER, G. (2009, March). The proper interpretation of the federal Rules of Evidence. *Cardozo Law Review*, pp. 1627-1628.

¹⁴³⁴ Sometimes the adherence to both statutes and common law was interpreted to mean that state common law governs substantive issues and federal law deals with procedures. It is however not clear what is substantive and what is procedural and the distinction is subject to discussion. For a more in depth insight in this topic, the articles of Imwinkelried, Craig, Weissenberger and Cheng are a good start. IMWINKELRIED, E. (2011, Winter). The golden anniversary of the 'preliminary study of the advisability and feasibility of developing uniform rules of evidence for the federal courts': mission accomplished? *Wayne Law Review*, pp. 1367-1393; WEISSEBERGER, G. (2009, March). The proper interpretation of the federal Rules of Evidence. *Cardozo Law Review*, pp. 1615-1646; CRAIG, R. (1999, Vol. 77). When Daubert gets Erie: medical certainty and medical expert testimony in Federal Court. *Denver University Law Review*, pp. 69-135; CHENG, E. (2012, December 5). Erie and the rules of evidence. *Vanderbilt Law Review En Banc*, pp. 231-239.

¹⁴³⁵ *Milward versus Acuity Specialty Products Group, Inc.*, 639 F.3d 11 (United States Court of Appeals, First Circuit March 22, 2011); art. 1353 of the French Civil Code; Hoge Raad 17 December 2004, *Nederlandse jurisprudentie* 2006, 147, LJN AR3290, conclusion Advocate-General Spier, note of C.J.H. Brunner. (Hertel/Van der Lugt). For more details see Part III on Causation.

Wood. The un rebutted evidence of Wood's exposure to organic solvents was considered a probable connection between that heavy and prolonged exposure and Wood's neurological damage.¹⁴³⁶

Meanwhile it is clear that evidence and its delivery in court are in all four countries subject to standards. It is also clear that the courts in both Common and Continental law are relatively free to translate these rules into pragmatic solutions. In toxic tort scientific information is thereby of importance.¹⁴³⁷ In fact science has become a necessary tool for proving the complex causation and appropriate decisions in cases where chemicals are at the basis of damage. Paramount in delivering proof is a clear and understandable communication. This is the first topic of this chapter on the delivery of science in court.

5.1.1 Speaking the same language

It might seem exaggerated to include a paragraph on language in a study on toxic tort. However, since this type of tort highly relies on scientific knowledge when trying to prove causation between an activity and a disease or injury, one cannot ignore that some misunderstandings originate from the lack of comprehension between each other. Communication is always difficult, but the fact that science and law use words and concepts in different senses does not help. Neither does the fact that both areas of expertise have their specific methodologies and logic.

Not appreciating these differences can have a high impact on the outcome of a toxic tort case, as was the case in *Elam versus Alcolac*.¹⁴³⁸ Part of the blame for losing the lawsuit should be put on Alcolac's choice of experts. The experts were too much inclined to caution and understatement.¹⁴³⁹ By the way, this is the normal approach expected of scientists, but it is not suitable for court proceedings. The intellectual tasks of a jurist and a scientist are intrinsically

¹⁴³⁶ Ministry of Defence versus Wood, 2011 WL 2582705 (High Court of Justice Court of Appeal (Civil Division) July 7, 2011). This case is further elaborated in paragraph 5.1.2.1, c) on the Bradford Hill factors.

¹⁴³⁷ Science refers within the context of this study to mathematics, statistics, medicine, physics, chemistry, engineering, etc. Please note that this does not mean that law, sociology, psychology, etc. are not sciences.

¹⁴³⁸ *Elam versus Alcolac, Inc.*, 765 S.W.2d 42 (Missouri Court of Appeals November 1, 1988).

¹⁴³⁹ HUBER, P. W. (1991 - 1995). *Galileo's Revenge: Junk Science in the Courtroom*. New York: Basic Books, p. 103.

different. Law aims at final decisions whilst scientific conclusions are provisional.¹⁴⁴⁰

Science aims for an accurately understanding of the phenomena they study and is open-ended. Results of scientific research are always under review and altered based on new insights. Tort law wants to realize equitable, just and lasting solutions of disputes.¹⁴⁴¹ Scientists are generally careful with their conclusions and therefore will rarely or never present these as certain.¹⁴⁴² Judges frequently interpret the habit of scientists to express tentativeness and dubiety as incertitude of the validity of their scientific conclusions. Unless judges can understand the rhetoric of scientists, they risk rejecting reliable evidence or get stuck in incorrect assumptions.¹⁴⁴³

For many years both sides have tried to find a common ground of understanding.

Was this quest successful? Not really, thus it is useful to explain briefly what is different between both disciplines.

Legal certainty will always differ from scientific certainty. Indeed when a scientific expert gives an opinion on causation he refers to results in terms of certain or uncertain. He is never completely sure, except in the inconceivable event a 100 % deterministic link would exist and observed.¹⁴⁴⁴

But, when a scientific expert will say he is sure on the existence of causation from 95 % likelihood on, the court will still doubt if that is sufficient. Jurisprudence is looking for certainty and wants to make decisions that last for the future. The task is, in other words, to assimilate the scientific standard with

¹⁴⁴⁰ BROWN, R. (2010, Vol. 55). The possibility of "inference causation": inferring cause-in-fact and the nature of legal fact-finding. *McGill Law Journal ~ Revue de droit de McGill*, p. 20.

¹⁴⁴¹ CRANOR, C. F., & ESATMOND, D. A. (2001, Vol. 64 issue 4). Scientific Ignorance and reliable patterns of evidence in toxic tort caUStion: is there a need for liability reform? *Law and Contemporary Problems*, p. 18.

¹⁴⁴² GROSS, S. (1991). Expert Evidence. *Wisconsin Law Review*, pp.1113-1132; CRANOR, C. F., & ESATMOND, D. A. (2001, Vol. 64 issue 4). Scientific Ignorance and reliable patterns of evidence in toxic tort causation: is there a need for liability reform? *Law and Contemporary Problems*, p. 22.

¹⁴⁴³ CRANOR, C. F., & ESATMOND, D. A. (2001, Vol. 64 issue 4). Scientific Ignorance and reliable patterns of evidence in toxic tort caUStion: is there a need for liability reform? *Law and Contemporary Problems*, pp. 23-26.

¹⁴⁴⁴ 100 % deterministic causal links cannot be proved since it is inherent to people that we cannot know everything. Reality is an epistemic experience.

the legal standard; a challenge since there is no correlation between scientific certainty and legal certainty.¹⁴⁴⁵

“Judges and lawyers must approach with great care, the idea that court decisions can be justified solely on the findings of science, lest the quest for justice be lost along the way.”¹⁴⁴⁶

However the very nature of toxic tort forces courts to work with scientific evidence. What studies are the most commonly used in court? The following paragraph describes them.

5.1.2 Scientific studies used in court

Many methods exist to gather information on associations between chemicals and diseases or other damage. An association is however not the same as a causal link. It remains difficult to prove causation beyond the influence of other agents, like those present at background level.

Furthermore results of scientific studies require interpretation and extrapolation. Experts deliver their opinions on these results in court. But who are those experts and what exactly is their role in court? The following paragraph discusses the most frequently used research methods and the presentation of the findings by experts.

5.1.2.1 Epidemiology

Epidemiology is the most used type of evidence in toxic tort cases¹⁴⁴⁷, especially for proof of general causation.¹⁴⁴⁸ Epidemiology studies the incidence, distribution and aetiology of diseases in a specified human population.¹⁴⁴⁹ They use statistical methods to discover associations¹⁴⁵⁰ between conditions and

¹⁴⁴⁵ EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters, p. 293.

¹⁴⁴⁶ *Allen versus United States of America*, 588 F.Supp. 247 (US District Court, D. Utah, Central Division May 10, 1984).

¹⁴⁴⁷ Please note that epidemiology can also study the impact of beneficial agents, but that is not relevant for the study of toxic tort.

¹⁴⁴⁸ For the definition and role of general causation, see Chapter 5.2 of this Part.

¹⁴⁴⁹ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 335; JOHNSON, C. (2000, vol. 11). When science is too daunting: multiple chemical sensitivity, federal courts and the struggling spirit of Daubert. *Villanova Environmental Law Journal*, p. 289.

¹⁴⁵⁰ An association between exposure to an agent and disease exists when they occur together more frequently than one would expect by chance. GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center,

exposures.¹⁴⁵¹ Such studies aim at identifying an association between the substances and the increased disease incidence, quantify the increase of a disease and provide a profile of the type of individual who is likely to be damaged.¹⁴⁵²

a) The design of an epidemiological study

Epidemiological studies can be experimental or observational.

Experimental epidemiological studies assign subjects randomly to one of two groups. Thereafter one group is exposed to the substance of interest and the other group is not. After a period of time the development of the disease is compared between the two groups and conclusions are made. Such experimental research is the most reliable method for determining an association between an exposure and a consequence.¹⁴⁵³

Because it is morally and ethically impossible to experiment with people in order to assess the consequence of an exposure to an alleged toxic substance, observational epidemiological research is mostly used. Groups of unexposed individuals are compared with groups of individuals exposed to a potential cause of disease. In most cases these studies analyse the incidence on the basis of the past, meaning exposed and unexposed groups. On the other hand it is also possible to compare one group that likely will remain unexposed with another group that likely will be exposed.¹⁴⁵⁴ The objective is always to determine if the persons, exposed to a specific substance, have a greater risk of contracting a particular disease, subject of the study, than the unexposed ones. The circumstances and the rate of exposure are however always partially unknown. Results can thus be blurred by hidden influences.

Reference Manual on Scientific Evidence (pp. 374-380). Federal Justice Center of the United States, p. 348.

¹⁴⁵¹ DORE, M. (1985, Vol. 28 Issue 3). A Proposed Standard for Evaluating the Use of Epidemiological Evidence in Toxic Tort and other Personal Injury Cases. *Howard Law Journal*, pp. 681-682.

¹⁴⁵² GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States. p. 335.

¹⁴⁵³ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States. p. 335.

¹⁴⁵⁴ This is possible in situations where people are professionally exposed to substances that are suspected to be noxious.

Consequently it is important for the reliability of such studies that some design criteria are respected. Firstly, the population studied should be large enough to reflect the characteristics of the total population of interest. Secondly, deviations must be measured against a norm set through the results of a study of a control population. Then the deviations from the norm must be large enough to be distinguished from random fluctuations.¹⁴⁵⁵

The category of observational epidemiological studies is further divided in cohort, case-control and cross-sectional studies.

Cohort studies start with a group of people without the disease. Then that group is split in two subgroups. One group consists of people who were exposed to the substance and the other group of people who were not exposed.¹⁴⁵⁶ The following step is then to measure and compare the incidence of disease in the exposed and the unexposed group.¹⁴⁵⁷ A cohort study can be retrospective, namely both exposure and diseases occurred before the start of the research. A cohort study may also be prospective. Then the exposure happened before the start of the study and the researchers now investigate the incidence of the disease in the future.¹⁴⁵⁸ Typically this research is performed over a long period of time.

Case control studies start from people who have the disease. Epidemiologists relate the disease status to the exposure to the toxic substance through a comparison with unexposed individuals.¹⁴⁵⁹ These studies work with past exposure. An association between substance and diseases exists when there are more people with the disease amongst the exposed group than in the unexposed

¹⁴⁵⁵ DORE, M. (1985, Vol. 28 Issue 3). A Proposed Standard for Evaluating the Use of Epidemiological Evidence in Toxic Tort and other Personal Injury Cases. *Howard Law Journal (How. L.J.)*, pp. 431-434.

¹⁴⁵⁶ JOHNSON, C. (2000, vol. 11). When science is too daunting: multiple chemical sensitivity, federal courts and the struggling spirit of Daubert. *Villanova Environmental Law Journal*, p. 289.

¹⁴⁵⁷ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 340.

¹⁴⁵⁸ PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc; p. 65.

¹⁴⁵⁹ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 342.

group.¹⁴⁶⁰ In statistical terms: the rate of exposure is compared to the overall incidence of the disease.

The third category, cross-sectional studies, is not very useful for identifying associations between a substance and a disease. They do not determine the incidence of the disease. In such studies individuals are examined on both exposure and disease at a single point in time. Consequently it is not possible to establish the temporal relation between exposure and disease, which is necessary for drawing any causal inference.¹⁴⁶¹

The previously mentioned types of studies gather data for each individual included in the research. Another type of studies, also used in court, are studies that collect data only on the group level.¹⁴⁶² These are called ecological studies. Such research may be useful for detecting associations, but rarely gives good information for the inference of casual links. Therefore this type is not discussed any further.¹⁴⁶³

All of these studies are used in court, but they have some downsides compared to laboratory experiments. Elements, like diet, exercise, exposure to other agents, life style, etc. can influence the outcome, since these factors cannot be controlled directly. Only the factors considered by the investigator in the study design are included in the scientific conclusions.¹⁴⁶⁴

b) Interpreting the results

The result of an epidemiological study is the finding whether an association exists between the exposure and the harm. Factors pointing to the existence of an association are a temporal, plausible or/and consistent relation between exposure and harm, the strength of the association and a noticeable dose-

¹⁴⁶⁰ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 342.

¹⁴⁶¹ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 343.

¹⁴⁶² Epidemiological studies collect individual data, but conclude on group level.

¹⁴⁶³ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 344.

¹⁴⁶⁴ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, pp. 338-339.

response relationship.¹⁴⁶⁵ These findings apply to the populations of living people from which a study's sample is drawn and not to an individual person.¹⁴⁶⁶

Causal links as such are not proved.¹⁴⁶⁷ We cannot observe both situations (being exposed and being unexposed, having cancer and not having cancer) on the same individual.¹⁴⁶⁸ Consequently an association does not necessarily prove that there is a cause-effect relationship. The evaluation of the existence of causation requires an assessment of the quality of the study and a judgment based on (scientific) knowledge or on other reasons.

In order to obtain reliable interpretations, the design of the study has to be evaluated. First the influence of confounding factors should be investigated and eliminated. A confounding factor is both a risk factor for the disease and a factor associated with the exposure.¹⁴⁶⁹ The effects of the two processes are not separate.¹⁴⁷⁰

Notorious errors are attributable to confounding factors.¹⁴⁷¹ In the *New England Journal of Medicine*, a professor, chairman of the department of epidemiology at Harvard, wrote that there was an association between coffee drinking and pancreas cancer. After protest from the coffee distributors, the question was raised if the pancreas cancer could not be caused by smoking. A connection between smoking and the cancer was already established and nearly all smokers were coffee drinkers. The association could thus be due to the confounding

¹⁴⁶⁵ JOHNSON, C. (2000, vol. 11). When science is too daunting: multiple chemical sensitivity, federal courts and the struggling spirit of Daubert. *Villanova Environmental Law Journal*, p. 295.

¹⁴⁶⁶ GOLD, S. (2011). The "reshapement" of the false negative asymmetry in toxic tort causation. *William Mitchell Law Review*, p. 1520.

¹⁴⁶⁷ *Wells versus SmithKline Beecham Corp.*, 601 F.3d 375 (United States Court of Appeals, Fifth Circuit March 22, 2010); GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, pp. 336-337.

¹⁴⁶⁸ This can be done in experiments, but ethical concerns frequently prohibit this.

¹⁴⁶⁹ Green gives following example: Researchers may conduct a study that finds individuals with gray hair have a higher rate of death than those with hair of another color. Instead of hair color having an impact on death, the results might be explained by the confounding factor of age. If old age is associated differentially with the gray-haired group (those with gray hair tend to be older), old age may be responsible for the association found between hair color and death. GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2.e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 369.

¹⁴⁷⁰ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, pp. 369-370.

¹⁴⁷¹ EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters, p. 303.

factor of smoking.¹⁴⁷² Indeed, the professor preliminary investigated the danger of confounding factors. Consequently he had separated his data in smokers and non-smokers.

Especially studies that do not assign participants randomly run the risk of making errors by confounding. Such studies are frequently carried out in relation to toxic exposure.¹⁴⁷³ An example is research conducted in the work environment whilst neglecting the situation of the employees at home, their age, smoking, drinking, etc. Regretfully the risk of confounding is inherent to uncontrolled, observational studies as frequently used in toxic tort litigation.

On top epidemiological studies are extremely difficult to design. Not all factors that may affect the data can be detected and/or controlled, what can additionally lead to errors and oversights.¹⁴⁷⁴

Secondly, one should assess if the association between the disease and the exposure is strong enough.¹⁴⁷⁵ The stronger the association is, the more likely it points towards a causal link. Therefore the relative risk is calculated to translate the strength of association into a number. Relative risk is the ratio of the risk or the disease among people exposed to a substance to the risk among people unexposed to that substance.

In concreto, if the strength is 2.0 relative risk¹⁴⁷⁶ then the risk of developing the disease in an exposed group is two times higher than the risk in an unexposed group. Or, if 10 % of the people in the exposed group develop cancer whilst in the unexposed group this is 5 %.

¹⁴⁷² GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2,e) Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 370.

¹⁴⁷³ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, pp. 370-371.

¹⁴⁷⁴ BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. *Columbia Law Review*, pp. 2125-2126.

¹⁴⁷⁵ Concepts as the relative risk, odds risk, attributable risk, sampling error, selection and/or information bias are no further explained in this text. For more information, see the article of Green. GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, pp. 348-369.

¹⁴⁷⁶ A relative risk of 1 indicates no exposure. GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 395.

If epidemiological research is the only proof of an association and consequently the casual link has to be derived from this data, courts are generally inclined to require strength of 2.0 or more, even when these courts do not want to conflate the strength with the standard of persuasion.¹⁴⁷⁷ But, in fact such statistical breakpoint is not necessary.¹⁴⁷⁸

When it is with great certainty known that a substance causes adverse health effect(s), like it is the case for radioactive substances or dioxins, the standard is lowered and associations beneath 2.0 are accepted.¹⁴⁷⁹ Even a weak association can indicate¹⁴⁸⁰ a causal relationship when other factors support the conclusions.¹⁴⁸¹ Then the appreciation of the complete pack of evidence is based on a judgment of the court.

Another method used by epidemiologists trying to establish causation is the sensitivity analyses, thereby exploring alternative explanations for their findings. Other studies, like *in vivo* or *in vitro* studies, can also be carried out to confirm or rebut the casual link.¹⁴⁸²

In all this one should always bear in mind that statistics do not appreciate a situation; they only register events and facts. It is only a factual observation

¹⁴⁷⁷ King versus Burlington Northern Santa Fe Railway Company, 762 N.W.2d 24 (Supreme Court of Nebraska February 27, 2009), Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II), 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995).

¹⁴⁷⁸ A remark has to be made on a strength (or RR) of 1. Generally this is understood as if there is no effect of the exposure on the incidence of a disease or, in other words, the probability of the cause is zero. This conclusion is incorrect. A strength of 1 only implies that the exposure has no net effect on the incidence of the disease. See BROADBENT, A. (2011, Vol. 17 issue 4). Epidemiological evidence in proof of specific causation. *Legal Theory*, p. 254.

¹⁴⁷⁹ In re Bextra and Celebrex Marketing Sales Practices, 524 F.Supp.2d 1166 (United States District Court, N.D. California November 19, 2007); In re Silicone Gel Breast Implants products liability litigation, 318 F.Supp.2d 879 (United States District Court, C.D. California April 22, 2004); Jeanne Jaros versus E.I. DuPont (In re Hanford Nuclear Reservation Litigation), 292 F.3d 1124 (US Court of Appeals, Ninth Circuit June 18, 2002); Magistrini versus One Hour Martinizing Dry Cleaning, 180 F.Supp.2d 584 (D.N.J.2002)., 180 F.Supp.2d 584 (United States District Court, D. New Jersey January 4, 2002); Miller versus Pfizer, Inc., 196 F.Supp.2d 1062 (United States District Court, D. Kansas February 7, 2002); In re Joint E. & S. District Asbestos Litigation, 52 F.3d 1124 (United States Court of Appeals, Second Circuit April 6, 1995).

¹⁴⁸⁰ For example through a meta-analysis of the different epidemiological studies.

¹⁴⁸¹ Int'l Union of operating engineers versus Merck & Co, Inc., 929 A.2d 1076 (Supreme Court of New Jersey September 6, 2007); Paoli Railroad Yard PCB litigation - Brown versus Monsanto e.a., 916 F.2d 829 (US Court of Appeals, Third Circuit November 23, 1990); GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 376.

¹⁴⁸² DOMINICI, F. (2007, October 17). The role of epidemiology in the law: a toxic tort litigation case. *Law, Probability and Risk*, p. 26.

that (for example) 50 % of smokers have more lung cancer. There are smokers without lung cancer, non-smokers with lung cancer and smokers who without their habit would anyhow have developed lung cancer.... That is why 'attributable fraction' (AF) is calculated. This factor reflects the proportion of a disease that is 'attributable' to a given exposure in a given population.¹⁴⁸³ They are the people who smoke and have lung cancer, and would not have contracted the disease if they would not have smoked.

Another flaw of epidemiological research is that in situations of exposure to a variety of substances, as is likely the case with environmental exposure, the studies generally do not single out a specific substance. This has already proved to be an impediment for a plaintiff to produce the required evidence of causation. When two tanker men contracted bladder cancer and Hodgkin's lymphoma, they filed a claim against their employer on the basis that more than fifty studies provided an adequate basis for the opinion that the types of chemicals appellants were exposed to could cause these particular injuries in the general population.¹⁴⁸⁴ There was no reliable evidence delivered that could support a decision that benzene specifically caused the diseases. The content of the studies presented in court were considered not relevant to the facts at hand.¹⁴⁸⁵

On the basis of mentioned aspects, it can be concluded that epidemiological evidence alone will not be sufficient to establish a causal link. Epidemiological studies are probabilistic studies.¹⁴⁸⁶ Although these studies are particularly relevant, the discovery of causation still requires an interpretation based on other elements. One methodology to approach this challenge is the Bradford Hill criteria, which are discussed in the following paragraph.

c) The Bradford Hill factors

Once an association is established, epidemiologists often used the Bradford Hill factors for the discovery of a causal link. In the sixties Sir Austin Bradford Hill

¹⁴⁸³ AF = (risk among exposed – risk among unexposed)/risk among exposed, BROADBENT, A. (2011, Vol. 17 issue 4). Epidemiological evidence in proof of specific causation. *Legal Theory*, p. 240.

¹⁴⁸⁴ Knight versus Kirby Inland Marine Inc., 482 F.3d 347 (United States Court of Appeals, Fifth Circuit March 19, 2007).

¹⁴⁸⁵ Watts versus Radiator Specialty Company, 990 So.2d 143 (Supreme Court of Mississippi September 18, 2008).

¹⁴⁸⁶ EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters, p. 299.

wanted to find out if there was an association or/and a causal link between the environment¹⁴⁸⁷ and diseases.¹⁴⁸⁸

Sir Austin Bradford Hill was one of the first to link tobacco smoking and lung cancer.¹⁴⁸⁹ But, as already mentioned, there is a difference between an association and a causal link. An association between two elements exists when they occur more frequently together than one would expect by chance.¹⁴⁹⁰ Causation, on the other hand, can be defined as an association between two events when one event is a necessary link for an effect to occur.¹⁴⁹¹ Consequently associations found by epidemiological research cannot be directly translated into causation. Bradford Hill wanted to find a method for translating an observed association into causation. A method that would justify abandoning the conviction that correlation is not causation.¹⁴⁹²

The Bradford Hill factors were developed. Subsequently they are used in several toxic tort cases with uncertain causation.¹⁴⁹³ They are in the US officially recognized and formally referred to, for example, in the Restatement (Third) of Tort, in the guidelines of the Environmental Protection Agency (2005), and in the Federal Reference Manual on Scientific Evidence. They are used in several court cases in the US and the UK.¹⁴⁹⁴

¹⁴⁸⁷ In the Bradford Hill study, environment refers to the surroundings (for example the work place) and not to nature.

¹⁴⁸⁸ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, pp. 295-300.

¹⁴⁸⁹ DOLL, R., & BRADFORD HILL, A. (1956, November 10). Lung Cancer and other causes of death in relation to smoking. *British Medical Journal*, p. 1071

¹⁴⁹⁰ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2.e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 348.

¹⁴⁹¹ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2.e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 336.

¹⁴⁹² BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 300.

¹⁴⁹³ *Dunn versus Sandoz Pharmaceuticals Corp*, 275 F. Supp. 2d 672 (United States District Court, M.D. North Carolina August 4, 2003); *Magistrini versus One Hour Martinizing Dry Cleaning*, 180 F.Supp.2d 584 (D.N.J.2002)., 180 F.Supp.2d 584 (United States District Court, D. New Jersey January 4, 2002); *Glastetter versus Novartis Pharmaceuticals Corporation*, 252 F.3d 986 (US Court of Appeals, Eighth Circuit June 8, 2001); *Conde versus Velsicol Chemical Corporation*, 24 F.3d 809 (United States Court of Appeal May 16, 1994).

¹⁴⁹⁴ *Wood versus Ministry of Defence*, 2011 WL 2582705 (High Court of Justice Court of Appeal (Civil Division) July 7, 2011), § 60; *Jones versus Metal Box Ltd*, 2007 WL 2041783

However, in view of the reluctance of UK courts to use epidemiological evidence, the Bradford Hill criteria are not frequently found in their decisions.¹⁴⁹⁵ The Sellafield example is an exception.

On 8 October 1961 a little girl, named Dorothy, was born. On 2 September 1962 she died from early acute lymphatic leukaemia. On 10 May 1965 Vivien was born. In June 1988 she was diagnosed with non-Hodgkin's lymphoma. Both cases were allegedly caused by ionizing radiation from the Sellafield nuclear plant.¹⁴⁹⁶ In court the question was if the epidemiological study submitted proved an association between the radiation and the diseases validity of the study. If an association was found, the next question was if such an association could be considered the source of the diseases.¹⁴⁹⁷ According to the plaintiffs the results supported the existence of a significant association between the excess of leukaemia and the pre-conception irradiation. In order to form his own opinion, judge French applied the Bradford Hill Criteria.¹⁴⁹⁸ He took thereby into account Bradford's remark that:

"[n]one of my nine viewpoints can bring indisputable evidence for or against the cause-and-effect hypothesis, and none can be required as a sine qua non".¹⁴⁹⁹

The criterion of analogy, for example, was considered as having little importance in the case.¹⁵⁰⁰ The ambivalent role of specificity, namely the fact that irradiation

(Cardiff County Court January 11, 2007); *McTear versus Imperial Tobacco Ltd*, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005), § 6.1; *Dunn versus Sandoz Pharmaceuticals Corp*, 275 F. Supp. 2d 672 (United States District Court, M.D. North Carolina August 4, 2003); *Elvicta Wood Engineering Ltd versus Huxley*, 2000 WL 664536 (Court of Appeal (Civil Division) April 19, 2000); *Dingley versus Chief Constable of Strathclyde*, 2000 S.C. (H.L.) 77 (House of Lords March 9, 2000), § 5.39.

¹⁴⁹⁵ McIVOR, C. (2013, Vol. 21). Debunking some judicial myths about epidemiology and its relevance to UK tort law. *Medical Law Review*, pp. 554-558.

¹⁴⁹⁶ *Reay versus British Nuclear Fuels Plc*, [1994] Env. L.R. 320 (Queen's Bench Division October 8, 1993).

¹⁴⁹⁷ *Reay versus British Nuclear Fuels Plc*, [1994] Env. L.R. 320 (Queen's Bench Division October 8, 1993), p. 322.

¹⁴⁹⁸ *Reay versus British Nuclear Fuels Plc*, [1994] Env. L.R. 320 (Queen's Bench Division October 8, 1993), pp. 362-365.

¹⁴⁹⁹ HAACK, S. (2008, Vol. IV Issue 2). Proving CaUStion: The Holism of Warrant and the Atomism of Daubert. *Journal of Health & Biomedical Law*, footnote 72.

¹⁵⁰⁰ *Reay versus British Nuclear Fuels Plc*, [1994] Env. L.R. 320 (Queen's Bench Division October 8, 1993), p. 363.

could produce a variety of damage, placed the use of this criterion into perspective.¹⁵⁰¹

The case demonstrates that a judgment is necessary, as well for the criteria applicable to the concrete case as for the appreciation of the assessment of each criterion. Indeed there exists no algorithm to determine if a statistical association truly reflects a causal link.¹⁵⁰² However the factors are considered a valid method to assess causal links in epidemiology.¹⁵⁰³

Their formulation is broad and in nonspecific terms. This makes them usable and valid for a wide variety of research questions.¹⁵⁰⁴

The factors are:¹⁵⁰⁵

Strength (1) refers to the strength of the association, or, as it is nowadays formulated, the statistical significance of the relation between event A and event B. A strong association is more likely to have a causal link than a modest association.¹⁵⁰⁶ The absence of a strong association does however not rule out a causal effect. A strong association can also exist when there is no causal relation with the specific factor studied.¹⁵⁰⁷ Other prevalent causes can influence the outcome. The advantage of a strong association is that it cannot solely be due to small biases.

Consistency (2) means that the relationship between a factor and an outcome is observed repeatedly. Hill refers thereby to different persons, places,

¹⁵⁰¹ Reay versus British Nuclear Fuels Plc, [1994] Env. L.R. 320 (Queen's Bench Division October 8, 1993), p. 364.

¹⁵⁰² Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 5. Factual Cause, § 28 Burden of Proof (2012), § 28 cmt. c (1).

¹⁵⁰³ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 375.

¹⁵⁰⁴ GOLD, S. (2013, Vol.3 Issue 1 April). A fitting vision of science for the courtroom. *Wake Forest Journal of law & policy*, fn. 143; MILLER, C. (2006, December Vol. 26 No. 4). Causation in personal injury: legal or epidemiological common sense, *Legal Studies*, p. 545.

¹⁵⁰⁵ For a more detailed discussion of the Bradford Hill criteria, see HOFLE, M. (2005, November 3). The Bradford Hill considerations on causality: a counterfactual perspective. *Emerging Themes in Epidemiology*, p. 1-21.

¹⁵⁰⁶ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, pp. 295-300.

¹⁵⁰⁷ HOFLE, M. (2005, November 3). The Bradford Hill considerations on causality: a counterfactual perspective. *Emerging Themes in Epidemiology*, p. 3.

circumstances and time.¹⁵⁰⁸ Flaws in studies can be reduced by using different study designs. However, if similar flaws do occur, they lead to the same erroneous conclusions.¹⁵⁰⁹ Causal agents might require that another condition is present.¹⁵¹⁰ For example: transfusion can lead to HIV only if the virus is present.¹⁵¹¹

Specificity (3) or a factor influences specifically a particular outcome or population.¹⁵¹² If that is the outcome of a study, there is a strong argument for the existence of a causal effect. However if specificity is not detected, then one should be aware that a disease can have more than one cause. The specificity criteria should be evaluated in combination with the strength of the association.¹⁵¹³

The criterion of specificity is often without meaning, mainly because a disease can be caused by several agents. Likewise a chemical can cause several diseases or at least can have an effect of several. Höfler concludes that the criterion of specificity is only useful when the causal links are simple and the knowledge about these is largely certain.¹⁵¹⁴

Temporality (4) is often used in philosophy when talking about 'the way time is'. Here it refers only to the linear progression of time: the factor must precede the outcome it is assumed to affect.

It is a factor that is especially relevant in cases of diseases or injuries with a long latency period or a slow development, as is often the case with

¹⁵⁰⁸ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, pp. 295-300.

¹⁵⁰⁹ HOFLE, M. (2005, November 3). The Bradford Hill considerations on causality: a counterfactual perspective. *Emerging Themes in Epidemiology*, p. 3.

¹⁵¹⁰ HOFLE, M. (2005, November 3). The Bradford Hill considerations on causality: a counterfactual perspective. *Emerging Themes in Epidemiology*, p. 3.

¹⁵¹¹ Failing such a strong causal link in diseases caused by chemicals (even mesothelioma is not 100% due to asbestos), the example of human immunodeficiency virus infection was used.

¹⁵¹² BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 297.

¹⁵¹³ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 297.

¹⁵¹⁴ HOFLE, M. (2005, November 3). The Bradford Hill considerations on causality: a counterfactual perspective. *Emerging Themes in Epidemiology*, p. 5.

chemicals.¹⁵¹⁵ Temporal direction might be difficult to establish if a disease develops slowly and initial forms of disease were difficult to observe or assess.¹⁵¹⁶

Biological gradient (5) or a dose-response curve is useful for obvious reasons. If the relation is linear then the situation is clear. However if the relation dose-effect is not linear the explanation of the relation becomes complex. Without going into more detail, the dose-response relationship is in many studies not required to have only a particular shape that is theoretically predicted.¹⁵¹⁷ One thing is clear: causation can be refused when the exposure of the plaintiff is lower than the proved negative impact dose.¹⁵¹⁸

Plausibility (6) means that the observed association can be plausibly explained by substantive matter explanations, for example on the basis of biology.¹⁵¹⁹ For Hill it is a criterion that is 'nice to have', but not necessary. It depends very much on the state of knowledge and associations that are new to science often cannot be observed.¹⁵²⁰

Coherence (7) or a causal conclusion should not fundamentally conflict with the generally known facts and knowledge.¹⁵²¹ It is important that that knowledge is undisputable.

Experiment (8) it is more likely to find proof of causation if evidence is based on randomised experiments. For example if lung cancer is related to smoking then

¹⁵¹⁵ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, pp. 297-298.

¹⁵¹⁶ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, pp. 297-298.

¹⁵¹⁷ HOFLE, M. (2005, November 3). The Bradford Hill considerations on causality: a counterfactual perspective. *Emerging Themes in Epidemiology*, p. 5.

¹⁵¹⁸ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 298.

¹⁵¹⁹ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 298.

¹⁵²⁰ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 298.

¹⁵²¹ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 298.

one could forbid smoking and study if the incidence of cancer changes. Experiments can deliver strong evidence for causation.¹⁵²²

Analogy (9) can be used in circumstances when it is incorrect or unethical to experiment. It means that one is referring to analogous exposures and outcomes for which an effect has already been shown.¹⁵²³ There should, however, be a strong similarity between, for example, the structure and effects of two chemicals.¹⁵²⁴

The flexibility of the Bradford Hill method is demonstrated in several cases, as in the following case.

In *Wood versus the Ministry of Defence* Wood claimed that he contracted a neurological condition (similar to Parkinson's disease) from his exposure to organic solvent during his service as a painter in the Royal Air Force. It was known that the solvents he used, in particular dichloromethane and trichloroethylene, were neurotoxic substances. After becoming ill, Wood alleged that he suffered permanent organic damage to his nervous system resulting in a condition akin to Parkinson's disease.¹⁵²⁵ The exact cause or causes of the degeneration of the nervous system are not known.¹⁵²⁶ The Ministry of Defence claimed that Wood's symptoms were all due to psychological factors. Experts differed in opinion and provided contradicting evidence. Furthermore it was impossibility to exclude that the disease could have been caused by other factors, like a genetic predisposition.

Although it was clear that the solvents could cause temporary effects and even death when the dose was large enough, there was no satisfactory scientific proof that these substances could also cause permanent, serious damage. The expert's argued that, even where there are no supportive epidemiological

¹⁵²² BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 298-299.

¹⁵²³ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 299.

¹⁵²⁴ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 299.

¹⁵²⁵ Parkinson's disease (PD) is a progressive neurological. It is due to degenerative change in the ganglia at the base of the cerebrum, leading most commonly to a deficiency in a neurotransmitter called dopamine.

¹⁵²⁶ *Ministry of Defence versus Wood*, 2011 WL 2582705 (High Court of Justice Court of Appeal (Civil Division) July 7, 2011).

studies, there exist other means by which causation can be established. He referred to the Bradford Hill criteria. The judge accepted the use of the factors recognising that they are a sound basis for reaching conclusions.

“Whereas an epidemiologist will not declare that there is an association unless the study shows that it is 95% certain that the apparent association cannot be the result of chance, the judge in a civil claim need only be satisfied that it is more likely than not that the condition in question has been caused by the alleged exposure.”¹⁵²⁷

On the basis that there was (1) clear evidence of a very high level of exposure, (2) there was some scientific evidence of an association between heavy exposure to solvents and neurological damage, (3) there were three other RAF cases and there was an analogy with glue sniffing, the court accepted the existence of a causal link.¹⁵²⁸ The association in itself was not sufficient, but after using the Bradford test the court felt certain enough to decide in favour of Wood.

In the US the Bradford Hill criteria are used as well.¹⁵²⁹ The Magistrini case is a text book example. The judge refers to all nine factors and explicitly adds that, although one or more of the factors may be absent in the case, a causal relationship can be considered proved.¹⁵³⁰ Similarly in Raines versus PPG Industries the nine factors of Bradford Hill were analysed in detail and applied flexibly.¹⁵³¹

This use of the factors is in line with the intention of Bradford Hill when he promoted them.

“The ‘cause’ of illness may be immediate and direct, it may be remote and indirect underlying the observed association. But with the aims of

¹⁵²⁷ Ministry of Defence versus Wood, 2011 WL 2582705 (High Court of Justice Court of Appeal (Civil Division) July 7, 2011).

¹⁵²⁸ Ministry of Defence versus Wood, 2011 WL 2582705 (High Court of Justice Court of Appeal (Civil Division) July 7, 2011).

¹⁵²⁹ Soldo versus Sandoz Pharmaceuticals Corp., 244 F. Supp. 2d 434 (United States District Court, W.D. Pennsylvania January 13, 2003); Merrell Dow Pharmaceuticals Inc. versus Havner, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997).

¹⁵³⁰ Magistrini versus One Hour Martinizing Dry Cleaning, 180 F.Supp.2d 584 (D.N.J.2002)., 180 F.Supp.2d 584 (United States District Court, D. New Jersey January 4, 2002).

¹⁵³¹ Rains versus PPG Industries, Inc., 361 F.Supp.2d 829 (United States District Court, S.D. Illinois December 23, 2004).

occupational, and almost synonymously preventive, medicine in mind the decisive question is whether the frequency of the undesirable event B will be influenced by a change in the environmental feature A. How such a change exerts that influence may call for a great deal of research. However, before deducing 'causation' and taking action we shall not invariably have to sit around awaiting the results of that research."¹⁵³²

Epidemiological studies can be examined on their reliability using factors like the Bradford Hill criteria.¹⁵³³

One condition though. Sir Bradford Hill identified the existence of an association between two variables that is perfectly clear and beyond what is attributable to chance as the prerequisite for applying the factors.¹⁵³⁴ When there is no association between the substance and the disease, the factors cannot be used.

5.1.2.2 Toxicological studies

Whilst epidemiology's role is to detect differences in disease frequencies in human populations, toxicology investigates toxicological significance.¹⁵³⁵ Toxicology is the study of negative effects on biological systems caused by chemicals or other physical agents.¹⁵³⁶

For example, mercury is emitted by coal-burning facilities and transported over long distances by air, before falling into waters where it enters the aquatic food chain.¹⁵³⁷ Human beings can be affected by mercury by ingestion, through the skin and via inhalation.¹⁵³⁸

¹⁵³² BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 300.

¹⁵³³ Merrell Dow Pharmaceuticals Inc. versus Havner, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997).

¹⁵³⁴ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 295-300; Missouri Pacific R. Co. versus Navarro, 90 S.W.3d 747 (Court of Appeals of Texas, San Antonio June 26, 2002).

¹⁵³⁵ PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc., pp. 58-59.

¹⁵³⁶ DUKES, D. (1996, July). Toxicology made easy: what every trial advocate should know. *Defense Counsel Journal*, p. 338.

¹⁵³⁷ PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc., p. 150.

¹⁵³⁸ PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc., p. 22.

In the 1950s many Japanese people suffered from serious neurological harm, leading to disability. The source of the disease was unknown. Epidemiological studies found an association between eating fish and the neurological symptoms.¹⁵³⁹ Further investigation was necessary in order to find out why eating the fish had become noxious. Toxicological studies showed that methylmercury was at the basis of the disease. Aquatic bacteria transformed the mercury into methylmercury and that substance was transported to humans by the consumption of fish. Methylmercury is neurotoxic and causes birth defects. The toxicological research proved the route of exposure, the dose and time frame needed for the adverse effects.¹⁵⁴⁰ The study also specified the harm. This is important since a chemical can have a measurable effect, whilst not leading to a biological significant change in the body. In other words, a chemical can make changes to the body without resulting in a disease or harm.

Toxicological studies provide a tool to assess the impact of toxic chemicals that is more sensitive than epidemiological research.¹⁵⁴¹ They are overwhelmingly laboratory studies that are conducted either *in vivo* or *in vitro*.¹⁵⁴² *In vivo* studies are studies that use animals to determine the toxicity of substances. *In vitro* studies use cultures in a laboratory container.

It is an advantage that the environment of a laboratory enables the controllability of the tests. Consequently accurate information, including exposure data, becomes available.¹⁵⁴³ Thereby the problem of confounding, as it is present in epidemiological studies, is avoided.¹⁵⁴⁴ Furthermore these controlled studies can be carried out following various periods of exposure

¹⁵³⁹ In the 1950s an acetaldehyde plant discharged mercury and methylmercury into the Minamata Bay. An original video of the symptoms of the Minamata disease can be viewed on www.youtube.com/watch?v=ihFkyPv1jtU (accessed January 2, 2014)

¹⁵⁴⁰ PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc, pp.68-71.

¹⁵⁴¹ Human epidemiological studies generally detect the effect of a toxic chemical on 1 in 100 to 1 in 1 000 people. Extrapolation from animal toxicological studies detect toxic chemical risk in 1 to 100 000. PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc, p. 67 and figure 4.1.

¹⁵⁴² PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc, p. 63.

¹⁵⁴³ EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters, pp. 303-304.

¹⁵⁴⁴ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 345.

(acute versus chronic), across generations, with various doses of exposure, etc.¹⁵⁴⁵

The disadvantage is that extrapolations of the results are more difficult.¹⁵⁴⁶ Generalizing reactions as observed *in vivo* or *in vitro* to human beings is a big step. Differences in metabolism, absorption, etc. may influence the effects and consequently result in incorrect deductions.¹⁵⁴⁷ For example, thalidomide¹⁵⁴⁸ is a strong human teratogenic whilst it does not cause birth defects in mouse.¹⁵⁴⁹

Additionally, during *in vivo* experiments animals are exposed to higher doses than people in general would be exposed to. This poses questions on the dose-response relationship. It is another factor that puts the validity of the conclusions from these studies under strain. According to Green, the dose-effect relation is in such experiments almost always fraught with considerable uncertainty.

5.1.2.3 Bio monitoring studies

Bio monitoring studies measure levels of chemicals in the human body as a result of past exposure.¹⁵⁵⁰ On the basis of those studies an estimation is made on the concentrations of chemicals that humans tolerate without harm. It is an important research method for low-dose, long term exposure to toxic chemicals and their potential for adverse effects.¹⁵⁵¹

The results are mainly used for the development of policies and regulations.¹⁵⁵² In court their use is relatively new and has the disadvantage that an extrapolation from the population studied to specific individuals is necessary. Plus, to demonstrate that a chemical present in a person has caused the disease is quite another challenge, especially when the aetiology of the disease is

¹⁵⁴⁵ EATON, D. (2003, Vol. 12). Scientific judgment and toxic torts - A primer in toxicology for judges and lawyers. *Journal of Law and Policy*, p. 17.

¹⁵⁴⁶ EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters; p. 304.

¹⁵⁴⁷ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 346.

¹⁵⁴⁸ Thalidomide was the active substance of Softenon.

¹⁵⁴⁹ KNOBLOCH, J., REIMANN, K., KLOTZ, L.-O., & RUTHER, U. (2008, October 3). Thalidomide Resistance Is Based on the Capacity of the. *Molecular Pharmaceutics*, pp. 1138-1144.

¹⁵⁵⁰ EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters, pp. 307-309.

¹⁵⁵¹ PENNINGROTH, S. (2010). *Essentials of toxic chemical risk*. Boca Raton: Taylor & Francis Group, llc., p. 142.

¹⁵⁵² EGGEN, J. (2010). *Toxic Torts in a nutshell*. St. Paul: Thomson Reuters, pp. 308.

unknown. An understanding of the relation between chemicals in the body and disease is still necessary.

5.1.2.4 Differential diagnosis

Liability is between private parties and focuses on the damage the plaintiff suffers. To hold the defendant liable proof of a causal link between him and the plaintiff is necessary. Evidence on group level is generally not sufficient. Evidence has to be translated to the individual situation. A method frequently used for this purpose is differential diagnosis. It is:

“[t]he method by which a physician determines what disease process caused a patient's symptoms. The physician considers all relevant potential causes of the symptoms and then eliminates alternative causes based on a physical examination, clinical tests, and a thorough case history.”¹⁵⁵³

Differential diagnosis is about the assessment of specific causation.¹⁵⁵⁴

The cause of harm and/or disease is discovered by the elimination of alleged alternative causes. An approach that aims at overcoming problems that occur when an expert cannot provide adequate epidemiological conclusions or well-established threshold exposure levels at which the disease of the plaintiff occurs.¹⁵⁵⁵ The search for causes is done by the use of standard methodologies/techniques, like physical examinations of the patient, review of medical records, analysis of medical history and the results of laboratory research.¹⁵⁵⁶ The selected methods can vary from case to case. The general acceptance of the combination of methods and techniques is not *per se* required and is in itself not a sign of unreliability.¹⁵⁵⁷ In view of the fact that differential diagnosis is used for individual causation, there is no standard design available, neither is there generally an interest to peer review or publish such individual cases.

¹⁵⁵³ Hardyman versus Norfolk & Western Railway Co., 243 F.3d 255 (United States Court of Appeals, Sixth Circuit March 13, 2001).

¹⁵⁵⁴ See chapter 5.2 on general and specific causation.

¹⁵⁵⁵ Hardyman versus Norfolk & Western Railway Co., 243 F.3d 255 (United States Court of Appeals, Sixth Circuit March 13, 2001).

¹⁵⁵⁶ Easum versus Miller, 92 P.3d 794 (Supreme Court of Wyoming June 24, 2004).

¹⁵⁵⁷ Brown v. U.S. Stove Co., 98 N.J. 155 (Supreme Court of New Jersey December 21, 1984).

When used as a method for delivering proof in tort, the evidence will however be considered unreliable if not all causal alternatives are ruled out.¹⁵⁵⁸ The consideration of all (known) potential causes is necessary because most of the time multiple causes are known that each can be independently responsible for the occurrence of a disease in a population. The subsequent elimination of as many causes as possible increases the probability that the substance subject of the claim caused the plaintiff's damage.¹⁵⁵⁹

"If a differential diagnosis provides a sufficient basis on which to prescribe medical treatment with potential life-or-death consequences, it should be considered reliable enough to assist a fact finder in understanding certain evidence or determining certain fact issues."¹⁵⁶⁰

Several courts have accepted that a reliable differential diagnosis in itself may be a valid basis for a causation inference, even in the absence of epidemiological studies, peer-reviewed published studies, animal studies, or laboratory data.¹⁵⁶¹ However it should be noted that differential diagnosis is a non-deductive argument and inferences are not absolutely certain.¹⁵⁶² The inferential link between premises and conclusions will have varying degrees of strength. The conclusions based on differential diagnosis are not invalid; they are strong or weak or in between.¹⁵⁶³

¹⁵⁵⁸ *Brown v. U.S. Stove Co.*, 98 N.J. 155 (Supreme Court of New Jersey December 21, 1984).

¹⁵⁵⁹ *Milward versus Acuity Specialty Products Group, Inc.*, 664 F. Supp. 2d at 137 (United States District Court, D. Massachusetts July 31, 2009).

¹⁵⁶⁰ *Coastal Tankships, U.S.A., Inc. versus Anderson*, 87 S.W.3d 591 (Court of Appeals of Texas, Houston (1st Dist.) August 8, 2002).

¹⁵⁶¹ *McMunn versus Babcock & Wilcox Power Generation Group, Inc.*, 2014 WL 814878 (US District Court, W.D. Pennsylvania February 27, 2014); *Glastetter versus Novartis Pharmaceuticals Corporation*, 252 F.3d 986 (US Court of Appeals, Eighth Circuit June 8, 2001); *Turner versus Iowa Fire Equipment Co.*, 229 F.3d 1202 (United States Court of Appeals, Eighth Circuit September 22, 2000); *Westberry versus Gislaved Gummi AB*, 178 F.3d 257 (United States Court of Appeals, Fourth Circuit March 3, 1999).

¹⁵⁶² CRANOR, C. (2007, Vol. 15). A framework for assessing scientific arguments: gaps, relevance and integrated evidence. *Journal of Law and Policy*, p. 13.

¹⁵⁶³ CRANOR, C. (2007, Vol. 15). A framework for assessing scientific arguments: gaps, relevance and integrated evidence. *Journal of Law and Policy*, pp. 13-14.

5.1.3 A crusade for evidence

*"It is a daunting task for judges who do not have a scientific background (and most do not) to decide whether a scientist's testimony is real science or not".*¹⁵⁶⁴

It is indeed a daunting task to prove causation in toxic tort. As mentioned before, most chemicals leave no physical evidence behind after ingestion, inhalation or contact. Adding to that difficulty is the background presence of many chemicals in the environment (house, garden, school, work...).¹⁵⁶⁵ One has to prove that the harm caused to the plaintiff is distinguishable from the background incidence of the diseases.¹⁵⁶⁶ Such is the core of the role of an expert. Experts are called into court if they add to the facts, knowledge and information necessary for the court to be able to make a decision.

Logically experts play a major role in all toxic tort cases, regardless if these are pleaded in the US, the UK, France or the Netherlands. They support parties and court with their scientific insights. This is especially useful since science has become complex and evidence ramifies in many directions.¹⁵⁶⁷ The quality of the experts' testimonies is frequently decisive for the outcome of a case.

How do courts manage this scientific evidence and its delivery that is so important?

There exists no quantitative measurement for the correctness of a scientific conclusion. As Popper said: one cannot prove the assumption that all swans are white. Only when you encounter a black swan, you know that your assumption was wrong. Scientists live with this uncertainty; lawyers try to solve it. In following paragraphs the practicalities of scientific proof in court is discussed, starting with procedures; followed by the role of statistical information.

¹⁵⁶⁴ As Judge Kozinski has emphasized in *Rosen versus Ciba-Geigy Corporation*, 78 F.3d 316 (US Courts of Appeals March 11, 1996), p. 318.

¹⁵⁶⁵ Background risk of disease (or background rate of disease) is the rate of disease in a population that has no known exposures to an alleged risk factor for the disease. GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 388.

¹⁵⁶⁶ GOLD, S. C. (2010, Vol. 34). The more we know, the less intelligent we are? How genoinformation should and should not, change toxic tort causation doctrine. *Harvard Environmental Law Review*, p. 371.

¹⁵⁶⁷ HAACK, S. (2009, Vol. 72). Irreconcilable differences? The troubled marriage of science and law. *Law and Contemporary Problems*, pp. 9-10.

5.1.3.1 Procedural aspects for a good understanding

Evidence in tort is for an important part ruled by substantive law, but procedural aspects also have to be taken into account. It is in those procedural aspects that Continental Law and Common Law differ considerably.

The Continental Law is described as inquisitorial, meaning that the judge has an active role in the proceedings. It is the judge who questions the parties¹⁵⁶⁸ and who clarifies the issues.¹⁵⁶⁹ Judges have authority and freedom of deciding.

In Common Law the process is best described as adversarial. The parties each put forward their case and the judge acts as a neutral arbiter. The parties lead the proceedings, whereby the judge remains rather passive. The court should decide the case for the most convincing party.¹⁵⁷⁰

A short and pragmatic explanation on procedural aspects is thus useful. The US is discussed separately because of their particular system whereby the admissibility of the evidence has to be evaluated by the trial judges. Only after a positive result the evidence is then submitted to the court (incl. jurors) for factual and substantial use. Based on the importance to get the evidence admitted for the substantial proceedings, both courts and academics have elaborated a vast database of information and best practices or standards. This warrants a separate analysis as it can be useful for inspiration and lessons to be learned.

After the analysis of the US the situation in the other three countries, UK, Netherlands and France, is analysed.

a) The United States

US experts are not *de facto* admitted in court. The reason for their presence should be justified by circumstances that make it difficult or impossible for the judges to decide without assistance. When the facts are too vague, complex or doubtful, rational judgment needs information gathered using special skills and knowledge. This information is delivered by experts.¹⁵⁷¹ However before allowing

¹⁵⁶⁸ Cross examination rarely is allowed.

¹⁵⁶⁹ PEJOVIC, C. (2001, Vol. 32). Civil Law and Common Law: two different paths leading to the same goal. *Victoria University of Wellington Law Review*, p. 830.

¹⁵⁷⁰ PEJOVIC, C. (2001, Vol. 32). Civil Law and Common Law: two different paths leading to the same goal. *Victoria University of Wellington Law Review*, p. 830.

¹⁵⁷¹ Consolidated Gas, Elec. Light & Power Co. versus State, 109 Md. 186 (Court of Appeals of Maryland January 13, 1909), p. 658; Davidson versus Miller, 344 A.2d 422 (Courts of

an expert to contribute, courts have to approve both the appointment and the role of the expert plus the admissibility of the testimony and evidence that the expert will present.¹⁵⁷² Both elements are discussed separately in the following two paragraphs.

i) Appointment and role of an expert

In general courts in the US require plaintiffs to use experts whenever scientific proof of causation is necessary. Lay people on their own can normally not make rational judgments about causal connections in complex cases like those concerning toxic torts.¹⁵⁷³ If the damage is such that its full extent is clear to any lay observer, the jury or judge is permitted to determine the future consequences without the aid of expert evidence.¹⁵⁷⁴

An example is the case of Johnson versus Arkema.¹⁵⁷⁵ In court expert testimony was deemed necessary for assessing the liability of the defendant for the chronic injuries. The defendant was however held liable for the acute damage (the sore throat, the watering eyes, etc.), caused by the same chemical on the basis that the occurrence and conditions complained of were such that the general experience and testimonies of laypersons were sufficient to find that the chemical caused the acute damage.¹⁵⁷⁶

Expert testimony is necessary to establish causation as to medical conditions outside the common knowledge and experience of courts.¹⁵⁷⁷

If damage is such that its full extent is clear to any lay observer, the jury or judge is permitted to determine the future consequences without the aid of expert evidence.

Appeal of Maryland September 18, 1975); *Stumore versus Shaw*, 68 Md. 11 (Court of Appeals of Maryland October 1887), p. 505.

¹⁵⁷² SHAPO, M. (2010). *Principles of Tort Law*. St. Paul: West (Thomas Reuters), p. 316.

¹⁵⁷³ SHAPO, M. (2010). *Principles of Tort Law*. St. Paul: West (Thomas Reuters), p. 314.

¹⁵⁷⁴ On the other hand courts sometimes use the concept of "common knowledge" in toxic torts as they do in medical cases. This concept allows the testimonies of lay persons on causation in certain circumstances.

¹⁵⁷⁵ *Johnson versus Arkema, Inc.*, 685 F.3d 452 (United States Court of Appeals June 20, 2012).

¹⁵⁷⁶ See also the analysis of the case of Johnson versus Arkema in paragraph 3.2.1.2, b).

¹⁵⁷⁷ *Guevara versus Ferrer*, 247 S.W.3d 662 (Supreme Court of Texas August 31, 2007), p. 665.

“Expert testimony is admissible only when necessary to aid the fact finder's understanding of technical matters that are beyond the general knowledge of the average layperson.”¹⁵⁷⁸

An expert is qualified to testify in court on the basis of his knowledge, skill, experience, training, or education.¹⁵⁷⁹ His testimony should be based on sufficient facts or data and being collected using reliable scientific principles and methods.¹⁵⁸⁰ The proponent of the material has to show that these conditions are met.¹⁵⁸¹

Subject to these conditions, a qualified expert can be appointed by the parties or by the court. Most of the time the experts are appointed by the parties in the case.

The expert must advise the parties of any findings he makes, he may be called to deliver his testimony in court and he may also be cross-examined by any party, including the party that called the expert.¹⁵⁸²

On the other hand, each party and the trial judge can also show a reason why expert witnesses should not be commissioned. An expert can also be deposed of by any party.

ii) Admissibility

In the US the trial judge has the authority to evaluate experts and expert testimonies before admitting these to the pleadings.¹⁵⁸³ This evaluation proceeds in two phases: first it must be assessed that the proffered witness is qualified as an expert in the relevant domain; secondly the evidence and testimony are assessed in relation to the requirements to be respected for a scientific

¹⁵⁷⁸ Jansen versus Baker, 2005 WL 2065232 (United States District Court, D. Maryland August 25, 2005); Hartford Acc. and Indem. Co. v. Scarlett Harbor Associates Ltd. Partnership , 674 A.2d 106 (Court of Special Appeals of Maryland April 3, 1996).

¹⁵⁷⁹ Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II), 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995).

¹⁵⁸⁰ Federal Rule of Evidence, rule 702, testimony by expert witnesses; Allen versus Pennsylvania Engineering corp., 102 F.3d 194 (United States Court of Appeals, Fifth Circuit December 31, 1996).

¹⁵⁸¹ King versus Burlington Northern Santa Fe Railway Company, 762 N.W.2d 24 (Supreme Court of Nebraska February 27, 2009).

¹⁵⁸² Federal Rule of Evidence, rule 706, Court-Appointed Expert Witnesses, (b) Expert's Role.

¹⁵⁸³ Sometimes the analysis is relied upon criminal cases. Because of their heightened standard of proof the argumentation on admittance of evidence demonstrates clearly the process of reasoning.

study.¹⁵⁸⁴ This task is called the truth seeking function. It is the court's duty to act as a 'gatekeeper', excluding junk science from entering litigation.¹⁵⁸⁵ When the opinion of the expert is not based on sufficient data and facts or is not the result of reliable principles and methods, then the testimony is not admitted.¹⁵⁸⁶ The reliability is based in the acceptance of the method by the scientific community. However, once a published appellate judgment has affirmed that a certain scientific technique is admitted, that technique is considered admissibly as a matter of law.¹⁵⁸⁷ The proof of the publication should be delivered by the party offering the material.¹⁵⁸⁸

On the other hand, techniques that are novel to the court can also be accepted, but when those techniques are novel to the relevant scientific community and the court, then such evidence should be banned.¹⁵⁸⁹ General acceptance is not necessary, reliability is.¹⁵⁹⁰

The reliability is also linked to the fact whether the expert's theory can be and has been tested, whether it was subject to peer review, whether it was published, etc. Any step that makes an expert's analysis unreliable renders the expert's testimony inadmissible. It is irrelevant whether a reliable methodology completely changes or merely misapplies the methodology.¹⁵⁹¹ For example,

¹⁵⁸⁴ *Henricksen versus Conocophillips company*, 605 F.Supp.2d 1142 (United States District Court, E.D. Washington February 11, 2009).

¹⁵⁸⁵ *Dukes versus Wal-Mart, Inc.*, 509 F.3d 1168 (United States Court of Appeals, Ninth Circuit December 11, 2007); *Cooper versus Brown*, 510 F.3d 870 (United States Court of Appeals, Ninth Circuit December 4, 2007); *Daubert versus Merrel Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (Supreme Court of the United States June 28, 1993).

¹⁵⁸⁶ *King versus Burlington Northern Santa Fe Railway Company*, 762 N.W.2d 24 (Supreme Court of Nebraska February 27, 2009). *Olson versus Ford Motor Co.*, 411 F.Supp.2d 1137 (United States District Court, D. North Dakota, North-western Division January 25, 2006); *Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II)*, 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995); *Daubert versus Merrel Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (Supreme Court of the United States June 28, 1993).

¹⁵⁸⁷ *The People versus Doolin*, 198 P.3d 11 (Supreme Court of California January 5, 2009); *The People versus Nelson*, 185 P.3d 49 (Supreme Court of California June 16, 2008); *Kuxhausen versus Tillman Partners*, 197 P.3d 859 (Court of Appeals of Kansas September 2, 2009).

¹⁵⁸⁸ *Parker versus the State*, 704 S.E.2d 438 (Court of Appeals of Georgia November 23, 2010).

¹⁵⁸⁹ *Moore versus Harley-Davidson Motor Company Group, Inc.*, 241 P.3d 808 (Court of Appeals of Washington, Division 2. November 9, 2010)

¹⁵⁹⁰ *Suter versus General Acc. Ins. Co. of America*, 424 F.Supp.2d 781 (United States District Court, District New Jersey March 30, 2006); *Chapple versus Ganger*, 851 F.Supp. 1481 (United States District Court, E.D. Washington May 12, 1994).

¹⁵⁹¹ *Henricksen versus Conocophillips company*, 605 F.Supp.2d 1142 (United States District Court, E.D. Washington February 11, 2009); *Rosen versus Ciba-Geigy Corporation*, 78 F.3d 316 (US Courts of Appeals March 11, 1996).

when an analytical gap exists between the circumstances of a case and the scientifically reliable data assessing if exposure to the benzene could cause acute myelogenous leukaemia (AML), the causal link between the disease and the exposure is not scientifically proved. A hypothesis is not enough to prove causation and the plaintiff's claim will not be granted.¹⁵⁹²

The standards generally used are: (1) testability and falsifiability of the method; (2) whether the method was subjected to peer review; (3) the known or potential error rate; (4) whether standards exist to control procedures for the method; (5) the general acceptance of the method; (6) the relationship of the technique to methods that have been established as reliable; (7) the qualifications of the expert; and (8) the non-judicial uses to which the method has been put.¹⁵⁹³

A reliable expert opinion should thus be based on scientific methodology, but also ensure that the conclusion is not speculative.¹⁵⁹⁴

The opinion of a neurologist stated that welding rod products triggered manganese-induced Parkinsonism. The testimony however contained, according to the court, not just one speculation but a string of speculations. Thus the expert's opinion should not have been admitted as evidence. The aetiological component of neurologist's opinion, namely that manganese caused the Parkinsonism, was a mere hypothesis and did not constitute scientific knowledge.¹⁵⁹⁵

Evidence should be admissible when professional standards of 'intellectual rigor' are met, even when the used methods are not common practice.¹⁵⁹⁶

By the obligation that trial judges need to assess if the evidence and the expert's conclusions are not speculative, it becomes clear that the evaluation of

¹⁵⁹² *Henricksen versus Conocophillips company*, 605 F.Supp.2d 1142 (United States District Court, E.D. Washington February 11, 2009).

¹⁵⁹³ DENNISON, M., & FREEDMAN, W. (2013). *Handling Toxic Tort Litigation*. In *American Jurisprudence - trials* (§ 395). Westlaw.

¹⁵⁹⁴ *Stephenson versus Honeywell Intern., Inc.*, 703 F.Supp.2d 1250 (United States District Court, D. Kansas April 2, 2010); *In re Acceptance Ins. Companies, Inc. Securities Litigation*, D.Neb.2004, 423 F.3d 899. See also Federal Rule of Evidence, rule 702, testimony by expert witnesses.

¹⁵⁹⁵ *Tamraz versus Lincoln Elec. Co.*, 620 F.3d 665 (United States Court of Appeals, Sixth Circuit September 8, 2010).

¹⁵⁹⁶ *Rosen versus Ciba-Geigy Corporation*, 78 F.3d 316 (US Courts of Appeals March 11, 1996), p. 319

evidence involves both the domain of the adjective law¹⁵⁹⁷ and that of substantive tort law.¹⁵⁹⁸ The judge's task is procedural, but the evaluation of the evidence is based on its sufficiency and reliability. Admissibility decisions influence the causal questions and causal requirements or principles affect admissibility.¹⁵⁹⁹

b) The others

i) The UK: another Common Law system, but different

The other Common Law country, namely the UK, differs substantially from the procedural system of the US and is more similar to the Continental Law systems. The expert review does not take place in an admissibility stage, but happens during the pleading in court. The admission of expert evidence is thereby ruled by UK Civil Procedure Rules. UK courts have in comparison with the US more freedom in the appreciation of the quality. The admissibility assessment of the expert's qualifications and the relevance of his testimony remains minimal.

Experts have the duty to assist the court on matters within their expertise.¹⁶⁰⁰ The evidence submitted should be uninfluenced, objective and unbiased, and should consider all material facts.¹⁶⁰¹ If a person is called as an expert witness in civil proceedings, his opinion is admissible on condition that he is to give expert evidence on the topic in question.¹⁶⁰² The relevance of the expert testimony and report are sufficient.¹⁶⁰³

¹⁵⁹⁷ The portion of the law that deals with the rules of procedure governing evidence, pleading, and practice. As opposed to that body of law which the courts are established to administer (called "substantive law"), it means the rules according to which the substantive law is administered, such as the Federal Rules of Civil Procedure. Merriam Webster, www.merriam-webster.com/dictionary/adjective%20law, (accessed on 13 September 2013).

¹⁵⁹⁸ SANDERS, J. (2009, Winter). The controversial comment c: Factual causation in toxic-substance and disease cases. *Wake Forest Law Review*, p. 1033.

¹⁵⁹⁹ SANDERS, J., & MACHAL-FULKS, J. (2001, Vol. 64). The admissibility of differential diagnosis testimony to prove causation in toxic tort case: the interplay of adjective and substantive law. *Law and Contemporary Problems*, p. 109.

¹⁶⁰⁰ Civil Procedure Rules 1998/3132, Part 35 Experts and assessors, 35.3 Experts- overriding duty to the court.

¹⁶⁰¹ GENN, H. (2013, Vol. 32, issue 2). Getting to the truth: experts and judges in the "hot tub". *Civil Justice Quarterly*, p. 279.

¹⁶⁰² Civil Evidence Act of 1972, c. 30, 3. Admissibility of expert opinion and certain expressions of non-expert opinion. (1) Subject to any rules of court made in pursuance of [...] 1 this Act, where a person is called as a witness in any civil proceedings, his opinion on any relevant matter on which he is qualified to give expert evidence shall be admissible in evidence.

With respect to complex matters parties shall disclose to each other the expert evidence they want to use.¹⁶⁰⁴ The UK approach is considered liberal in relation to the admission and presentation of dubious expert testimony.¹⁶⁰⁵ In his 1996 review of civil justice an attempt was made to improve the quality of experts by distinguishing between their fact finding and opinion giving roles.¹⁶⁰⁶ The court should control the experts and limit expert evidence to that which is reasonably

(2) It is hereby declared that where a person is called as a witness in any civil proceedings, a statement of opinion by him on any relevant matter on which he is not qualified to give expert evidence, if made as a way of conveying relevant facts personally perceived by him, is admissible as evidence of what he perceived.

(3) In this section "relevant matter" includes an issue in the proceedings in question. In force from January 1, 1997 to present – westlaw.co.uk (accessed on January 31, 2014).¹⁶⁰³ JURIS, A. (2011-2012, Vol. 95). Balancing legal process with scientific expertise: expert witness methodology in five nations and suggestions for reform of post-Daubert U.S. reliability determinations. *Marquette Law Review*, p. 1378.

¹⁶⁰⁴ Civil Evidence Act of 1972, c. 30, 2. Rules of court with respect to expert reports and oral expert evidence [...] repealed,

Notwithstanding any enactment or rule of law by virtue of which documents prepared for the purpose of pending or contemplated civil proceedings or in connection with the obtaining or giving of legal advice are in certain circumstances privileged from disclosure provision may be made by rules of court—

(a) for enabling the court in any civil proceedings to direct, with respect to medical matters or matters of any other class which may be specified in the direction, that the parties or some of them shall each by such date as may be so specified (or such later date as may be permitted or agreed in accordance with the rules) disclose to the other or others in the form of one or more expert reports the expert evidence on matters of that class which he proposes to adduce as part of his case at the trial; and

(b) for prohibiting a party who fails to comply with a direction given in any such proceedings under rules of court made by virtue of paragraph (a) above from adducing in evidence [...] 2, except with the leave of the court, any statement (whether of fact or opinion) contained in any expert report whatsoever in so far as that statement deals with matters of any class specified in the direction.

(4) Provision may be made by rules of court as to the conditions subject to which oral expert evidence may be given in civil proceedings.

(5) Without prejudice to the generality of subsection (4) above, rules of court made in pursuance of that subsection may make provision for prohibiting a party who fails to comply with a direction given as mentioned in subsection (3)(b) above from adducing, except with the leave of the court, any oral expert evidence whatsoever with respect to matters of any class specified in the direction.

(6) Any rules of court made in pursuance of this section may make different provision for different classes of cases, for expert reports dealing with matters of different classes, and for other different circumstances.

(7) References in this section to an expert report are references to a written report by a person dealing wholly or mainly with matters on which he is (or would if living be) qualified to give expert evidence.

Version in force from: April 1, 2005 to present - westlaw.co.uk (accessed on January 31, 2014).

¹⁶⁰⁵ O'BRIAN, W. (2003, Vol. 7). Court scrutiny of expert evidence: recent decisions highlight the tensions. *International Journal of Evidence & Proof*, pp. 172-173.

¹⁶⁰⁶ GENN, H. (2013, Vol. 32, issue 2). Getting to the truth: experts and judges in the "hot tub". *Civil Justice Quarterly*, p. 278.

required to resolve the issues at hand.¹⁶⁰⁷ If a judge can form his own conclusion without assistance, he should not appoint an expert.¹⁶⁰⁸ Additionally, no other party may call an expert or put in evidence an expert's report without the court's permission.¹⁶⁰⁹

An interesting possibility that could make proceedings more efficient is the following:

“where two or more parties wish to submit expert evidence on a particular issue, the court may direct that the evidence on that issue is to be given by a single joint expert.”¹⁶¹⁰

If parties cannot agree on the nomination, then the judge can appoint an expert.¹⁶¹¹

In practice UK courts spend a lot of time and effort in analysing whether the claim is proved. In XYZ versus Schering Health Care Ltd 42 days of testimonies on complex epidemiological evidence had to be reviewed.¹⁶¹² Despite that, specialist evidence can be refused when it does not meet the standards, as was the case in Wood versus the Ministry of Defence. Both the trial judge and the judge in appeal decided to disregard the testimony of the expert witness, because of its inconsistency, unreliability and lack of credibility. These flaws were observed as well in the reports, as in the explanations and the attitude.¹⁶¹³ The fact that the expert had good credentials did not impact the decision.

ii) The Netherlands: two kinds of expert's evidence

Contrary to the Common Law systems European Continental jurisdictions have mainly used court appointed experts in complex cases requiring specialized

¹⁶⁰⁷ Civil Procedure Rules 1998/3132, Part 35 Experts and assessors, 35.1 Duty to restrict evidence.

¹⁶⁰⁸ GENN, H. (2013, Vol. 32, issue 2). Getting to the truth: experts and judges in the "hot tub". *Civil Justice Quarterly*, p. 278.

¹⁶⁰⁹ Civil Procedure Rules 1998/3132, Part 35 Experts and assessors, 35. Court's power to restrict expert evidence (1).

¹⁶¹⁰ Civil Procedure Rules 1998/3132, Part 35 Experts and assessors, 35.7. Court's power to direct that evidence is to be given by a single joint expert (1).

¹⁶¹¹ Civil Procedure Rules 1998/3132, Part 35 Experts and assessors, 35.7. Court's power to direct that evidence is to be given by a single joint expert (2).

¹⁶¹² XYZ versus Schering Health Care Ltd 70 BMLR 88, (2003) 70 BMLR 88 (High Court of Justice July 29, 2002).

¹⁶¹³ Wood versus Ministry of Defence, 2011 WL 2582705 (High Court of Justice Court of Appeal (Civil Division) July 7, 2011), §§ 39-41.

knowledge.¹⁶¹⁴ Alternatives do exist, for example in the Netherlands. There a judge may obtain information in different ways: experts testifying on behalf of a party in the litigation and expert reports from joint parties in the case.

When a judge appoints an expert, he follows the procedures written down in the Dutch Code of Civil Procedure.¹⁶¹⁵ The judge is free in his choice of experts. He does not have to follow the proposals of the parties.¹⁶¹⁶ Neither is there a specific legal requirement to control the appropriateness of the qualifications of the expert or of his knowledge.¹⁶¹⁷

Parties are thus also allowed to nominate their own experts. The conclusion of these experts is however experienced as less objective than the conclusion of experts directly appointed by the court.

The Netherlands has two kinds of expert testimonies: a 'normal' report and a preliminary report. The request for preliminary research should mention the topics and aspects on which the opinion of an expert is needed.¹⁶¹⁸ The preliminary work of the expert collects evidence with the objective to define the correct basis for the claim. This way the parties in the case can assess their chances.

On the other hand it is not necessary that the request for a preliminary research by an expert details a connection between the preliminary study and the legal claims (still to be defined). It is sufficient to mention the facts that can be used to evaluate the necessity of expert testimonies and why the research could be of importance for the (eventual) legal claims.¹⁶¹⁹

¹⁶¹⁴ Hoge Raad 31 March 2006, LJV AU6092, www.rechtspraak.nl; VERKERK, R. (2009, Vol. 13). Comparative aspects of expert evidence in civil litigation. *The international journal of evidence & proof*, p.167.

¹⁶¹⁵ Articles 194-200 (expert report) and 202-207 (preliminary expert report) Wetboek van Burgerlijke Rechtsvordering (Code of Civil Procedure). For more information see: ASSER, W. (2013). *Procesrecht*. Deventer: Kluwer.

¹⁶¹⁶ Hoge Raad 5 januari 2005, LJV AA9307, *Jurisprudentie Online*, 2001/1.

¹⁶¹⁷ VERKERK, R. (2007). Procesrechtelijke waarborgen voor een betrouwbaar deskundigenonderzoek. *Nederlands Tijdschrift voor Burgerlijk Recht*, p. 71.

¹⁶¹⁸ Preliminary expert report or hearing (Voorlopig bericht of verhoor van deskundigen) - Art. 203 (2) Wetboek van Burgerlijke Rechtsvordering: het verzoekschrift houdt in:

- (a) de aard en het beloop van de vordering;
- (b) de punten waarover het oordeel van de deskundigen wordt gevraagd of de plaats of de zaak die in ogenschouw moet worden genomen;
- (c) de naam en de woonplaats van de wederpartij of de redenen waarom de wederpartij onbekend is.

¹⁶¹⁹ Hoge Raad 13 September 2002, LJV AE3345, *Nederlandse Jurisprudentie* 2004/18, note of H.J. Snijders; Hoge Raad 19 februari 1993, LJV ZC0878, *Nederlandse Jurisprudentie* 1994/345.

However, as Snijders rightfully observes, this lack of substantiation is not in line with the law, which requires a description on the nature of the claim.¹⁶²⁰ There exists some inconsistency between the obligation of the judge to allow the delivery of evidence and the judgments of the Supreme Court trying to limit the expanding use of resources to deliver proof.¹⁶²¹ The parties in litigation however have a right to evidence of allegations and defences. It is suggested that rules that take into account the complexity of the subject of the claim should be developed.¹⁶²² At this moment a request for a preliminary report has to be granted, unless the judge is convinced that the proceedings would suffer or if he has another serious concern.¹⁶²³

The opposite is true for a 'normal' request for expert opinion. The actual legal doctrine states that, in relation to the ordinary expert report, has a broad authority to evaluate and deny the request for such expertise.¹⁶²⁴ The contradiction between preliminary report and the broad authority of the court expert testimony during substantial proceedings originates in the fact that the ordinary expert report focuses mainly on informing the judge, and the preliminary expertise supports the parties with the delivery of the required evidence and the assessment of their chances in the case.¹⁶²⁵ In other words, there is a difference in the goal of each kind of expert testimony that could justify the differences.

Akkermans does not agree with the power of the judge to deny 'normal' expert testimony as it is now. A judge cannot without motivation deny the appointment

¹⁶²⁰ Art. 9:203, 2, (a) Wetboek Burgerlijke Rechtsvordering, "Het verzoekschrift houdt in: a. de aard en het beloop van de vordering"; Hoge Raad 13 September 2002, *Nederlandse Jurisprudentie* 2004/18, note of H.J. Snijders.

¹⁶²¹ ASSER, W. (2013). *Procesrecht* - Deel 3: Bewijs. 244 Case management op het punt van bewijslevering, Deventer: Kluwer.

¹⁶²² ASSER, W. (2013). *Procesrecht* - Deel 3: Bewijs. 244 Case management op het punt van bewijslevering, Deventer: Kluwer.

¹⁶²³ Hoge Raad 13 September 2002, LJN AE3345, *Nederlandse Jurisprudentie* 2004/18, note of H.J. Snijders.

¹⁶²⁴ Hoge Raad 14 December 2001, LJN AD3993, *Nederlandse Jurisprudentie* 2002/73; Hoge Raad, December 2002, LJN AE8457, *Nederlandse Jurisprudentie* 2003/63, Hoge Raad 6 February 1998, LJN ZC2574, *Nederlandse Jurisprudentie* 1999/478, note of H.J. Snijders.

¹⁶²⁵ Hoge Raad 14 December 2001, LJN AD3993, *Nederlandse Jurisprudentie* 2002/73; Hoge Raad 6 February 1998, LJN ZC2574, *Nederlandse Jurisprudentie* 1999/478, note of H.J. Snijders.

of an expert for a 'normal' report¹⁶²⁶, whilst on the other hand it is sufficient (without further motivation) to stipulate in a request for a preliminary expertise that the facts make such a research useful.¹⁶²⁷ The former is not in line with the purposes of those expert testimonies.

When the expert accepts an assignment, he is obliged to perform his duties in an objective manner and to the best of his abilities.¹⁶²⁸ If an expert neglects his duties and/or does not work in line with the required ethical standard, he can be held liable in tort and even in criminal law.¹⁶²⁹

The information delivered by the expert of one party in a case should also be made available to the other party or parties, except when information relating to personal medical data is blocked by the concerned party.¹⁶³⁰ The violation of the right to an adversary proceeding is sufficient for the Dutch Supreme Court to quash a judgment.¹⁶³¹

When the expert delivers his findings, should the judge accept these? The judge is obliged to analyse the expert report and to take into account all remarks concerning facts and circumstances made by the parties. This is the basis for the decision to follow or reject the report.¹⁶³² When there is disagreement between the experts, the judge can decide to follow one conclusion (and not the

¹⁶²⁶ AKKERMANS, A. (2004, June 1). De beoordeling van het verzoek om een voorlopig deskundigenbericht, in het bijzonder bij wijze van contra-expertise in een letselschadezaak. *Aansprakelijkheid, Verzekering & Schade*, p. 18.

¹⁶²⁷ Hoge Raad 13 September 2002, LJN AE3345, *Nederlandse Jurisprudentie* 2004/18.

¹⁶²⁸ Art. 198 (1) Wetboek van Burgerlijke Rechtsvordering: De deskundige die zijn benoeming heeft aanvaard, is verplicht de opdracht onpartijdig en naar beste weten te volbrengen.

¹⁶²⁹ GROENE SERIE. (2009). 19.4 *Deskundigen*. In GROENE SERIE, *Onrechtmatige daad*.

¹⁶³⁰ Art. 198 (2) Code of Civil Procedure: De deskundigen stellen hun onderzoek in, hetzij onder leiding van de rechter, hetzij zelfstandig. De deskundigen moeten bij hun onderzoek partijen in de gelegenheid stellen opmerkingen te maken en verzoeken te doen. Uit het schriftelijke bericht moet blijken of aan dit voorschrift is voldaan. Van de inhoud van de opmerkingen en verzoeken wordt in het schriftelijke bericht melding gemaakt. Indien een partij schriftelijke opmerkingen of verzoeken aan de deskundigen doet toekomen, verstrekt zij daarvan terstond afschrift aan de wederpartij.

Experts research the case with or without the guidance of the Judge. Experts should enable the parties to make remarks and file requests. The content of the remarks and requests are mentioned in the written report. When a party in the case makes remarks or requests in writing, then a copy is immediately provided to the other party.

¹⁶³¹ Hoge Raad 18 November 2006, LJN AT6843, *Jurisprudentie Online (JOL) 2005*, 655

¹⁶³² Hoge Raad 8 July 2011, LJN BQ3514, *Rechtspraak Aansprakelijkheids- en Verzekeringsrecht* 2011/93; Hoge Raad 19 October 2007, LJN BB5172.

dissenting others) without much motivation.¹⁶³³ It is sufficient to state that the expert motivated his findings and that these findings are more convincing than the other opinion(s). This is especially so since the expert report is based on specialized knowledge, experience and/or intuition.¹⁶³⁴ However if parties have explicit and specific concerns with the decision, the judge should motivate the correctness of his judgment sufficiently.¹⁶³⁵

The system seems not full proof. Faure and Visscher are convinced that the Dutch experts are 'overconfident' in their abilities. They make mistakes like the failure to recognize that human failure can substantially influence the effectiveness of technological systems; mistakes in assessing probabilities (calibration).¹⁶³⁶

iii) France: the Code of Civil Procedure combined with the sovereignty of the judge

Conditions of objectivity and independence are imposed and experts cannot perform activities that are incompatible with the objectivity needed for their tasks as an expert.¹⁶³⁷ This requirement can create difficulties in areas of knowledge where only few specialists are available. Close relations with one of the parties in a tort case, for example the expert is an employee of the defendant/industry, is believed to jeopardize that objectivity.¹⁶³⁸

Necessarily, the decision to appoint an expert mentions the reasons why that particular expert has an added value for the case. These reasons are subsequently translated into specific tasks. For example: when damages occur after toxic exposure, the plaintiff has to be examined by an expert knowledgeable on the toxicity and the medical aspects. Thereafter the expert

¹⁶³³ Hoge Raad 8 July 2011, LJN BQ3514, *Rechtspraak Aansprakelijkheids- en Verzekeringsrecht* 2011/93; Hoge Raad 10 February 2010, LJN BK4476, *Nederlandse Jurisprudentie* 2011/121.

¹⁶³⁴ Hoge Raad 8 July 2011, LJN BQ3514, *Rechtspraak Aansprakelijkheids- en Verzekeringsrecht* 2011/93.

¹⁶³⁵ Hoge Raad 8 July 2011, LJN BQ3514, *Rechtspraak Aansprakelijkheids- en Verzekeringsrecht* 2011/93; Hoge Raad 5 December 2003, LJN AN8478, *Nederlandse Jurisprudentie* 2004/74.

¹⁶³⁶ FAURE, M., & VISSCHER, L. (2011, Vol. 3). The role of experts in assessing damages - a law and economics account. *European Journal of Risk Regulation*, pp. 385-386.

¹⁶³⁷ Art. 2, 6° of the Decree nr. 2004-1463, 23 December 2004. Similar principles can be found in article 237 of the French Code of Civil Procedure.

¹⁶³⁸ Cour de Cassation (chambre civile) 5 December 2002, *Dalloz* 2003, 2260, note of A. Penneau; Crim. 25 September 2012, nr. 12-82.770. MAUD, L. (2012, October 15). Procès équitable et nécessaire indépendance de l'expert judiciaire. *Dalloz actualité*.

has to explain the aetiology of the disease and give his opinion on the eventuality of a link with other noxious facts.¹⁶³⁹

The observations and remarks of the parties in the litigation should be considered and mentioned in the expert's report.¹⁶⁴⁰ A written copy of the findings is not obligatory if the judge is convinced that the results can be shared verbally.¹⁶⁴¹ Notes will anyhow be included in the '*procès verbal*' of the pleadings. Parties are obliged to cooperate with the expert and to submit all the requested and necessary information.¹⁶⁴² Throughout the whole procedure the judge and the expert(s) stay in close contact and communicate regularly on the findings. The judge may take an active role in the elaboration of the expertise.¹⁶⁴³ Overall the French judge remains sovereign in the appointment and the appreciation of the expert's findings. Consequently he can decide on the basis of all elements in the case and not only on the expert testimony that causation is (considered) proved.¹⁶⁴⁴ The concept of presumption can be used.

The judge appoints an expert who is on the list of experts.¹⁶⁴⁵ If the court wants to deviate and appoint another expert, this decision should be motivated and communicated.

France has also a system of preliminary measures aimed at collecting evidence (*mesures d'instruction*).¹⁶⁴⁶ A judge, called '*juge de la mise en état*', prepares the trial and performs an inquiry, for example by appointing an expert on request of the parties.¹⁶⁴⁷ His task is to guarantee proper and fair proceedings, especially in complex cases. Only when he judges the file to be complete,

¹⁶³⁹ Cour d'Appel d'Orléans, 14 November 2008, nr. 05/02470, *Jurisprudence Dalloz*.

¹⁶⁴⁰ Art. 276 Code of Civil Procedure.

¹⁶⁴¹ Art. 282 Code of Civil Procedure.

¹⁶⁴² Art. 275 Code of Civil Procedure.

¹⁶⁴³ Art. 274 Code of Civil Procedure.

¹⁶⁴⁴ In this case, the court decided on the basis that there is no evidence of a causal link between the exposure and the disease, as there is no evidence that there is no causal link. Several other elements could have caused the disease as well. There was no sufficient proof to convince the judge that the disease was caused by the exposure. Thus the plaintiffs lost their case. Cour d'Appel d'Orléans, 14 November 2008, nr. 05/02470, *Jurisprudence Dalloz*.

¹⁶⁴⁵ Consolidated version of Law No. 71-498, 29 June 1971, www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000874942.

¹⁶⁴⁶ FAIRGRIEVE, D., & G'SELL-MACREZ, F. (2011). Causation in French Law: pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (p. 111). Oxford: Hart Publishing Ltd., p. 125

¹⁶⁴⁷ Art. 763-781 French Code of Civil procedure.

including arguments and evidence submitted by the parties, the substantive proceedings can start.¹⁶⁴⁸

5.1.3.2 Basic statistics and the value of epidemiology

After analysing the characteristics of epidemiological research as such¹⁶⁴⁹, the following text the practical use of epidemiology is analysed, together with the interpretations courts have developed when using the results in relation to (mainly general) causation.

a) A short description of relevant terms and concepts.

i) Epistemic and objective probability

Epistemic probability is the degree to which a rational person should believe that some proposition is true, given a body of evidence.¹⁶⁵⁰

Objective probability is independent of the available evidence and is based on factual elements.

ii) The definition of relative risk

A brief recapitulation on the definition of relative risk seems useful.¹⁶⁵¹

Relative risk indicates the risk of disease in the exposed group as compared to the risk in the unexposed group. The factor is calculated by dividing the incidence rate in the exposed group by the incidence rate in the unexposed group.¹⁶⁵²

Thereby the incidence rate expresses the risk that a person in a defined population will develop the condition within a specified period of time. The incidence is the result of dividing the number of people that develop the condition during the specified period of time divided by the number of person in the group.¹⁶⁵³

¹⁶⁴⁸ See www.justice.gouv.fr (accessed 28 February 2014).

¹⁶⁴⁹ See paragraph 5.1.2.1.

¹⁶⁵⁰ PERRY, S. (2001 (reprint)). Risk, harm and responsibility. In D. OWEN, *Philosophical foundations of tort law* (pp. 321-346). Oxford: Oxford University Press, p. 332.

¹⁶⁵¹ See also paragraph 5.1.2.1.

¹⁶⁵² GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States. p. 348.

¹⁶⁵³ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 348.

Consequently a relative risk of 2.0 means that the people in the exposed group have twice as much risk of developing the condition studied than the people in the unexposed group.

b) Avoiding errors: statistical significance and confidence intervals

Knowing that the relative risk factor is an estimate, the concept obviously can and is subject to errors. Therefore statistical significance and confidence intervals are used to assess errors in epidemiological studies.¹⁶⁵⁴ A statistical significant study has results that are unlikely to be the result of random errors.¹⁶⁵⁵

Confidence intervals consist of a range of values obtained by examining different samples of a population that are good estimates of the unknown population parameter. For example 'we are 95 % certain that the true value of the parameter is in the confidence interval'. When a sample is taken the parameter of that sample is either in the interval or not. In science a confidence interval of 95 % is mostly used. A confidence of 95 % has a significance level of 5% or 0.05.

Statistical significance is the probability that an effect is not due to just chance alone. It is used to test a hypothesis, generally a null hypothesis (nothing happens). The hypothesis can only be rejected if the result of the research is statistically significant. To determine if a result is statistically significant, a researcher would have to calculate a p-value, which is the probability of observing an effect given that the null hypothesis is true. The p-value should be less than the probability of rejecting a true hypothesis. Thereby the p-value is the probability of obtaining a test statistically at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. In the UK a slightly different approach is used. There the p-value is the probability of getting the same value for a model built around two hypotheses, one is the "neutral" hypothesis, and the other is the hypothesis under tests. If this p-value is less

¹⁶⁵⁴ Duran and Fitzsimmons versus U.S. Bank National Association, 2013 WL 2600218 (Supreme Court of California May 8, 2013); CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. ???; Harvard Law Review Association. (1995, May). Confronting the new challenges of scientific evidence. *Harvard Law Review*, pp. 1532-1562.

¹⁶⁵⁵ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, Reference Manual on Scientific Evidence (pp. 374-380). Federal Justice Center of the United States. p. 354.

than the threshold value previously set, it rejects the neutral hypothesis and accepts the hypothesis as valid.

An outcome is statistically significant if the observed p-value falls below the significance level. Statistical theory conventionally requires the probability of committing sampling errors by chance alone to be maximum 0.05 or a one in twenty chance.¹⁶⁵⁶

All things being equal, the more common the disease and the stronger the association between the exposure and the disease, the more likely that the result of the study is statistically significant. But, significance only bears on whether the magnitude of the association is a result of random chance or is 'real'. It does not appreciate the level of association.

However statistical significance is no indication that the result (relative risk) of a study is significant. It is an indication of the potential errors. A study can find a weak association/relative risk and be statistically significant and vice versa.

Some courts mix these things up.¹⁶⁵⁷ Most likely because the statistical significance of a study's depends in part on the incidence of the disease and the magnitude of the association.

Still, association and statistical significance remain two distinct concepts that should not be mingled.

An example of good use of epidemiology is the case of Chambers versus Exxon. Chambers worked as an independent contractor in an Exxon's refinery. He claimed to have contracted chronic myelogenous leukaemia (CML) from exposure to chemicals and substances that contained benzene. The district court decided that the expert testimony that benzene exposure causes CML was inadmissible for lack of scientific reliability, in absence of epidemiological study that conclusively established a statistically significant risk of contracting CML

¹⁶⁵⁶ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. 100; GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 359, fn. 72.

¹⁶⁵⁷ In re Joint E. & S. Dist. Asbestos Litig, 52 F.3d 1124 (United States Court of Appeals, Second Circuit April 6, 1995) concluding that any relative risk less than 1.50 is statistically insignificant.

from exposure to benzene.¹⁶⁵⁸ Several studies mention the possibility that benzene causes CML, but each one concluded that there was no statistically significant association between the disease and the exposure.¹⁶⁵⁹ The Court of Appeal confirmed the judgment.¹⁶⁶⁰

5.1.3.3 Experts and their evidence in a nutshell

Scientific evidence is quite different compared with 'standard' evidence in 'normal' tort cases. Obviously the evidence is based on science and delivered by scientists. Judges and lawyers are *stricto sensu* no scientists, as are scientist no lawyers. Both domains have different methodologies and use concepts and terms in different ways. Misunderstandings can and do follow. The former can have a considerable impact on the outcome of a court case. Despite attempts to find a common ground of understanding legal certainty will always differ from scientific certainty. Toxic tort however needs scientific evidence to prove causation.

Epidemiological studies are the most commonly used, followed by toxicological research and differential diagnosis.

Epidemiology uses statistical methods to discover associations between conditions and exposures, and thereby aims at identifying an association between the substances and the increased disease incidence, quantify the increase of a disease and provide a profile of the type of individual who is likely to be damaged. An association is however not a causal link. An interpretation of the association is necessary before it can be concluded that the disease is caused by the substance. Several methods exist to find this association, for example: toxicological in vivo and in vitro experiments. Another, but more interpretative method is the application of the Bradford Hill Factors. The consideration of nine factors structures the analytical process of deciding in favour or against a causal link. The method is frequently used in the US and in the UK if scientific evidence is presented in court.

¹⁶⁵⁸ Chambers versus Exxon Corporation, 81 F.Supp.2d 661 (United States District Court, M.D. Louisiana January 21, 2000).

¹⁶⁵⁹ Chambers versus Exxon Corporation, 81 F.Supp.2d 661 (United States District Court, M.D. Louisiana January 21, 2000).

¹⁶⁶⁰ Chambers v. Exxon Corp., 247 F.3d 240 (United States Court of Appeals, Fifth Circuit January 5, 2001).

Differential diagnosis is a method used by physicians for determining what process caused an individual disease. All potential relevant causes are considered and gradually eliminated on the basis of additional information. The remaining cause is then considered to be the actual cause. Differential diagnosis is used in court for the discovery of the causal link between the act of the defendant and the damage of the plaintiff.

Bio monitoring is relatively new in court, but is an important research method for low-dose, long term exposure to toxic chemicals.

Studies have to be delivered in court. This is done through experts and reports. Both Continental and Common law regulate the delivery of evidence and the testimony of experts in court. These rules can be found in Civil Codes on proceedings (Netherlands and France), the Civil Evidence Acts (UK) and the Federal Rules of Evidence (USA).

In the US experts present their findings in toxic tort cases. In the Netherlands and the UK an expert is called in when he will have an added value to the court proceedings and the decision. In France evidence does not have to be written down, verbal presentation of understandable research is sufficient. The findings are anyhow included in the case notes.

In practice experts prove to be necessary when courts have to deal with specialised expertise concerning chemical exposures and complex injuries.

The US system concerning evidence on causation is special. It is a two-step assessment, whereby first the reliability of the evidence and the expert is evaluated. Thereafter the admitted evidence is considered in the substantive proceedings leading to a judgment. In practice the first step also considers to a certain extent the validity of the conclusions of the research and the expert testimony. Methodology and conclusions cannot completely be separated.

The other countries evaluate the evidence during proceedings. Concerning the appointment of experts, these specialists are checked upon their qualifications and the relevance of their knowledge or inclusion on an expert list. All experts have to assist the judge and add value to the decision making process.

The Dutch courts have the possibility to ask for a preliminary expert report and for a 'normal' report. The judge cannot refuse the request for a preliminary

expert report. The difference between a preliminary and a normal expert opinion is that the first mainly supports the parties with the delivery of evidence, whilst the second focuses on informing the judge.

The very nature of toxic tort forces courts to work not only with scientific studies but also with probabilistic evidence.

Statistics are normally not part of the core knowledge and expertise of judges, lawyers or legal academics. Some basic knowledge is useful. Following terms and concepts belong to the basic instruments necessary to understand the value and reliability of probabilistic evidence:

- Relative risk indicates the risk of disease in the exposed group as compared to the risk of disease in the unexposed group;
- Statistical significance is the probability that an effect is not due to just chance alone.
- Confidence intervals are used to indicate the reliability of an estimate.

Proof in toxic tort is complex and demanding. To facilitate the search for causation two concepts are introduced: general causation and specific causation. Both are the subject of the following chapter 5.2.

5.2 General and specific causation: an improved approach?

Sometimes a disease or an injury is strongly associated with a chemical substance. This is the case with some active ingredients of medicines, but also with some chemicals. The specific harm these substances cause are called signature diseases. Notorious examples are asbestos and mesothelioma, mercury and Minamata disease, DES and vaginal adenocarcinoma.¹⁶⁶¹ When such a signature disease is observed, the proof of causation is easier. Such clear links between a chemical and a disease are however exceptional. Thus in most cases it is necessary to prove that the substance can cause the disease, and that on the individual level it can be proved that the specific exposure to the substance is sufficient to hold that the disease was caused by that substance.¹⁶⁶² The first is called general causation or, formulated differently, can A cause B. The second is specific causation: did A cause B. The first is looking into the

¹⁶⁶¹ Signature diseases are relatively rare. Research has detected several, but most are less frequent than those mentioned above.

¹⁶⁶² FARBER, D. (1987, May). Toxic causation. *Minnesota Law Review*, pp. 1251-1252.

future, the second is looking to the past. Epistemological, when asking the question about general causation, we do not yet know the concrete outcome and the putative cause might even not be realised yet. But, when asking the question on specific causation we have knowledge about the outcome as well as the putative cause.¹⁶⁶³

These two types of causation are called respectively general causation and specific causation. They are both discussed in the following paragraphs.

5.2.1 Together or apart: general versus specific causation

In Part III the split between the cause-in-fact and the legal cause was discussed. In this chapter we go one step further. A distinction is made within the factual phase, namely between general and specific causation. Making a difference between both types of causal links brings structure to the search for evidence in complex factual circumstances and is thus especially relevant in chemical liability cases. But what differentiates both types of causation?

In toxic tort causal uncertainty is an ordeal frequently to be faced. Hume's statement that 'whenever A has happened, B has followed and so will it always be' is not a correct supposition.¹⁶⁶⁴

Firstly it should be proved that A can cause B. This is general causation. But there exist several possible causes for B and general causation does not differentiate causes on the individual level. Holding a defendant liable in tort should however be based on a clear understanding of what exactly happened in a specific situation. Thus proof of specific causation is also necessary.

Consequently three situations can be identified: (1) only group based information supporting general causation is available, (2) information on both general and a specific causal link exists, and (3) there is no or not yet evidence that a substance can cause the injuries. In the following paragraphs these situations are discussed separately: firstly the need for group based evidence, secondly specific causation as based in general data, thirdly is proof of specific

¹⁶⁶³ DAWID, P. (2011). The role of scientific and statistical evidence in assessing causality. In R. GOLDBERG, Perspectives on causation (pp. 133-147). Oxford and Portland: Hart Publishing, pp. 133-134.

¹⁶⁶⁴ See Part III on Causation.

causation possible without group based evidence that the substance can cause harm.

5.2.1.1 General causation

Chemicals are contributing to economic development, agricultural production and welfare. Several chemical substances pose also health risks.¹⁶⁶⁵ Several diseases, like cancers are linked to chemical substances, but these are no different from the diseases caused by other agents.¹⁶⁶⁶ Chemicals leave no trace of their presence in the body of a living being. When biological-mechanism are known, causation can be proved.¹⁶⁶⁷ However, the aetiology of the diseases allegedly caused by chemicals is still largely unknown. How should the plaintiff prove his case?

In most situations the available evidence is based on studies comparing the incidence of disease in groups of individuals (epidemiologic evidence) or animals (toxicological evidence) with the level of exposure. When a difference is found between exposed and unexposed groups then there is proof of an association between the exposure and the harm.

Roughly it can be said that if the increase (if any) of a disease amongst the exposed population would not have occurred when the exposure would not have taken place, then it can be concluded that a causal link between the substance and the disease exists. However the step from association to causation has to be motivated.¹⁶⁶⁸ Several factors should be considered before arriving at that conclusion. Usually these factors are: the temporal relationship, the strength of the association, the dose-response relationship, and the replication of the findings, the biological plausibility, and the consideration of alternative

¹⁶⁶⁵ WORLD HEALTH ORGANIZATION. (2011). Collaboration between the World Health Organization and the National Institute of Environmental Health Sciences: highlights from 30 years of partnership. Geneva: WHO Document Production Services, p. 3.

¹⁶⁶⁶ EATON, D. (2003, Vol. 12). Scientific judgment and toxic torts - A primer in toxicology for judges and lawyers. *Journal of Law and Policy*, p. 23.

¹⁶⁶⁷ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 5. Factual Cause, § 28 Burden of Proof (2012), (3)

¹⁶⁶⁸ See also the paragraph on epidemiology 5.1.2.1.

explanations.¹⁶⁶⁹ Opinions must be expressed to 'a reasonable degree of certainty'.¹⁶⁷⁰

Failing to consider these factors can lead to inadmissibility of the study, as happened in *Soldo versus Sandoz*. The court analysed the individual items of proof as well as the aggregate, but concluded that the plaintiff's experts 'cannot lump together lots of hollow evidence' and reach a reliable conclusion.¹⁶⁷¹

Although epidemiological studies are considered the best evidence for general causation, general causation can also be proved on the basis of *in vivo* and *in vitro* experiments, animal tests, conclusions per analogy, etc.¹⁶⁷² The aim is to prove that a substance can cause a particular damage and these studies are reliable methods to do so. They have the advantage that they are more controllable than epidemiological studies and causal links can more easily be observed. The downside is however that the conclusions need extrapolation to humans.¹⁶⁷³ Epidemiological studies remain the most used evidence for general causation.

Again, no matter what type of research is used, it remains difficult to close the gap between the finding of an association and the judgment that a causal link exists.¹⁶⁷⁴ Despite that, several associations and causal links between environmental exposure to chemicals and harm have been discovered through such studies. For example, the links between smoking and cancer, asbestos and

¹⁶⁶⁹ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, *Reference Manual on Scientific Evidence* (pp. 374-380). Federal Justice Center of the United States, p. 375.

¹⁶⁷⁰ *Soldo versus Sandoz Pharmaceuticals Corp.*, 244 F. Supp. 2d 434 (United States District Court, W.D. Pennsylvania January 13, 2003).

¹⁶⁷¹ *Soldo versus Sandoz Pharmaceuticals Corp.*, 244 F. Supp. 2d 434 (United States District Court, W.D. Pennsylvania January 13, 2003).

¹⁶⁷² *Norris versus Baxter Healthcare Corp.*, 397 F.3d 878 (United States Court of Appeals, Tenth Circuit February 8, 2005); *Jaros versus E.I. DuPont (In re Hanford Nuclear Reservation Litigation)*, 292 F.3d 1124 (US Court of Appeals, Ninth Circuit June 18, 2002), p 1133; *In re Hanford Nuclear Reservation Litigation*, 1998 WL 775340 (United States District Court, E.D. Washington August 21, 1998); *In re "Agent Orange" product liability litigation*, 611 F.Supp. 1223 (US District Court, E.D. New York May 8, 1985); *Merrell Dow Pharmaceuticals Inc. versus Havner*, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997).

¹⁶⁷³ For an explanation of epidemiology, see paragraph 5.1.2.2.

¹⁶⁷⁴ For more details on this topic, see paragraph 5.3 and 5.4.3.

cancer, benzene and leukaemia, etc. were established on the basis of an analysis of disease patterns in populations.¹⁶⁷⁵

In court, a lot depends on the final assessment of the scientific information by the judges (or juries), as is shown in the following case of which the outcome might surprise you.

Mrs. McTear sought to recover damages for the premature death of her husband, allegedly caused by lung cancer contracted after smoking for nearly his whole life.¹⁶⁷⁶ The exact causes of the cancer were unknown, as was the mechanism whereby such a disease as lung cancer developed. It was a difficult case. Judge Lord Nimmo Smith wrote a judgment of 320.000 words before rejecting the claim.¹⁶⁷⁷ The only evidence of an association between smoking and lung cancer were epidemiological studies.¹⁶⁷⁸ In fact these studies had so far failed to establish how lung cancer developed. Additionally no constituent of cigarette smoke had been shown to cause such cancer.¹⁶⁷⁹ Judge Smith stated the following:

“If an association between an exposure and a condition is judged to be statistically significant... that in itself does not constitute a judgment that there is a causal connection between the exposure and the condition.”¹⁶⁸⁰

Judge Smith further felt unable to conclude on the basis of epidemiologic evidence that there was a general causal link between smoking and lung cancer, because the epidemiologists failed to instruct him in a way that he was able to form his own judgement on the matter. Without certainty that smoking could cause lung cancer, it became impossible to prove that smoking caused the plaintiff's cancer. Formulated in causal terms, the lack of proof of general causation blocked the evaluation of specific causation.

¹⁶⁷⁵ MARINO, A., & MARINO, L. (1995-1996, Vol. 21). The scientific basis of causality in toxic tort cases. *University of Dayton Law Review*, pp. 1-63.p. 38.

¹⁶⁷⁶ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005).

¹⁶⁷⁷ MILLER, C. (2006, December Vol. 26 No. 4). Causation in personal injury: legal or epidemiological common sense? *Legal Studies*, pp. 544-545.

¹⁶⁷⁸ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005), § 6.152.

¹⁶⁷⁹ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005), §§ 6.51, 6.52, 6.123, 6.139, 6.153.

¹⁶⁸⁰ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005), § 6.158.

Generally relevant (and understandable) epidemiological studies are accepted as evidence for general causation.¹⁶⁸¹ If a statistically significant association is found and there is no apparent bias, it can be inferred that there may be a cause-and-effect relationship between the substance and the medical effect.¹⁶⁸² On the other hand, a number of courts have accepted that an epidemiological study with a relative risk of 2 justifies the inference of specific causation.¹⁶⁸³ Sometimes, plaintiffs could satisfy their burden of proof with a relative risk smaller than 2, if additional evidence that bears on individual causation was present.¹⁶⁸⁴ This happened for example in the case of *Grassis versus Johns-Manville Corp.*, where the epidemiological studies were combined with other known risk factors like family history, diet, alcohol consumption, and smoking.

5.2.1.2 General and specific causation: together they are strong

General causation alone is not sufficient. Liability can only be assigned when the act of the defendant caused the harm of the plaintiff. This causal link is called specific causation and thus refers to particular events that are related to the particular damage to a particular plaintiff.¹⁶⁸⁵

Courts prefer to receive evidence of general and specific causation.¹⁶⁸⁶ Indeed, ideally evidence for both should be submitted.

How is specific causation proved? Group based evidence is normally not suited

¹⁶⁸¹ Please not the reluctance of UK courts to use this type of evidence. For more informative see the article of McIVOR, C. (2013, Vol. 21). Debunking some judicial myths about epidemiology and its relevance to UK tort law. *Medical Law Review*, pp. 553-587.

¹⁶⁸² *Smith versus Ortho Pharmaceutical Corp.*, 770 F.Supp. 1561 (United States District Court, N.D. Georgia, Atlanta Division January 30, 1991). See also remarks in paragraph 5.3.

¹⁶⁸³ GREEN, M., FREEDMAN, M., & GORDIS, L. (2000). Reference Guide on Epidemiology. In 2. e. Fed. Judicial Center, Reference Manual on Scientific Evidence (pp. 374-380). Federal Justice Center of the United States, p. 384. See for court cases: *Merrell Dow Pharmaceuticals Inc. versus Havner*, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997); *Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II)*, 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995); *DeLuca versus Merrell Dow Pharmaceuticals, Inc.*, 911 F.2d 941 (United States Court of Appeals, Third Circuit August 17, 1990); *In re Agent Orange Product Liability Litigation MDL No. 381*, 818 F.2d 187 (United States Court of Appeals, April 21, 1987).

¹⁶⁸⁴ *Grassis v. Johns-Manville Corp.*, 591 A.2d 671, 675 (N.J. Super. Ct. App. Div. 1991):

¹⁶⁸⁵ *Sterling versus Velsicol Chemical Corporation*, 855 F.2d 1188 (US Court of Appeals August 29, 1988); *In re Hanford Nuclear Reservation Litigation*, 1998 WL 775340 (United States District Court, E.D. Washington August 21, 1998); *WALKER, V.* (2004, Winter). Restoring the individual plaintiff to tort law by rejecting 'junk logic' about specific causation, *Alabama Law Review*, p. 382.

¹⁶⁸⁶ *Norris versus Baxter Healthcare Corp.*, 397 F.3d 878 (United States Court of Appeals, Tenth Circuit February 8, 2005).

as prove of cause for individual harm. For example, Mrs. McTear could not prove that her husband would not have contracted lung cancer if he would not have smoked. She could thus not overcome the uncertainty linked to a probability of having contracted lung cancer by smoking. In other words, she could not prove specific causation. A conclusion that was made by Judge Smith, although he already found for the defendant on the basis of lack of general causation.¹⁶⁸⁷ Courts struggle with the impossibility to prove with absolute certainty that a chemical caused a damage. Circumstantial evidence is not sufficient.¹⁶⁸⁸ They have turned to statistics and the calculation of probabilities for a solution. Statistical calculations are used to make group results suitable for answering for the questions on specific causation. More aspects are analysed in chapter 6.1 on uncertainty and probability.

5.2.1.3 No general causation: is the case really lost?

General causation is mostly considered as an essential element of liability.¹⁶⁸⁹ Many courts opine that proof of specific causation only has value when it is preceded by evidence that general causation is proved.¹⁶⁹⁰ Lack of evidence that a substance can cause the injury, blocks then further proceedings on the individual case.¹⁶⁹¹ For example, in the case of Merrell Dow versus Havner, the

¹⁶⁸⁷ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005).

¹⁶⁸⁸ Mascarenas versus Miles, Inc., 986 F.Supp. 582 (United States District Court, W.D. Missouri November 19, 1997).

¹⁶⁸⁹ BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. Columbia Law Review, p. 2121.

¹⁶⁹⁰ Henricksen versus ConocoPhillips company, 605 F.Supp.2d 1142 (United States District Court, E.D. Washington February 11, 2009); Kerns versus Hobart Bros. Co., 2008 WL 1991909 (Court of Appeals of Ohio, Second District, Miami County. May 9, 2008); Ashburn versus General Nutrition Centers, Inc., 533 F. Supp. 2d 770 (United States District Court, N.D. Ohio, Western Division February 5, 2008); XYZ versus Schering Health Care Ltd 70 BMLR 88, (2003) 70 BMLR 88 (High Court of Justice July 29, 2002); Bonner versus. ISP Technologies, Inc., 259 F.3d 924 (United States Court of Appeals, Eighth Circuit August 3, 2001); DuPont de Nemours versus Castillo, 748 So.2d 1108 (District Court of Appeal of Florida, Third District February 9, 2000); Raynor versus Merrell Pharmaceuticals Inc., 104 F.3d 1371 (United States Court of Appeals, District of Columbia Circuit January 21, 1997); Wright versus Willamette Industries, Inc., 91 F.3d 1105 (US Court of Appeals, Eight Circuit September 19, 1996); Sutera versus Perrier Group of America Inc., 986 F. Supp. 655 (United States District Court, D. Massachusetts September 29, 1997); In re "Agent Orange" product liability litigation, 597 F.Supp. 740 (US District Court, E.D. New York September 25, 1984).

¹⁶⁹¹ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. 267.

opinion based on differential diagnosis was excluded because there was no proven scientific basis for concluding that general causation existed.¹⁶⁹²

Another court decided differently. Katie Bonner was twice exposed to FoamFlush, an organic solvent.¹⁶⁹³ Once she was sprayed with the product because of a leakage in a hose; the other time she breathed the product when vapours were released from a drum near her working place. She alleged three permanent injuries: damage to her brain, psychological problems, and Parkinsonian symptoms. First Bonner had to prove that the chemicals in the solvent were capable of causing injuries similar to the ones she contracted. Secondly she had to demonstrate that she was exposed to a 'sufficient' level of solvent to cause her injuries and that the injuries were indeed caused by FoamFlush.¹⁶⁹⁴ The defendant argued, *inter alia*, that the causal link between the damage and the solvent, as expressed by the expert testimony, was unreliable because there was no epidemiological support for it. Thus general (generic) causation was lacking.¹⁶⁹⁵ However, since the scientific methodology used by the plaintiff's expert was solid and scientifically valid, the lack of epidemiological studies was not detrimental. The novelty of a conclusion does not bar its admissibility.¹⁶⁹⁶

But, still courts require proof of general causation before granting a claim in an individual case.

"On July 11, 2008, Mrs. Cooper was hospitalized due to weakness, memory loss, cognitive issues, tremors, and psychological/personality changes. She was diagnosed with hypothyroidism and encephalopathy of unknown aetiology, possible pesticide exposure. On July 16, 2008, Mrs. Cooper was hospitalized again due to convulsions and diagnosed with acute psychotic reaction, hypothyroidism, possible exposure to

¹⁶⁹² Merrell Dow Pharmaceuticals Inc. versus Havner, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997).

¹⁶⁹³ FoamFlush contains 57% gamma-butyrolactone and three other chemical compounds in smaller quantities. In the human body, BLO metabolizes into gamma-hydroxybutric acid. p. 927.

¹⁶⁹⁴ Bonner versus ISP Technologies, Inc., 259 F.3d 924 (United States Court of Appeals, Eighth Circuit August 3, 2001), p. 928.

¹⁶⁹⁵ Bonner versus ISP Technologies, Inc., 259 F.3d 924 (United States Court of Appeals, Eighth Circuit August 3, 2001), p. 930.

¹⁶⁹⁶ Bonner versus ISP Technologies, Inc., 259 F.3d 924 (United States Court of Appeals, Eighth Circuit August 3, 2001), p. 929.

pesticides of unknown significance, and metabolic encephalopathy. Approximately one year later, Mrs. Cooper was diagnosed with hypothyroidism caused by Hashimoto's thyroiditis."¹⁶⁹⁷

After reviewing the deposition of the expert appointed for proving general causation the Court of Appeal decided that the expert had not based his opinion on reliable scientific, technical, or other specialized information. Failure to establish general causation, all claims submitted by the plaintiffs failed.¹⁶⁹⁸

In the UK the problem of using trends in general population to prove specific causation by using statistics was also recognised.¹⁶⁹⁹

5.2.2 The Continental Law system: a hidden methodology?

The concepts of general and specific causation can be broadly applied. The information in the former paragraph is however mainly based on the Common Law system and in particular on the US. There the most information was available, mainly because the Common Law system necessitates the elaboration of reasoning and logic explicitly and in length. This paragraph will now look at the Continental System as it exists in the Netherlands and France. Maybe those systems do use general and specific causation, but not so outwardly.

In essence the distinction between general and specific causation is a method to solve evidential problems relating to the question if the substance at hand really caused the observed damage. In other words: it is easier to first look at the toxicity of the substance and thereafter investigate the role of the substance in plaintiff's harm.

5.2.2.1 The Netherlands

On the basis of his exposure to neuro-toxic substance, like hardeners, adhesives, silicones, polyesters, and varnishes, a Dutch plaintiff claimed that he contracted serious damage to the respiratory tract and the nervous system.¹⁷⁰⁰

¹⁶⁹⁷ Cooper versus BASF, Inc., 2013 WL 3356680 (Court of Appeals of Ohio, Ninth District, Summit County June 28, 2013).

¹⁶⁹⁸ Cooper versus BASF, Inc., 2013 WL 3356680 (Court of Appeals of Ohio, Ninth District, Summit County June 28, 2013).

¹⁶⁹⁹ McTear versus Imperial Tobacco Ltd, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005); Gregg versus Scott, [2005] WL 62248 (House of Lords January 27, 2005); Hotson versus East Berkshire Health Authority, [1987] A.C. 750 (House of Lords July 2, 1987).

¹⁷⁰⁰ Hoge Raad 23 June 2006, *Nederlandse Jurisprudentie* 2006/354

The plaintiff had to prove the exposure to substances that were noxious for human health, but also had to prove that these substances caused his disease. Merely proving that one is exposed to toxic substances is thus not sufficient, not even for the reversal of the burden of proof.

When the court demanded proof that the disease can be caused by the substances and that the plaintiff was exposed to these substances allegedly causing the harm, the plaintiff was in fact requested to prove general and specific causation.¹⁷⁰¹ Although one could observe that in the cited court decision general and specific causation are inherently taken into account, there was not a formal split between both in pleadings.

5.2.2.2 France

In France the concept of general and specific causation is equally not explicitly used in litigation.¹⁷⁰²

Residents living nearby an incineration plant filed claims in liability for cancer contracted by the exposure to emitted dioxins. In the preparatory inquiry the claims were inadmissible on the basis that the current state of scientific knowledge did not provide evidence of an exclusive and direct causal relationship between dioxin and cancer. Although it could also not be excluded that dioxin causes cancer. Only a case-controlled investigation could give an answer. The arguments refer to the doubt that dioxin can cause cancer, and are thus linked to general causation.

Additionally it was stated that the mere fact of living nearby the incinerator, emitting toxic dioxin, cannot in itself constitute an injury in the absence of any proven harm having a causal link or a connection with the defective operation of the incinerator and the subsequent emissions.¹⁷⁰³ The plaintiffs failed to prove any direct and personal damage or, in other words, they did not prove specific causation.¹⁷⁰⁴

¹⁷⁰¹ Hoge Raad 23 June 2006, *Nederlandse Jurisprudentie* 2006/354; Hoge Raad 17 November 2000, *Rechtspraak van de Week* 2000/230.

¹⁷⁰² Cour d'Appel d'Orléans, 14 November 2008, nr. 05/02470, *Jurisprudence Dalloz*. See also FAIRGRIEVE, D., & G'SELL-MACREZ, F. (2011). Causation in French Law: pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (p. 111). Oxford: Hart Publishing Ltd., p. 123.

¹⁷⁰³ Cour de Cassation (Chambre Criminelle) 9 May 2007 *Jurisprudence* nr. 06-87.174

¹⁷⁰⁴ Concerning the impact of use of general and specific causation in this case, a reservation should be made. Although the claim is also based on article 1382 of the French Civil Code, the ruling court is a criminal chamber. This has an impact in the sense that,

However, in 2009 a claim was granted in the absence of proof of general causation. The claim was about the development of multiple sclerosis after vaccination against hepatitis B. A causal link between both the vaccine and the disease was accepted on the basis of the temporal proximity between the injection and the disease, and on the basis of the absence of other risk factors.¹⁷⁰⁵ A link could not be excluded, even when no scientific evidence supported a significant causal relation. The proximity and lack of other risk factors were sufficient for a presumption of causation. Consequently the claim was granted.

Meanwhile some French courts have resisted this approach of the Court of Cassation. These courts will not hold defendants liable when no proof of general causation is submitted.¹⁷⁰⁶ But in the next judgment the Court of Cassation changed its approach again. Despite the fact that the situation was similar to the former decision, now required proof of general causation. The decision of the Court of Appeal of Paris in favour of the defendants was now upheld. The Court of Appeal of Paris refused to consider specific causation on the basis in the absence of a scientific consensus supporting a general causal link between Hepatitis B and multiple sclerosis.¹⁷⁰⁷

It is wait and see what the future will bring, but for the moment there is uncertainty. Can a plaintiff find recovery if he cannot prove general causation? Is evidence of specific causation then sufficient?

The cases on the vaccination against hepatitis B are also discussed in paragraph 5.2.2.2, since the lack of consistence in the litigation of the Court of Cassation has also impacted the use and evaluation of statistics, a matter that is linked to the use of general and specific causation.

beside stricter standards on proof, in France criminal court motivate their judgements much more than civil courts. There is however no reason to assume that civil courts do not use the same logic as described in this case, although they do make.

¹⁷⁰⁵ Cour de Cassation (1re Chambre Civile) 9 July 2009, nr. 08-12781.

¹⁷⁰⁶ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 175.

¹⁷⁰⁷ Cour de Cassation (1re Chambre Civile) 25 November 2010, nr. 09-16.556.

5.2.3 More structure in causation: a summary of the application of general and specific causation

General and specific causation present the differences in proving that a chemical can cause harm and that a chemical has caused a particular harm to an individual.

Three possible situations can be identified:

- General causation is proved;
- Both general and specific causation can be proved;
- No prove of general causation is available.

Diseases are linked to chemicals, but often there is no observable difference between a disease caused by chemicals and the same disease caused by other agents. When biological-mechanism or toxicity is known, then it is possible to prove that the substance can cause the disease or harm. Epidemiological evidence is used as the best solution.

However the analytical gap between an association and a causal link remains difficult to close, especially on the individual level. Epidemiological studies are thus mainly used for proving general causation. In practice such a proof can only be delivered on a probability basis.

Then the plaintiff had to prove a causal link between his exposure to the substance and the harm. This is as a request for evidence of specific causation. Despite the analytical gap, it has been claimed that high quality epidemiological evidence can be used to proof individual causation.¹⁷⁰⁸ A relative risk factor greater than two is thereby considered sufficient.¹⁷⁰⁹ The question is if this is a correct approach. To answer that question, the scientific methods used in courts have to be studied and evaluated.

The distinction between the cause-in-fact and legal cause is used in both Common and Continental Law, but not always explicit. The method is only formally recognized in the US. Concretising the use of both concepts in decisions would support transparency and understanding of the judgments. (See also the issues of probability, scientific evidence and belief probability)

¹⁷⁰⁸ BROADBENT, A. (2011, Vol. 17 issue 4). Epidemiological evidence in proof of specific causation. *Legal Theory*, p. 239.

¹⁷⁰⁹ BROADBENT, A. (2011, Vol. 17 issue 4). Epidemiological evidence in proof of specific causation. *Legal Theory*, p. 239.

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In the former part the delivery of evidence is analysed, together with the method of differentiating between general and specific causation. This differentiation is useful in complex causation as occurs in toxic tort. Although it makes the challenge of proof more transparent, the confrontation with limited knowledge, scientific evidence and legal reasoning is still vivacious. Part VI deals with these issues, as the last brick in the foundation of advice and solution concerning toxic tort litigation.

6.1 Uncertainty and probability

When an event is probably to occur, then that occurrence is less than certain. If in court a cause is described as probable, it means that the cause is not fully supported by factual evidence. 'More likely than not' is not certitude. Consequently any evidence that is not conclusive in relation to the alleged tortfeasor's liability bears in itself the possibility that the tortfeasor is innocent.¹⁷¹⁰ Probabilistic evidence bears in itself a threat of error. Why then use it?

6.1.1 Statistics as a necessity in toxic tort

Statistical evidence on causation is mentally more difficult to process than specific and concrete evidence.¹⁷¹¹ Due to the lack of observability of causal processes, statistical probability is however usually necessary in toxic tort. The former can lead to decisions that are difficult to understand and communicate. The best way to illustrate this is with the simplified example on probability, first elaborated in the Herskovits case and since then repeated so many times that only a citation of the original will do honour to it.

"Assume there are two cab companies in a town; one has three blue cabs and the other has one yellow cab. A pedestrian is hit by a cab, but doesn't know what color it was. In a suit for personal injury, plaintiff wants to admit the statistical fact that there is a 75 % chance that she

¹⁷¹⁰ COLB, S. (2010, Vol. 73). Probabilities in probable cause and beyond: statistical versus concrete harms. *Law and Contemporary Problems*, p. 81.

¹⁷¹¹ COLB, S. (2010, Vol. 73). Probabilities in probable cause and beyond: statistical versus concrete harms. . *Law and Contemporary Problems*, p. 78.

was hit by a blue cab. This fact has relevancy; it is admissible. But is it sufficient to prove the blue cab company more probably than not committed the act?”¹⁷¹²

As Judge Brachtenbach said in his minority opinion: adhering to probability, the blue cab company could be held liable for every unidentified cab accident that occurs.¹⁷¹³ Statistical evidence alone is not sufficient to prove cause.¹⁷¹⁴ Though the use of probability is valid, it may indeed not be judged sufficiently probative in an individual case. Providing additional evidence is better.¹⁷¹⁵

“Thus statistics alone should not be sufficient to prove proximate cause. What is necessary, at the minimum, is some evidence connecting the statistics to the facts of the case. Referring back to the cab example, testimony that a blue cab was seen in the vicinity of the accident before or after it occurred or evidence of a recently acquired, unaccounted for, dent in a blue cab could combine with the statistical evidence to lead a jury to believe it was more probable than not that this plaintiff was hit by a blue cab.”¹⁷¹⁶

Statistics on their own do not demonstrate what actually happened in an individual case, how things happened and who did it.¹⁷¹⁷

Additionally, the acceptance of a causal link is in science based on a different standard of probability, than in law. For (medical) science a probability of at least 95 % is required before the existence of a causal link is considered. In tort

¹⁷¹² *Herskovits versus Group Health Cooperative of Puget Sound*, 664 P.2d 474 (Supreme Court of Washington, En Banc May 26, 1983).

¹⁷¹³ Judge Brachtenbach, dissenting in *Herskovits versus Group Health Cooperative of Puget Sound*, 664 P.2d 474 (Supreme Court of Washington, En Banc May 26, 1983).

¹⁷¹⁴ FINKELSTEIN, M., & FAIRLEY, W. (1970, January). A Bayesian approach to identification evidence. 83 *Harvard Law Review*, 489, pp. 516-517.

¹⁷¹⁵ STAPLETON, J. (2012). Factual causation, mesothelioma and statistical validity. *Law Quarterly Review*, pp. 228-229.

¹⁷¹⁶ *Herskovits versus Group Health Cooperative of Puget Sound*, 664 P.2d 474 (Supreme Court of Washington, En Banc May 26, 1983).

¹⁷¹⁷ WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1057.

a causal link is (generally) accepted as proved on the basis of the balance of probabilities, equalling a 50 % probability.¹⁷¹⁸

Since probability does not provide certainty on causation, the question should be asked if the statistical calculations are in line with the objectives of tort. The error margins inherent to the use of naked statistics seem to be difficult to match with corrective justice and deterrence.

6.1.2 Ex ante and ex post: differences between prediction and assessment.

What if epidemiological studies are the only evidence available? Wright distinguishes the use of statistical evidence for the prediction of an outcome from the use of statistics for the assessment of the probability that a substance caused the damage.¹⁷¹⁹ Probabilities that are calculated for predicting the future, namely *ex ante*, are less reliable than probabilities calculated *ex post*, namely when the result materialised. *Ex ante* causal probability is abstract and group based; independent of the concrete situation in the tort case.¹⁷²⁰ *Ex post* probability is probative of what happened and particularistic.¹⁷²¹ Evidence generally involves *ex ante* and *ex post* probabilities.¹⁷²²

If in a tort case the only evidence is an epidemiological study, the *ex post* appreciation of a causal link as it happens in specific causation merges with the *ex ante* proof of risk.¹⁷²³ This is not a problem if the causal link is deterministic. Then the exposure in itself is sufficient as specific proof, like with signature diseases. In contrast with the former a problem emerges when such a one-to-

¹⁷¹⁸ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd., p. 150.

¹⁷¹⁹ WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, pp. 1048-1055.

¹⁷²⁰ WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1049.

¹⁷²¹ WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1057.

¹⁷²² WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1049.

¹⁷²³ GREEN, M. (2005). The Future of Proportional Liability. In S. MADDEN, *Exploring Tort Law* (pp. 352-402). Cambridge University Press, pp. 362-363.

one relation is absent. Exposure is then only sufficient when no other causes exist; a situation that cannot be achieved. After all, it is impossible to eliminate all alternative causes, even when one limits himself to epistemic causal links.¹⁷²⁴ *Ex post* probability calculations can in such situations provide a solution.

Green disagrees with the former. He claims that the *ex ante* statistically increased risk along with other particularistic evidence can be used to evaluate the probability of a causal link.¹⁷²⁵ Statistical evidence on causation is thereby not second best, it is rather the most fitting approach for the truth.¹⁷²⁶

6.1.3 Statistics: assessing chance, whose chance?

Mrs. McTear could not prove that her husband contracted lung cancer from smoking. How was that possible, everybody knows that cigarettes cause cancer, or not?

Mrs. McTear was the 'victim' of the dichotomy between statistical and personal chance.

A statistical chance is:

“a figure collected from previous unconnected outcomes, giving a probability of that outcome in any non-individual case.”¹⁷²⁷

Personal chance is peculiar to an individual, the chance is personalized.¹⁷²⁸

In the McTear case Lord Smith based his decisions about questions of fact only on factual evidence. Consequently Mrs. McTear should have proved that her husband would not have contracted lung cancer if he would not have smoked.¹⁷²⁹ She could not.

¹⁷²⁴ WRIGHT, R. (1988, July 73 IOWA L. REV. 1001). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1054.

¹⁷²⁵ GREEN, M. (2005). The Future of Proportional Liability. In S. MADDEN, *Exploring Tort Law* (pp. 352-402). Cambridge University Press, pp. 362-363.

¹⁷²⁶ GOLD, S. (2013, Vol. 70). When certainty dissolves into probability: a legal vision of toxic causation for the post-genomic era. *Washington and Lee Law Review*, p. 334.

¹⁷²⁷ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 161;

¹⁷²⁸ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 161

¹⁷²⁹ *McTear versus Imperial Tobacco Ltd*, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005), §§ 1.5, 6.29, 9.5.

6.1.3.1 The burden or the added value of a threshold

As was said in the former paragraph, statistics and the resulting probabilities do not prove causation in an individual situation. Statistical analysis focuses on the probability that chance is at the basis for an observed relationship between two factors.¹⁷³⁰ Torts is concerned with the probability or likelihood that a result is explained not by chance.¹⁷³¹

Particularistic evidence is necessary for the determination of what actually happened.¹⁷³² Probability can be used to provide that evidence.

Courts have used epidemiological evidence for proof of causation in individual cases.¹⁷³³ The studies are the source of *ex ante* probability, namely what is the chance to get a disease after exposure.

One of the most discussed topics in relation to the use of probability in court is if it is correct to use a probability threshold for deciding on the defendant's liability? One popular standard in litigation is the doubling of the risk: above 50 % the causal link is considered certain.¹⁷³⁴ *Vice versa*, if it cannot be proved that the result of a risk was above a 50 % chance, then causation is not established for that case. Only if a disease is present in an exposed population at minimal twice the rate of occurrence in the unexposed population, a finding of cause is

¹⁷³⁰ In fact a scientific study tries to eliminate all the 'not chance' explanations of all factors other than the one subject of the research.

¹⁷³¹ BARNES, D. (2001, Vol. 64, issue 4). Too many probabilities: statistical evidence of tort causation. *Law and Contemporary Problems*, p. 204.

¹⁷³² WRIGHT, R. (1988, July). Causation, responsibility, risk, probability, naked statistics and proof: pruning the bramble bush by clarifying the concepts. *Iowa Law Review*, p. 1054.

¹⁷³³ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 5. Factual Cause, § 28 Burden of Proof (2012), cmt. c.

¹⁷³⁴ *Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II)*, 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995); *Hall versus Baxter Healthcare Corp*, 947 F. Supp. 1387 (United States District Court, D. Oregon December 18, 1996); *Maiorana versus US Mineral Products, e.a. (In re Joint Eastern and Southern Dist. Asbestos Litigation)*, 827 F.Supp. 1014 (United States District Court, S.D. New York July 23, 1993), p. 1024, *DeLuca versus Merrell Dow Pharmaceuticals, Inc*, 911 F.2d 941 (United States Court of Appeals, Third Circuit August 17, 1990); *Marder versus G.D. Searle & Co.*, 630 F. Supp. 1087 (United States District Court, D. Maryland March 19, 1986).

permitted.¹⁷³⁵ Failing to meet the standard equals failure to prove causation and the defendant wins the case.¹⁷³⁶

The requirement of a relative risk greater than two as a benchmark leads to counter-intuitive results.¹⁷³⁷ The cut-off threshold is sometimes difficult to accept. For example. Hundred people visit the competition of the Yellow Lions. 51 % of the supporters have not paid their entree fee, the other 49 % of the supporters paid. No tickets were issued. Each supporter attending the game can be held liable in court for not paying an entree fee, although there is a considerable chance that they have paid.

In other words, if more than 50 % of lung cancers in a population are caused by smoking, then the cancer of any smoking individual is more likely than not caused by smoking.

This conclusion is however incorrect, as is best explained by following example:¹⁷³⁸

“If a jar contains seventy red jelly beans and thirty green jelly beans, the probability that a randomly - selected jelly bean will be red is 70 %, but the chosen bean is either red or green - it is not 70 % likely to be red.”

The act of taking the bean leads to 70 % chance that you will get a red bean. From the viewpoint of the bean, there is 50 % that it is red and 50 % that it is green.

Still the ‘doubling the risk’ standard was and is applied. In the case of XYZ versus Shering the threshold was used for the first time. Besides being critical

¹⁷³⁵ GIVELBER, D., & STRICKLER, L. (2006, Vol. 96, issue 1). Junking Good Science: Undoing Daubert v Merrill Dow through Cross-Examination and Argument. *American Journal of Public Health*, p. 33.

¹⁷³⁶ Wells versus SmithKline Beecham Corp., 601 F.3d 375 (United States Court of Appeals, Fifth Circuit March 22, 2010); Merrell Dow Pharmaceuticals Inc. versus Havner, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997). DeLuca versus Merrell Dow Pharmaceuticals, Inc, 911 F.2d 941 (United States Court of Appeals, Third Circuit August 17, 1990). *A contrario* Grassis versus Johns-Manville Corp., 591 A.2d 671 (Superior Court of New Jersey, Appellate Division May 30, 1991).

¹⁷³⁷ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 5. Factual Cause, § 28 Burden of Proof (2012), comment c.

¹⁷³⁸ Example from GOLD, S. (2011). The "reshapement" of the false negative asymmetry in toxic tort causation. *William Mitchell Law Review*, fn. 297.

on the added value of epidemiological evidence, the judge dismissed the claim, since the evidence indicated a relative risk of 1.7.¹⁷³⁹

But, the requirement of a relative risk of 2 is subject to scepticism.¹⁷⁴⁰ Thus the standard is not always applied. In practice these exceptions are mainly found in cases concerning signature diseases or where the damaging effect of an exposure to the substance is known, like radioactive material.¹⁷⁴¹ But also in other circumstances courts have refused to use a threshold limit. These courts acknowledge that the requirement of a relative risk of at least 2 is a misunderstanding of the concept. Following citation summarizes it all:

“[...] the relative risk is a statistical term derived from a study of hundreds or thousands of subjects. It is obtained by dividing the proportion of individuals in an exposed group who contract the disease by the proportion of individuals who contract the disease in a non-exposed group. Thus, any properly-performed epidemiological study that

¹⁷³⁹ XYZ versus Schering Health Care Ltd 70 BMLR 88, (2003) 70 BMLR 88 (High Court of Justice July 29, 2002).

¹⁷⁴⁰ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, pp.234-238, 281.

¹⁷⁴¹ For example: UK - Sienkiewicz versus Greif (UK) Ltd, [2011] I.C.R. 391 (Supreme Court March 9, 2011): The mother of the plaintiff Sienkiewicz died of mesothelioma in 2006. She was an office worker, whose duties took her all over the factory premises. Thereby she spent some time in areas that were occasionally contaminated with asbestos. On the other hand she was also exposed to asbestos in the general atmosphere outside her working environment, like all other inhabitants of the industrialized area where she lived and worked.

The total tortious exposure in the deceased's workplace was lower than the total environmental exposure. It was calculated that the risk at work increased the environmental risk by 18%, as was based on the extrapolation of expert epidemiological evidence. The plaintiff could thus not show that the exposure during work at least doubled the risk. Being a signature disease this was finally not necessary;

US - Jeanne Jaros versus E.I. DuPont (In re Hanford Nuclear Reservation Litigation), 292 F.3d 1124 (US Court of Appeals, Ninth Circuit June 18, 2002), p. 1136: A similar reasoning is followed in the US, as shown in for example the Hanford Nuclear Reservation litigation. After the release in 1990 of a report disclosing that large quantities of radioactive and non-radioactive substances were released from Hanford since 1940, thousands of individual plaintiffs filed complaints alleging illnesses caused by exposure to Hanford's toxic emissions. They allegedly got ill through ingestion of contaminated vegetables, meat, fish, drinking water and milk, swimming in the irradiated Columbia River, and inhalation of toxic air. In its decision, the court held that the risk of damage should statistically be double the risk faced by the general population in order to meet the 'more likely than not' standard. Failing this, the 'plaintiffs lacked direct proof' that radiation from the Hanford Nuclear Reservation caused their injuries. On appeal the plaintiffs contended that the 'double the risk' level is not relevant in cases where it has been scientifically proved that a substance is capable of causing the injuries complained of. The court noted that the Daubert II standard was set in a case with no specific evidence that the substance, subject of the claim, caused injuries.

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finds a relative risk greater than 1.0 signifies that exposure to an agent increases the probability of contracting the disease. Where the study properly accounts for potential confounding factors and concludes that exposure to the agent is what increases the probability of contracting the disease, the study has demonstrated general causation - that exposure to the agent "is capable of causing [the illness at issue] in the general population."¹⁷⁴²

Equation of a causal link with a relative risk of at least 2 mixes the standard of proof with the standard of persuasion.¹⁷⁴³

The use of probability with or without threshold is neither a mathematical nor pure quantitative exercise. Judgment and interpretation are required, regardless of the methodology used to evaluate the existence of causation.¹⁷⁴⁴ Furthermore, a risk ratio is a numerical externalization of the relationship between exposure and disease. It does not incorporate a credibility assessment, but is a start into the assessment of credibility.¹⁷⁴⁵

A relative risk of 2 has no specific significance in epidemiology – it is not proof of causation – it can be used as a criterion in law for when probability is acceptable.

Summarizing there should be no minimum level for the evaluation of probability in relation to general causation.¹⁷⁴⁶ The application of the Bradford Hill factors is for example one of the other possible methods for assessing specific causation.¹⁷⁴⁷

¹⁷⁴² *In re Silicone Gel Breast Implants products liability litigation*, 318 F.Supp.2d 879 (United States District Court, C.D. California April 22, 2004).

¹⁷⁴³ GOLD, S. C. (2010, Vol. 34). The more we know, the less intelligent we are? How genomic information should and should not, change toxic tort causation doctrine. *Harvard Environmental Law Review*, p. 409.

¹⁷⁴⁴ *Milward versus Acuity Specialty Products Group, Inc.*, 639 F.3d 11 (United States Court of Appeals, First Circuit March 22, 2011).

¹⁷⁴⁵ BARNES, D. (2001, Vol. 64, issue 4). Too many probabilities: statistical evidence of tort causation. *Law and Contemporary Problems*, p. 205.

¹⁷⁴⁶ STOUT, N. C., & VALBERG, P. A. (2005, Vol. 38 Issue 4). Bayes' law, sequential uncertainties, and evidence of causation in toxic tort cases. *University of Michigan Journal of Law Reform*, pp. 1072-1073.

¹⁷⁴⁷ STOUT, N. C., & VALBERG, P. A. (2005, Vol. 38 Issue 4). Bayes' law, sequential uncertainties, and evidence of causation in toxic tort cases. *University of Michigan Journal of Law Reform*, p. 1075.

Although it happens that the UK courts use statistics, the approach of the Supreme Court (the former House of Lords) is not unequivocal.¹⁷⁴⁸ The use of the doubling the risk standard in *Sienkiewicz*¹⁷⁴⁹ was a rather isolated case, and not the recognition that statistical evidence is admissible in civil proceedings.¹⁷⁵⁰ On the contrary, the court (with only one judge with a different opinion) refuses to recognize the value of epidemiology. Lord Kerr said:

“There is a real danger that so-called “epidemiological evidence” will carry a false air of authority. It is necessary to guard against treating a theory based on assumptions as a workable benchmark against which an estimate of the increase in risk could be measured.”¹⁷⁵¹

6.1.3.2 The power of persuasion and presumption

In Continental Law evidence should be persuasive.

a) France

In France the Court of Cassation ruled that it is sufficient if the plaintiff establishes the possibility of a causal link. The calculation of the probability is not necessary.¹⁷⁵² Thereby the French courts must be convinced of or believe in the truth of the facts at issue.¹⁷⁵³ Such ‘*intime conviction*’ is not defined in the Civil Code, but is apparently broader than ‘beyond reasonable doubt’.¹⁷⁵⁴ One doctrine equals ‘*intime conviction*’ with certainty, whilst another doctrine accepts that the ‘*intime conviction*’ is based on a strong probability.¹⁷⁵⁵

¹⁷⁴⁸ MILLER, C. (2012, Vol. 11). Epidemiology in the courtroom: mixed messages from recent British experience. *Law, Probability and Risk*, p. 86.

¹⁷⁴⁹ *Sienkiewicz versus Greif (UK) Ltd*, [2011] I.C.R. 391 (Supreme Court March 9, 2011).

¹⁷⁵⁰ MILLER, C. (2012, Vol. 11). Epidemiology in the courtroom: mixed messages from recent British experience. *Law, Probability and Risk*, p. 87.

¹⁷⁵¹ *Sienkiewicz versus Greif (UK) Ltd*, [2011] I.C.R. 391 (Supreme Court March 9, 2011).

¹⁷⁵² OLIPHANT, K. (2009). Aggregation and divisibility of damage in tort law and insurance. In K. OLIPHANT, *Aggregation and divisibility of damage in tort law and insurance* (pp. 473-517). Vienna: Springer, p. 491.

¹⁷⁵³ ENGEL C. Preponderance of evidence versus intima conviction: a behavioural perspective on a conflict between American and continental European law, 2009 *Vermont law review*, p. 435.

¹⁷⁵⁴ TARUFFO, M. (2003, Vol. 51). Rethinking the standard of proof. *American Journal of Comparative Law*, p. 667.

¹⁷⁵⁵ VERGES, E. (2014). La réforme du droit de la preuve civile : enjeux et écueils d'une occasion à ne pas manquer. *Dalloz*, p. 617 ff.

Furthermore there is no specific standard of proof.¹⁷⁵⁶ The evaluation of evidence is free in the sense that there is no specific standard of proof.¹⁷⁵⁷ The standard of proof depends on the discretion of the judge. Several court decisions support the opinion that in uncertain situations a pragmatic conception of judicial syllogism is acceptable and proof can be based on presumptions.¹⁷⁵⁸ Presumption of causation is acceptable if based on individual experience and beliefs.¹⁷⁵⁹ The courts have discretionary power in determining the weight of evidence.¹⁷⁶⁰

More than once causation has been presumed when the act of the defendant was considered dangerous and the damage to the victim seemed to be a normal consequence of the created risk.¹⁷⁶¹ In the case of Hepatitis B vaccine, allegedly causing multiple sclerosis, no statistical relation between the vaccination and the disease was found, and there was no scientific evidence supporting a causal link. The aetiology of the disease was unknown, but the courts decided that the existing knowledge did not exclude such a causal link. The Council of State considered causation proved on the basis of the temporal proximity between the vaccination and the outbreak of the disease, the absence of other causes and the good health of the plaintiffs before the vaccination.¹⁷⁶²

Concerning the decisions of the Court of Cassation in similar cases quite some fluctuations are noticeable. First the court opted for a scientific approach of the causal link between the vaccination and the harm. The fact that a causal link

¹⁷⁵⁶ VERGES, E. (2014). La réforme du droit de la preuve civile : enjeux et écueils d'une occasion à ne pas manquer. *Dalloz*, p. 617; TARUFFO, M. (2003, Vol. 51). Rethinking the standard of proof. *American Journal of Comparative Law*, p. 666.

¹⁷⁵⁷ WRIGHT, R. (2011). Proving causation: probability versus belief. In R. GOLDBERG, *Perspectives on causation* (pp. 195-220). Oxford and Portland: Hart Publishing, pp. 198-199.

¹⁷⁵⁸ Cour de Cassation Civile (3e chambre), 18 May 2011, n° 10-17.645, *Dalloz* 2011/1483; Cour de Cassation Civile (1re chambre), 22 May 2008, n° 06-10.967, n° 05-10.593, n° 06-18.848 et n° 06-14.952, *Dalloz* 2008/1483.

¹⁷⁵⁹ TARUFFO, M. (2003, Vol. 51). Rethinking the standard of proof. *American Journal of Comparative Law*, p. 667. (Describing a "subjective 'intimate' persuasion" based on individual experience and emotional beliefs).

¹⁷⁶⁰ TARUFFO, M. (2003, Vol. 51). Rethinking the standard of proof. *American Journal of Comparative Law*, p. 666.

¹⁷⁶¹ VINEY, G. (2007). Principe de précaution et responsabilité des personnes privées. *Recueil Dalloz*, p. 1542.

¹⁷⁶² Conseil d'Etat, 9 March 2007, (5ème et 4ème sous-sections réunies), nr. 267635. See also : Conseil d'Etat 10 April 2009, nr. 296630 ; Conseil d'Etat 4 July 2008, nr. 299832; Conseil d'Etat 11 July 2008, nr. 289763.

was not formally excluded by scientific research was considered not sufficient for the presumption of a causal link.¹⁷⁶³

In 2009 the Court of Cassation confirmed a judgement assigning liability to the defendant on the basis of the temporal proximity between the vaccination and the harm. The assessment was within the authority of the judge to decide on facts.¹⁷⁶⁴ In one case the Court of Cassation explicitly stated that the guidances as mentioned in the decisions of the Council of State are not sufficient to prove a causal link.¹⁷⁶⁵ Later on the Court of Cassation conversely squashed judgements that refused to accept a causal link between the vaccination and the harm.¹⁷⁶⁶ The court did so on the basis of presumption, that were serious, precise and coherent. The court explicitly reprimanded the Courts of Appeal for basing their decisions solely on a 'probabilistic and statistic approach'.

In July 2010 the Court of Cassation confirmed a decision of the Court of Appeal of Paris. The lack of scientific consensus and a statistical association does not allow to conclude that a causal link exists. It is however as important that the criteria leading to a presumption of causation in former cases were considered valid.¹⁷⁶⁷

Also in 2010, but at a lower level, the Court of Appeal of Bordeaux ruled in a similar case.¹⁷⁶⁸ The assessment of the alleged link between the vaccination and the plaintiff's disease is mentioned explicitly in the judgment. The defendant admits the potential of the vaccine to cause the disease. General causation is thus accepted. For the proof of specific causation, the existence of a serious presumption is discussed. Although not mentioned as a method, nor a scientific approach, the reasoning is similar to the method of differential diagnosis. No reference is made to any statistical probability. Neither in the case of a plaintiff

¹⁷⁶³ Cour de Cassation (1e Chambre Civile) 27 February 2007, nr. 06-10.063, Dalloz 2007/2899 ; Cour de Cassation (1e Chambre Civile) 23 September 2003, nrs. 01-13.063 and 01-13.064, Dalloz 2004/898.

¹⁷⁶⁴ Cour de Cassation (1^e Chambre Civile) 9 July 2009

¹⁷⁶⁵ Cour de Cassation (1e Chambre Civile) 23 September 2003, nrs. 01-13.063 and 01-13.064, Dalloz 2004/898

¹⁷⁶⁶ Cour de Cassation (1e Chambre Civile) 24 September 2009, nr. 08-16.097, Dalloz 2009/2426, note of Jourdain.

¹⁷⁶⁷ Cour de Cassation (1e Chambre Civile) 25 November 2010, nr. 09-16.556, Dalloz 2010/2909, note of Gallmeister.

¹⁷⁶⁸ Cour d'Appel Bordeaux, 16 June 2010, nr. 08/06174.

who has worked during 15 years with different chemicals ‘probably’ carcinogenic, were no probability figures used.¹⁷⁶⁹

The question is what the decision would be when this case would be assessed by Cassation. If it is settled law that the probative presumptions of fact are left to the trial courts, it is regrettable that the decisions of the Court of Cassation are inconsistent.¹⁷⁷⁰

In the cases on the harm allegedly done by the growing hormone the Court of Cassation has accepted the decisions of the lower court holding the manufacturer liable on the basis of serious presumptions although there was still uncertainty and no scientific proof of causation.¹⁷⁷¹

It still happens that because of the uncertainty on causation nobody is held liable.¹⁷⁷² The theory of equivalence accepts only two answers: yes, there is a causal link and no, there is no causal link. The answer can be linked to probability, but is in France rather linked to the (intimate) conviction of the judge.¹⁷⁷³

b) The Netherlands

In the Dutch case of ‘De Schelde’ the plaintiff was exposed to asbestos¹⁷⁷⁴, but he also smoked. It was not possible to differentiate lung cancer caused by asbestos from lung cancer caused by smoking. Neither was it possible to determine when the fatal exposure occurred. The Supreme Court worked with the presumption the plaintiff came into contact with the fatal fibre during his employment with the ‘De Schelde’. Consequently the defendant could only escape liability if he proved his innocence. However the defendant did not have to compensate the full damage. On the basis of a scientific appreciation of the situation by the assigned experts the importance of the exposure to asbestos

¹⁷⁶⁹ Cour d’Appel Riom, 4 February 2012, nr. 11/00043.

¹⁷⁷⁰ GALLMEISTER, I. (2010, December 3). Sclérose en plaques et vaccin contre l'hépatite B : lien de causalité. Dalloz actualité.

¹⁷⁷¹ Cour de Cassation (1re Chambre Civile), 24 January 2006, *Bulletin. Civile I*, nr. 34.

¹⁷⁷² Cour de Cassation (1re Chambre Civile), 23 November 2004, nr. 03/16885: A patient contracted a nosocomial (caught in hospital) infections after a treatment by two medical doctors, no related to the hospital. It was impossible to detect who of the two had caused the infection. Neither of them was held liable.

¹⁷⁷³ VINEY, G., & JOURDAIN, P. (2013). *Les conditions de la responsabilité*. Librairie générale de droit et de jurisprudence.

¹⁷⁷⁴ Hoge Raad 2 October 1998, LJN ZC2721, *Nederlandse Jurisprudentie* 1999/683, note of J.B.M. Vranken.

was estimated. Thereafter the increase in chance of contracting the disease by that exposure was assessed. Then that result was extrapolated to the exposure taking place at 'De Schelde', resulting in a probability percentage. (*kansaandeeel*), the latter being the guideline for the calculation of the compensation. Obviously, this was nearly impossible for the employer.¹⁷⁷⁵ Proportional liability based on the probability of the causal link should temper the consequences for the defendant who might still be innocent.¹⁷⁷⁶ Although, the question is if it is correct to link proportional compensation to probability of the causation. After all the damage is what it is, and not less because the causal link is only probable.¹⁷⁷⁷

In the Nefalit case the plaintiff was similarly exposed to asbestos and smoking.¹⁷⁷⁸ That the use of asbestos caused the lung cancer was 55 % and the increase in risk was 125 %. On the basis of this testimony a causal link between the exposure and the cancer was established.

In general Continental Law countries are sceptical versus probability in court.¹⁷⁷⁹

6.1.4 The Bayes Theorem¹⁷⁸⁰

The transition from general causation to specific causation remains a challenge. In the previous paragraphs it became clear that statistics are no miracle solution. Probabilities and the assessment of their value require interpretation and judgment. A quantitative standard of proof could assist the fact finder with

¹⁷⁷⁵ FAURE, M., HARTLIEF, T., & PHILIPSEN, N. (2006, Vol. 2 Issue 2). Funding of Personal Injury Litigation and Claims Culture: Evidence from the Netherlands. *Utrecht Law Review*, pp. 1-21.

¹⁷⁷⁶ AKKERMANS, A. (1995). Statistisch causaliteitsbewijs bij toxische schadeveroorzaking. *Verzekerings-Archief*, pp. 51-53.

¹⁷⁷⁷ See for example: TAN, R. (2008, February 1). Over het mogelijke en het waarschijnlijke, salomonsoordelen in het aansprakelijkheidsrecht. *Aansprakelijkheid, Verzekering & Schade*, pp. 4-10.

¹⁷⁷⁸ Hoge Raad 31 March 2006, LJN AU6092, Nederlandse Jurisprudentie, 2011/250, note of T.F.E. Tjong Tjin Tai. (Nefalit)

¹⁷⁷⁹ TARUFFO, M. (2003, Vol. 51). Rethinking the standard of proof. *American Journal of Comparative Law*, p. 663.

¹⁷⁸⁰ The frequentist approach focuses on the probability of the data, given the hypothesis. That is, this approach treats data as random (the hypothesis is either true or false, and so has a probability of either 1 or 0, you just don't know for sure which it is). Bayesian statistics focuses on the probability of the hypothesis, given the data. This approach treats the data as fixed (these are the only data you have) and hypotheses as random (the hypothesis might be true or false, with some probability between 0 and 1) Source: oikosjournal.wordpress.com (accessed December 2013).

the establishment of a causal link easier. The Bayesian statistics should make it possible to translate a statistical chance into a personal chance. Is this true?

Bayesian probability measures a degree of belief. Mathematicians are no big fans of the theorem. The theorem is said to be mainly useful for practical problems that require some decisions on imperfect information.¹⁷⁸¹ The result of a Bayesian calculation is the probability resulting from a comparison of the situation without and the situation with additional information. Presented schematically, it looks as follows:

For proposition A and evidence B:

- Before B the degree of belief in A is $P(A)$
- After B the degree of belief in A is $P(A/B)$
- The difference made by B is $P(B/A) / P(B)$

Or:

“the probability of an event is the ratio between the value at which an expectation depending on the happening of the event ought to be computed, and the value of the thing expected upon its happening.”¹⁷⁸²

(1) the probability that the data would have been observed if the hypothesis were true to

(2) the probability that the data would have been observed if the hypothesis were not true.

The ratio of (1) to (2) above is referred to as the likelihood ratio.¹⁷⁸³

In essence the theorem modifies evaluations of probability based on initial assumptions into individual chance using additional data. The result is called ‘belief probability’.

Referring to the McTear case, the plaintiff could have proved the statistical chance that her husband’s cancer was caused by smoking using the Bayes equation.¹⁷⁸⁴

¹⁷⁸¹ HIVELY, W. (1996, May). The mathematics of making up your mind. *Discover*, p. 1.

¹⁷⁸² CHAREST, S. (2002, Spring). Bayesian approaches to the precautionary principle. *Duke Environmental Law and Policy Forum*, p. 273.

¹⁷⁸³ CHAREST, S. (2002, Spring). Bayesian approaches to the precautionary principle. *Duke Environmental Law and Policy Forum*, p. 273.

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$$\frac{P(\text{cancer is smoking induced cancer})}{P(\text{cancer of any cause})} \times P(\text{smoking induced cancer})$$

= $P(\text{smoking induced cancer given McTear has cancer})$

Or as an algorithm:

$$\frac{\text{prior probability of } A}{1} \times \frac{\text{probability of } B \text{ given } A}{\text{unconditional probability of } B}$$

= posterior probability of A given B

But, what are the additional data necessary to make the transition to individual probability? The extra information is linked to a concrete situation and is thus case specific. The statistical chance is refined into a personal chance using specific factors (out of the victim's history) that are incorporated in the likelihood ratio. In the example of McTear the information could have concerned his (1) personality traits; (2) family history on cancer; (3) lifestyle, like stress; alcohol; (4) social-economic status; (5) residential environment; etc.¹⁷⁸⁵ The likelihood ratio is thus found by calculating the product of all the individual likelihood ratio factors, whereby the components must be statistically independent.¹⁷⁸⁶

$$\text{Likelihood (LR)} = LR(1) \times LR(2) \times LR(3) \times LR(4) \times LR(5)$$

The relative risk (or odds) is the ratio of the probability of an event's occurring to the probability of its not occurring.

Thus the relative risk after including the additional factors equals the original relative risk multiplied by all additional likelihood factors.¹⁷⁸⁷ This way a more accurate probability can be calculated.

All depends of course on the availability and quality of the additional information.

¹⁷⁸⁴ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, pp. 162-163.

¹⁷⁸⁵ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 163.

¹⁷⁸⁶ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 163.

¹⁷⁸⁷ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 163.

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In the Ferebee's case, a fatal disease after exposure to pesticides had to be proved. Physicians relied on the following evidence: results of clinical examinations and tests, plus conclusions of medical studies which suggested that dermal absorption of Paraquat can lead to chronic harm of the lungs, such as pulmonary fibrosis.¹⁷⁸⁸

“[A] cause-effect relationship need not be clearly established by animal or epidemiological studies before a doctor can testify that, in his opinion, such a relationship exists. As long as the basic methodology employed to reach such a conclusion is sound, such as use of tissue samples, standard tests, and patient examination, products liability law does not preclude recovery until a “statistically significant” number of people have been injured or until science has had the time and resources to complete sophisticated laboratory studies of the chemical. In a courtroom, the test for allowing a plaintiff to recover in a tort suit of this type is not scientific certainty but legal sufficiency.”¹⁷⁸⁹

If it can reasonably be established on the basis of the expert testimony that a chemical more likely than not caused the injury, then it is irrelevant that science would require more evidence (like proof of general causation) before conclusively considering that the causal link is irrelevant.¹⁷⁹⁰ In fact, on the basis of above it can be concluded that using the Bayesian method general causation is, strictly speaking, not necessary to prove a toxic tort case.

Bayesian statistics are subjective, they include factors that are not strictly quantitative and which require interpretation or appreciation. The advantage of the Bayesians' method is however that it maintains consistency among propositions.¹⁷⁹¹

¹⁷⁸⁸ Ferebee versus Chevron Chemical Co., 736 F.2d 1529 (United States Court of Appeals, District of Columbia Circuit June 12, 1984).

¹⁷⁸⁹ Ferebee versus Chevron Chemical Co., 736 F.2d 1529 (United States Court of Appeals, District of Columbia Circuit June 12, 1984).

¹⁷⁹⁰ Ferebee versus Chevron Chemical Co., 736 F.2d 1529 (United States Court of Appeals, District of Columbia Circuit June 12, 1984).

¹⁷⁹¹ ALLEN, R. (2013, Vol. 12). Taming complexity: rationality, the law of evidence and the nature of the legal system. Law, Probability and Risk, p. 104.

Bayesian statistics are, for example, used in the case of Milward versus Acuity Specialty Products.¹⁷⁹² The exposure of the plaintiff to benzene was investigated using the Advanced REACH Tool (ART).¹⁷⁹³ The ART is a tool for making better assumptions on the consequences of the exposure to chemicals. The resulting data are used for increasing the safe use of chemical substances and to reduce uncertainty on the effects of exposure. At this moment the tool focuses on inhalation.¹⁷⁹⁴ For that purpose specific input parameters such as ventilation rate, room size, orientation of spray operations, and secondary sources of exposure are defined.

Lacking actual exposure date, the expert of the plaintiff had to use estimates, namely the cumulative benzene exposure concentration, measured in parts of benzene per million parts of air (“ppm”) multiplied by the length of exposure in years (“ppm-years”). Besides the exposure to the benzene in the paint produced by the defendant, the expert took the other possible benzene exposures into account, like the product that Milward used to clean rusted material. The use of ART method made it possible to deliver proof of specific causation.

The judge accepted the resulting exposure scenario. The absence of actual exposure data was not fatal to the usefulness or reliability of the test.¹⁷⁹⁵ The ART model is not only suitable for group exposure, but also for individual

¹⁷⁹² Milward versus Acuity Specialty Products Group, Inc., 639 F.3d 11 (United States Court of Appeals, First Circuit March 22, 2011); Milward versus Acuity Specialty Products Group, Inc., 664 F. Supp. 2d at 137 (United States District Court, D. Massachusetts July 31, 2009).

¹⁷⁹³ EUROPEAN CHEMICALS AGENCY. (2012). Chapter R.14: Occupational exposure estimation. In *Guidance on information requirements and chemical safety assessment* (p. version 2.1). <http://echa.europa.eu/> (accessed 15 December 2014). In order to obtain qualitative Chemical Safety Assessments the Advanced REACH Tool (ART) can be used. ART version 1.5 incorporates a mechanistic model of inhalation exposure and a statistical. Both parts will be combined using a Bayesian statistical process in order to produce exposure estimates for specific scenarios relevant to the REACH process. The tool provides estimates of the whole distribution of exposure variability and uncertainty, allowing the user to produce a variety of realistic and reasonable worst-case exposure estimates, dependent upon the requirements of the particular risk assessment. The approach facilitates the inclusion of any new data that become available in the future or during the risk assessment process. The ART project has been conducted in close collaboration with a range of stakeholders from industry and member states.

¹⁷⁹⁴ For more information see: <https://www.advancedreachttool.com> (accessed on February 9, 2014.) and EUROPEAN CHEMICALS AGENCY. (2012). Chapter R.14: Occupational exposure estimation. In *Guidance on information requirements and chemical safety assessment* (p. version 2.1). <http://echa.europa.eu/> (accessed 15 December 2014).

¹⁷⁹⁵ Milward versus Acuity Specialty Products Group (United States District Court September 6, 2013).

assessment if the wide variability in exposure between individuals is taken into account.¹⁷⁹⁶

The conclusion is that, referring to the example of the cabs (supra paragraph 5.3.1), the use of 'belief probability' eliminates the uneasiness of the decision that a blue cab is liable because it has a higher probability to be involved in an accident.¹⁷⁹⁷ Belief probability is typically a concept for specific causation because it is based on particularistic evidence for the case.¹⁷⁹⁸

In the next chapter, the elaborated standards of proof in the US are briefly analysed. They can be seen as a way of structuring evidence in toxic tort, whilst they also demonstrate the several challenges encountered in toxic litigation. None of the other countries has such a detailed and highly discussed system. The text starts with the Daubert standards (that replaced Frye) and ends with a potential new evolution started by the Milward case in 2013.

6.1.5 Burden of proof and persuasion: belief probability

The posterior odds (relative risks) calculated on the basis of the Bayesian Theorem are referred to as a mean to calculate 'belief probability'. It is however not the only method of assessing belief probability. Gold made in 1986 the distinction between 'fact probability' and 'belief probability'. He simply defined fact probability (or the burden of proof) as more than 50% statistical probability of an event having occurred and belief probability (or the standard of persuasion) as more than 50% *belief* that a knowable fact has been established.¹⁷⁹⁹

Explaining exactly belief probability and its role in proving causation is done in the following paragraphs. First the terms used are defined and thereafter the use of the concept is analysed.

¹⁷⁹⁶ SCHINKEL, J., WARREN, N., FRANSMAN, W., & e.a. (2011, Vol. 13). Advanced REACH Tool (ART): Calibration of the mechanistic model. *Journal of Environmental Monitoring*, pp. 1374, 1379.

¹⁷⁹⁷ For example, adding the testimony of an eyewitness to the probabilistic evidence.

¹⁷⁹⁸ GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, fn. 42.

¹⁷⁹⁹ GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, p. 379.

6.1.5.1 Some definitions

'Burden of proof' refers to those facts which a plaintiff must prove to establish a prima facie case.¹⁸⁰⁰ This means that the plaintiff should prove the damage, the act leading to the damage and the causal link between both. In toxic tort statistical associations are used and these are expressed as probabilities. The court decides on these findings of act which version it believes. This belief does not need to be absolute.¹⁸⁰¹

The 'standard of persuasion' is a guideline or a threshold that defines the level of confidence that the court must feel in order to find the fact probability true.¹⁸⁰² The plaintiff has to convince the court that his version of the facts is the one that should be believed.¹⁸⁰³ Thereby a minimum level of certainty should be proved.

The burden of proof is part of the cause-in-fact. The standard of persuasion is part of the legal cause and is as such related to the legal certainty standard.¹⁸⁰⁴ This results in courts requiring a plaintiff to prove that the causal link is more likely than not. It thereby blurs the differences between fact probability and belief probability.¹⁸⁰⁵

6.1.5.2 The impact of probability on the burden of proof and the standard of persuasion

In toxic tort, because of the uncertain and complex causal links, probability is omnipresent as a basis for proving causation. The most used method is statistics, although in some court cases 'common sense' is still applied.

The appreciation of the factual probability, resulting in a belief probability, is decisive for the final decision of the court.¹⁸⁰⁶

¹⁸⁰⁰ GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, p. 381.

¹⁸⁰¹ GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, p. 381.

¹⁸⁰² GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, p. 381.

¹⁸⁰³ BARNES, D. (2001, Vol. 64, issue 4). Too many probabilities: statistical evidence of tort causation. *Law and Contemporary Problems*, p. 195; SNYDER, J. (1996, Vol. 34). Environmental (toxic) torts. *Duquesne Law Review*, p. 912.

¹⁸⁰⁴ CONWAY-JONES, D. (2002, January). Factual causation in toxic tort litigation: a philosophical view of proof and certainty in uncertain disciplines. *University of Richmond Law Review*, p. 923.

¹⁸⁰⁵ Merrell Dow Pharmaceuticals Inc. versus Havner, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997); In re "Agent Orange" product liability litigation, 611 F.Supp. 1223 (US District Court, E.D. New York May 8, 1985).

“if experts are willing to testify that such a link exists, it is for the jury to decide whether to credit the testimony.”¹⁸⁰⁷

Above was said in a case of concerning herbicide exposure. Each party's expert presented contrary testimony on the issue of factual causation.

“Courts have no special competence to resolve the complex and refractory causal issues raised by the attempt to link low-level exposure to toxic chemicals with human disease.”¹⁸⁰⁸

Since it is difficult for plaintiffs to provide factual evidence of specific causation, they are obliged to turn to probability calculations. Frequently the fact probability and the belief probability are then collapsed into one inquiry.¹⁸⁰⁹ In practice this means that the standard of persuasion is transferred to the burden of proof.¹⁸¹⁰ The strength of belief is now impacting the appreciation of the probability of a factual causal link. The court must decide how strongly it believes the fact probability.¹⁸¹¹ Thereby the standard of proof for the factual situation is de facto reduced. One is no longer obliged to meet the traditional standard of true-or-false to 50 %. It also stiffens the belief probability in as much that alternative causal links can then no longer be considered.

Belief probability is especially important in specific causation. Therefore the distinction between general and specific causation should be mirrored in the required evidence. As said before, it is not because only 30 % develops cancer from a substance A, that you are not (unfortunately) included in the 30 % group. On the basis of statistics alone the court cannot be persuaded to believe your cancer was caused by the substance A.

¹⁸⁰⁶ CONWAY-JONES, D. (2002, January). Factual causation in toxic tort litigation: a philosophical view of proof and certainty in uncertain disciplines. *University of Richmond Law Review*, p. 923.

¹⁸⁰⁷ *Ferebee versus Chevron Chemical Co.*, 736 F.2d 1529 (United States Court of Appeals, District of Columbia Circuit June 12, 1984).

¹⁸⁰⁸ *Ferebee versus Chevron Chemical Co.*, 736 F.2d 1529 (United States Court of Appeals, District of Columbia Circuit June 12, 1984).

¹⁸⁰⁹ SNYDER, J. (1996, Vol. 34). Environmental (toxic) torts. *Duquesne Law Review*, pp. 899-916; GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, pp. 376-402.

¹⁸¹⁰ The advocates of the collapse of both probabilities into one test, did not consider toxic tort cases, and where not confronted with fact probability. GOLD, S. (1986, Vol. 96). Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence. *Yale Law Journal*, p. 385.

¹⁸¹¹ Gold p 385 SNYDER, J. (1996, Vol. 34). Environmental (toxic) torts. *Duquesne Law Review*, p. 915.

The former is exactly what happens if fact and belief probability collapse. The 50 % rule for factual causation obstructs the ability to prove that in the specific case the harm was caused by the defendant. A proof that would have been based on belief probability. Relative risk as used in epidemiological evidence refers to group-based incidence.

In the UK with its diminishing aversion for epidemiological evidence¹⁸¹² Lady Hale of the House of Lords said in 2011 that:

“[j]udges do not define what they mean by “the overall probabilities” other than their own particular hunches about human behaviour ... Most judges will put everything into the mix before deciding which account is more likely than not. As long as they correctly direct themselves that statistical probabilities do not prove a case, any more than their own views about the overall probabilities will do so, their findings will be safe.”¹⁸¹³

The fact-finder has to believe that the defendant caused the harm, mere probable is not enough. Furthermore the fact-finder’s belief does not have to be an absolute one. The degree of his belief is important, not the substance of it.¹⁸¹⁴ Statistical evidence is thereby considered not to be able to generate such a belief.¹⁸¹⁵ Epidemiological evidence does not bind judges in findings of probability.¹⁸¹⁶ In some cases, legal cause considerations such as policy concerns may overrule this factual cause finding.¹⁸¹⁷

Lord Rodger's reasoning in *Sienkiewicz* (differing however from the majority opinion in the case) confirms that the balance of probability rule on causation requires that the fact-finder believes that the defendant's negligence actually

¹⁸¹² McIVOR, C. (2013, Autumn, Vol. 21). Debunking some judicial myths about epidemiology and its relevance to UK tort law. *Medical Law Review*, pp. 553-587.

¹⁸¹³ *Sienkiewicz versus Greif (UK) Ltd*, [2011] I.C.R. 391 (Supreme Court March 9, 2011).

¹⁸¹⁴ FULHAM-McQUILLAN, S. (2014). Judicial belief in statistics as fact: loss of chance in Ireland and England. *Professional Negligence*, p. 20.

¹⁸¹⁵ The author finds this disputable. FULHAM-McQUILLAN, S. (2014). Judicial belief in statistics as fact: loss of chance in Ireland and England. *Professional Negligence*, pp. 20-21.

¹⁸¹⁶ McIVOR, C. (2013, Autumn, Vol. 21). Debunking some judicial myths about epidemiology and its relevance to UK tort law. *Medical Law Review*, pp. 553-587.

¹⁸¹⁷ FULHAM-McQUILLAN, S. (2014). Judicial belief in statistics as fact: loss of chance in Ireland and England. *Professional Negligence*, p. 30.

caused the claimant's injury; not that the negligent act probably caused it.¹⁸¹⁸ In the latter situation the proof is only that on the balance of probability the defendant probably harmed the plaintiff. The balance of probabilities rule is still a probabilistic rule in so far as the belief does not have to be a certain one. The main point, however, is that the probabilistic aspect of the rule is a reflection of the fact-finder's degree of belief. The belief should consider the facts as presented true. The judge should be convinced. If only the probability in itself is believed, as in 'I believe you when you say that X % of the diseases are caused by the substance, the balance of probabilities rule is not satisfied. 'I should believe that the substance caused you disease'. But, statistical evidence generates only a belief in the probability because it does not speak to the specific case at hand. In the context of our dermatitis example given above, it only shows that in most cases the dermatitis would have been related to the lack of showers. It remains unknown, if the lack of showers caused the plaintiff's condition. In such cases their Lordships have used the reasonable or ordinary man.

6.1.6 Summarizing the role of statistics in relation to uncertainty

Statistics cannot be ignored in toxic tort, they are even considered a necessity. Statistics is a mathematical science, quite complex and often difficult to understand for laypersons. Moreover sometimes the use of probability leads to decisions that are counter-intuitive.

Statistics alone do not demonstrate in an individual case what actually happened, how it occurred, and who did it. Probability does not provide certainty on causation. An innocent defendant can be held liable and a plaintiff can be left without compensation.

However, probability in toxic tort supports the objective of deterrence. The aggregate amount of compensation equals the value of the harm caused.

The doctrine of corrective justice normally does not except probability in tort. However a decision based on such probability is considered more appropriate than the all-or-nothing approach in cases with irreducible uncertainty on cause is.

The risk of finding innocent defendants liable remains however real. That problem can be alleviated by 'proportional liability', namely the defendant liable

¹⁸¹⁸ Sienkiewicz versus Greif (UK) Ltd, [2011] I.C.R. 391 (Supreme Court March 9, 2011).

for the loss of a plaintiff in line with the probability that the defendant's activity was the cause. This approach is considered as supporting fairness and the pragmatic need for deterrence.

Probability is about chance. Whose chance? For example, smoking causes cancer. In the group of smoking people some will develop cancer, others not. But in the smoking group with cancer, some would have contracted the cancer even when they would not have smoked. Likewise some people who do not smoke, also develop cancer.

If X develops cancer and smokes, he will have to prove that he would not have contracted the disease in the absence of his smoking. This seems quite impossible.

Courts consider the 'double the risk' standard as one solution to the indecision of probability. The standard implies that if more than 50 % of lung cancers in a population are caused by smoking, then the cancer of any smoking individual is more likely than not caused by smoking.

This conclusion is however incorrect. It is a misunderstanding of the concept of relative risk and mixes the standard of proof with the standard of persuasion. Indeed the relative risk does not give information on the existence of a causal link in a specific situation. The use of probability anyhow requires judgment and interpretation. The standard of doubling the risk can be used as a criterion of law, but is not a quantitative criterion.

Especially the US system likes science and numerical standards.¹⁸¹⁹ The other countries are different. In France and the Netherlands evidence should be persuasive.

In France the Court of Cassation ruled that it is sufficient if the plaintiff establishes the possibility of a causal link. The calculation of the probability is not necessary.¹⁸²⁰ Presumption can be used for establishing the toxicity of a chemical (general causation) and for proving that the plaintiff was exposed

¹⁸¹⁹ UK is in between.

¹⁸²⁰ OLIPHANT, K. (2009). Aggregation and divisibility of damage in tort law and insurance. In K. OLIPHANT, *Aggregation and divisibility of damage in tort law and insurance* (pp. 473-517). Vienna: Springer.

(specific causation).¹⁸²¹ French courts should be convinced of the truth of the facts at issue.¹⁸²²

In the Netherlands probability experts can estimate the importance of an exposure and, subsequently, calculated the increase in chance of contracting the disease. This results in a probability percentage (*kansaandeel*).

Adhering to the equivalence and adequacy theories, the French courts will not refer to probabilistic evidence/reasoning. Rather their decision will be based on 'serious, precise and concurrent presumptions.'¹⁸²³

The overall conclusion is that 'simple' statistics are not satisfactory. The use of the Bayes Theorem should improve the translation of a statistical chance into a personal chance. Bayesian probability measures a degree of belief.

Thus:

“the probability of an event is the ratio between the value at which an expectation depending on the happening of the event ought to be computed, and the value of the thing expected upon its happening.”¹⁸²⁴

6.2 Trying to bring order in the confusion: practical standards for scientific evidence

Until approximately 1993 experts could in court testify almost without limit about any relevant issue within their speciality.¹⁸²⁵ Because of the experience that causation was often not supported by sound scientific evidence, judges restricted on their own initiative the admissibility of expert testimony. After a

¹⁸²¹ FAIRGRIEVE, D., & G'SELL-MACREZ, F. (2011). Causation in French Law: pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (p. 111). Oxford: Hart Publishing Ltd., p. 123.

¹⁸²² For certain kind of harm some mandatory presumption (*presomptions de droit*) have been introduced. This is, for example, the case for diseases following blood transfusions, like HIV or Hepatitis C. See for example Cour de Cassation (1re Chambre) 9 July 2009, nr. 08-11.073.

¹⁸²³ FAIRGRIEVE, D., & G'SELL-MACREZ, F. (2011). Causation in French Law: pragmatism and policy. In R. GOLDBERG, *Perspectives on causation* (p. 111). Oxford: Hart Publishing Ltd., p. 123.

¹⁸²⁴ CHAREST, S. (2002, Spring). Bayesian approaches to the precautionary principle. *Duke Environmental Law and Policy Forum*, p. 273.

¹⁸²⁵ The Frye's "general acceptance" test, meaning that scientific testimony could not be admitted unless it had "gained . . . standing and scientific recognition," or general acceptance, in the relevant scientific community. See *Frye versus United States of America*, 293 F. 1013 (Court of Appeals of District of Columbia December 3, 1923).

while the Supreme Court intervened and attempted to bring more structure into the delivery of scientific evidence in court. Three court cases mark the onset of specific standards. These cases are known as the Daubert trilogy. (Paragraph 6.2.1) From that moment on, experts, as well as their conclusions are checked on their qualifications, knowledge, skill, experience, training. Reliability becomes a major benchmark for the delivery of science in court.¹⁸²⁶

But courts do not solely turn to Daubert for guidance. In the UK Sir Austin Bradford Hill developed his guidelines in an attempt to describe what would justify considering an association as a causal link.¹⁸²⁷ The analytical step from a statistical association to the acceptance of a causal link is not easy. Bradford Hill developed his tool with the objective of providing a valid method to assess cause. The Bradford Hill factors were welcomed and are still widely used. Obviously, this is a subject worthy to discuss.¹⁸²⁸

Recently the United States Court of Appeal took a different view on scientific evidence in court, namely in the Milward case. There was immediately much discussion on the value and the impact of that decision and most probably the story is not yet finished. The Milward case cannot be ignored and is discussed in paragraph 6.2.2.

6.2.1 The Daubert trilogy¹⁸²⁹

In 1993 the Supreme Court decided for the first time in a Daubert case.¹⁸³⁰ After appeal, the Supreme Court remanded the case back, along with some standards to use when assessing the quality of the scientific evidence that was submitted. These standards are still valid, but were further refined by Daubert II¹⁸³¹ and

¹⁸²⁶ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. 63.

¹⁸²⁷ See paragraph 1.2.1.2 of this part. BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, pp. 295-300.

¹⁸²⁸ Paragraph 5.1.2.1 c).

¹⁸²⁹ The Daubert trilogy refers to the three Supreme Court cases that articulated the Daubert standard:

¹⁸³⁰ *Daubert versus Merrel Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (Supreme Court of the United States June 28, 1993).

¹⁸³¹ *Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II)*, 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995).

subsequently interpreted by *General Electric Co. v. Joiner*¹⁸³² and *Kumho Tire versus Carmichael*.¹⁸³³ These cases are the subject of the following subparagraph. Thereafter a comparison with Continental Law systems is made.

6.2.1.1 Daubert – Joiner – Kumho

The Daubert case was about Jason Daubert, who was born with a serious birth defect. His parents sued Merrel Dow alleging Jason's handicap was caused by the drug Bendectin, taken by his mother during pregnancy. Results of in vitro and in vivo animal studies, pharmacological research of the chemical structure of Bendectin plus published epidemiological studies were submitted as evidence of a causal link between the birth defect and the medicinal product.¹⁸³⁴

Deciding on the (in)admissibility of the evidence, the Supreme Court rejected the 'all is admissible' standard¹⁸³⁵ and required a significantly higher judicial scrutiny of expert and expert testimony in order to ensure reliability.¹⁸³⁶ The decision of admitting scientific evidence in court lies with the trial judges as the 'gatekeepers' in order to allow only good science into the substantial proceedings.

It is their role to assess the presented evidence on following, non-exclusive aspects: (1) the expert's theory was challenged in an objective way; (2) the technique or theory was subject to peer review and publication; (3) the observed or potential rate of error of the technique or theory when applied was acceptable; (4) the study and conclusion were subjected to relevant standards

¹⁸³² *General Electric Company versus Robert Joiner*, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸³³ *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

¹⁸³⁴ *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 727 F.Supp. 575 (United States District Court, S.D. California December 14, 1989); *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 951 F.2d 1128 (United States Court of Appeals, Ninth Circuit December 20, 1991); *Daubert versus Merrel Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (Supreme Court of the United States June 28, 1993); *Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II)*, 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995);

¹⁸³⁵ SHAPO, M. (2010). *Principles of Tort Law*. St. Paul: West (Thomas Reuters), p. 317.

¹⁸³⁶ BERNSTEIN, D. (2013, November). The misbegotten judicial resistance to the Daubert revolution. *Notre Dame Law Review*, p. 43; BERGER, M. (1997, November). Eliminating general causation: notes towards a new theory of justice and toxic torts. *Columbia Law Review*, pp. 2122-2123.

of control; and (5) the technique or theory was generally accepted in the scientific community.¹⁸³⁷

The general acceptance principle of Frye¹⁸³⁸ was thus de facto rejected and replaced by the Daubert standards.¹⁸³⁹ These standards were echoed in the Federal Rule of Evidence 702. The Federal Rule implemented the requirement that expert's testimony should not only be relevant but also reliable.¹⁸⁴⁰ The criteria included in the rule are similar to those in Daubert case:

- a) the expert's scientific, technical, or other specialized knowledge will help the trier of fact to understand the evidence or to determine a fact in issue;
- b) the testimony is based on sufficient facts or data;
- c) the testimony is the product of reliable principles and methods; and
- d) the expert has reliably applied the principles and methods to the facts of the case.

In 1995 the Daubert standard of 1993 was further refined.¹⁸⁴¹ The court accepted that epidemiological evidence proved that the plaintiffs' injuries could possibly have been caused by the drug,¹⁸⁴² but plaintiffs should also demonstrate that Bendectin has caused their individual damage.

Then in the case of Joiner, the second Supreme Court case in the trilogy, the Daubert statement of Judge Blackmun concerning the strict separation of methodology and opinions was challenged.¹⁸⁴³ Indeed, the judge had in the first Daubert ruling stated that an evaluation of the admissibility of evidence should be based:

¹⁸³⁷ Daubert versus Merrel Dow Pharmaceuticals, Inc., 509 U.S. 579 (Supreme Court of the United States June 28, 1993).

¹⁸³⁸ Frye versus United States of America, 293 F. 1013 (Court of Appeals of District of Columbia December 3, 1923).

¹⁸³⁹ Although some jurisdictions still apply the Frye principle.

¹⁸⁴⁰ Federal Rules of Evidence Rule 702, 28 U.S.C.A., www.westlaw.com (accessed 15 January 2014)

¹⁸⁴¹ The Supreme Court remanded the case to the District Court. This judgment of the latter court is generally referred to as Daubert II. See also supra for the direct history of the Daubert litigation.

¹⁸⁴² Daubert versus Merrel Dow Pharmaceuticals, Inc. (Daubert II), 43 F.3d 1311 (US Court of Appeals, Ninth Circuit January 4, 1995), p. 1322.

¹⁸⁴³ General Electric Company versus Robert Joiner, 522 U.S. 136 (Supreme Court of the United States December 15, 1997), pp. 518-519.

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“solely on principles and methodology, not on the conclusions that they generate.”¹⁸⁴⁴

The split proved however artificial. Conclusions and methodology are not entirely distinct from one another. However, the former does not imply that all opinions should be accepted. When an opinion is based solely on *ipse dixit*, then that evidence is inadmissible.¹⁸⁴⁵

A short description of the case clarifies why the distinction between methodology and conclusion is not tenable. Joiner worked as an electrician on electrical transformers, which used a mineral-oil-based dielectric fluid as a coolant. Joiner often had to put his hands and arms into the fluid to make repairs and the fluid would sometimes splash onto him. The fluid in some of the transformers was contaminated with polychlorinated biphenyls (PCB's). PCB's are widely considered to be hazardous to human health, as recognized by the Congress banning, with few exceptions, the production and sale of PCB's in 1978.¹⁸⁴⁶

Joiner claimed that the exposure to PCBs and their derivatives promoted his lung cancer.¹⁸⁴⁷ His experts testified that PCB's, furans, and dioxins can promote cancer, and that Joiner's exposure to those chemicals were more likely than not the cause of plaintiff's cancer.

The District Court ruled that there was a genuine issue of material fact as to whether Joiner had been exposed to PCB's. Joiner's experts failed to show that there was a link between exposure to PCB's and small-cell lung cancer. Therefore the evidence was considered inadmissible because the testimony was based on 'subjective belief or unsupported speculation'.¹⁸⁴⁸

¹⁸⁴⁴ Daubert versus Merrel Dow Pharmaceuticals, Inc., 509 U.S. 579 (Supreme Court of the United States June 28, 1993).

¹⁸⁴⁵ General Electric Company versus Robert Joiner, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸⁴⁶ TSCA (Toxic Substances Control Act), § 2605. Regulation of hazardous chemical substances and mixtures, (e) (2) (A).

¹⁸⁴⁷ Joiner versus General Elec. Co., 864 F.Supp. 1310 (United States District Court, N.D. Georgia, Atlanta Division September 16, 1994).

¹⁸⁴⁸ Joiner versus General Elec. Co., 864 F.Supp. 1310 (United States District Court, N.D. Georgia, Atlanta Division September 16, 1994).

In appeal the judgment was reversed.¹⁸⁴⁹ Then certiorari was granted¹⁸⁵⁰ and the Supreme Court ruled in the case.¹⁸⁵¹

As can be noticed in the concrete reasoning, methodology and conclusion are intermingled to a certain extent. The authors of two epidemiological studies out of four did not want to suggest a link between increases in lung cancer and PCB exposure among the workers. The studies are inadmissible because the experts relied their conclusion on the studies whilst the authors concluded differently. Nothing wrong with the methodology, but the conclusion was unreliable. Similarly the *in vivo* experiments on animals were methodologically correct, but the inference of the results to human was not. Furthermore it was not explained how and why the experts could have extrapolated their opinions from these animal studies.¹⁸⁵²

The District Court, examined every study one by one and concluded that none was sufficient to show a causal link between PCB's and Joiner's lung cancer.¹⁸⁵³ The Court of Appeal overturned the District Court's decision. Later on the Supreme Court reinstated the inadmissibility decision. The Supreme Court concluded that the District Court had not erred when studying and rejecting each scientific study/proof on its own validity. The conclusion of the experts, based on all studies they brought forward, was considered, but the final verdict was that there existed a too great an analytical gap between the data and the opinion proffered.

¹⁸⁴⁹ Joiner versus General Elec. Co., 78 F.3d 524 (United States Court of Appeals, Eleventh Circuit March 27, 1996).

¹⁸⁵⁰ Petition for a Writ of Certiorari - Joiner versus General Elec. Co. versus Joiner, 1996 WL 33414071 (Supreme Court of the United States August 5, 1996).

Since the Judiciary Act of 1925 and the Supreme Court Case Selections Act of 1988, most cases cannot be appealed to the U.S. Supreme Court as a matter of right. A party who wants the Supreme Court to review a decision of a federal or state court files a "petition for writ of certiorari" in the Supreme Court. The granting of a writ does not necessarily mean that the Supreme Court disagrees with the decision of the lower court. Granting a writ of certiorari means merely that at least four of the justices have determined that the circumstances described in the petition are sufficient to warrant review by the Court.

¹⁸⁵¹ General Electric Company versus Robert Joiner, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸⁵² General Electric Company versus Robert Joiner, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸⁵³ General Electric Company versus Robert Joiner, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

However, and despite the claim that the studies were not sufficient, 'whether individually or in combination', the court did in fact not assess the studies as an integrated whole and in combination.¹⁸⁵⁴ With this decision the Supreme Court allowed the lower courts to reject an expert's testimony if each part of evidence on itself fails to support the final conclusion and despite the fact that when the parts are joint, the conclusion is supported.¹⁸⁵⁵

But Joiner adds other elements to the Daubert trilogy? Firstly, the issue with admissibility is not whether studies (in case the animal studies) are methodologically admissible to establish causation, but whether these studies are sufficiently supported.¹⁸⁵⁶ Methodology and inferred opinion have both to be considered in deciding to the reliability and fit of the evidence. There is a difference between methodology and conclusions, but it is impossible to judge methodology without relying on some substantive scientific conclusions.¹⁸⁵⁷ Secondly, Courts of Appeal can decide on the 'abuse of discretion'¹⁸⁵⁸ and reverse the judgements of district courts if their decisions are manifestly erroneous.¹⁸⁵⁹

The third case in the trilogy is *Kumho Tire Co., Ltd. versus Carmichael*.¹⁸⁶⁰ The right rear tire of a mini-van blew out. An accident followed. One of the

¹⁸⁵⁴ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. 77.

¹⁸⁵⁵ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, pp. 76-77.

¹⁸⁵⁶ *General Electric Company versus Robert Joiner*, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸⁵⁷ "To determine whether this evidence (e.g., of the results of mouse studies) is relevant to that claim (e.g., about the causes of Mr. Joiner's cancer) requires substantive knowledge (e.g., about the respects in which mouse physiology is like human physiology, about how similar or how different the aetiologies are of small-cell lung cancer and alveologenic adenomas, etc.). And to determine the reliability of a scientific experiment, technique, or test, it is necessary to know what kinds of thing might interfere with the proper working of this apparatus, what the chemical theory is that underpins this analytical technique, what factors might lead to error in this kind of experiment and what precautions are called for, or to possess a sophisticated understanding of statistical techniques or of complex and controversial methods of meta-analysis pooling data from different studies." See HAACK, S. (2001, April). *An Epistemologist in the Bramble-Bush: At the Supreme Court with Mr. Joiner*. *Journal of Health Politics, Policy and Law*, p. 237.

¹⁸⁵⁸ CHENG, E. (2007, Vol. 56). *Independent judicial research in the Daubert age*. *Duke Law Journal*, pp. 1292-1293

¹⁸⁵⁹ *General Electric Company versus Robert Joiner*, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸⁶⁰ *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

passengers died, and others were severely injured. Plaintiffs consequently claimed that the tire was defective, as was in court confirmed by their expert. Although the testimony of the expert was rather technical than scientific, the District Court agreed to evaluate the evidence of the expert applying the Daubert standards.

Finally the Supreme Court had to decide if it is correct to assess expert testimony that might be characterized as based not upon scientific knowledge, but rather upon technical or other specialized knowledge, by applying the Daubert standards.¹⁸⁶¹ The answer was positive. Thereby the court referred to the basic principle of expert evidence, namely whether the particular expert has sufficient specialized knowledge to assist the trier of fact in deciding the particular issues in the case.¹⁸⁶²

As from then on the principles of Daubert apply to all expert testimony, regardless of the field of expertise. It is the specialized knowledge that is of importance.¹⁸⁶³

At the same time, the Supreme Court refused to make the four factors of the Daubert principle applicable in all cases. They reasoned that:

“Too much depends upon the particular circumstances of the particular case at issue.”¹⁸⁶⁴

An expert should in court employ the same intellectual rigor as an expert does in his area of expertise.¹⁸⁶⁵ Experts must demonstrate that their opinions are the result of methods consistent with how their colleagues in their or in a relevant field would work towards a proposition if they were put in a similar situation.¹⁸⁶⁶

The focus was in *Kumho* also on reliability of experts' conclusions and not on

¹⁸⁶¹ *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

¹⁸⁶² *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

¹⁸⁶³ *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

¹⁸⁶⁴ *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

¹⁸⁶⁵ *Kumho Tire Co., Ltd. versus Carmichael*, 526 U.S. 137 (Supreme Court of the United States December 6, 1999).

¹⁸⁶⁶ CRANOR, C. (2006). *Toxic torts. Science, law and the possibility of justice*. Cambridge: Cambridge University Press, p. 73.

(only) the reliability of the methodology used.¹⁸⁶⁷ Courts have considerable latitude in judging on admissibility.¹⁸⁶⁸

The fact that the gatekeeping principles applied to all expert testimonies, irrespective of their discipline: scientific, engineering, medical and any other specialized knowledge, is not without importance for chemical liability. Just one example, experts testifying in pesticide litigation are frequently agricultural engineers, hydrologists, equipment specialists, and farmers.¹⁸⁶⁹ These experts can now also be subjected to Daubert challenges.

6.2.1.2 Daubert outside the US: the Netherlands

In Continental Law the control of the evidence process is usually laid down in procedural rules.¹⁸⁷⁰ When parties prepare for their case, they are free to consult experts. During proceedings a judge can also appoint an expert.¹⁸⁷¹ The appointment of experts is more frequently done by the judge than by the parties.¹⁸⁷²

Indeed in most Dutch cases the court appoints the experts (whether or not on proposal of the parties), receives the joint or individual reports and conclusions of those experts and cites the findings in order to prove an argument.¹⁸⁷³

In the Halcion case the Court of Appeal appointed experts on proposal of the parties.¹⁸⁷⁴ These experts interviewed the victims and other relevant persons. Thereafter they submitted a report to the court. However no reference was made to factual data, nor to literature. This is possible since the court accepts

¹⁸⁶⁷ SANDERS, J. (2013, April). Milward v. Acuity Specialty Products group: constructing and deconstructing science and law in judicial opinions. *Wake Forest Journal of Law and Policy*, p. 158.

¹⁸⁶⁸ CRANOR, C. F., & ESATMOND, D. A. (2001, Vol. 64 issue 4). Scientific Ignorance and reliable patterns of evidence in toxic tort causation: is there a need for liability reform? *Law and Contemporary Problems*, p. 17.

¹⁸⁶⁹ CARPENTER, M., & WARE, G. (2012, August). Scientific evidence in pesticide litigation. *Defending Pesticides in Litigation*.

¹⁸⁷⁰ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. *U.C. Davis Law Review*, p. 995.

¹⁸⁷¹ For more details see paragraph... in paragraph 5.1.3.

¹⁸⁷² VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. *U.C. Davis Law Review*, p. 968.

¹⁸⁷³ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. *U.C. Davis Law Review*, p. 984.

¹⁸⁷⁴ Hoge Raad 20 September 1996, LJN ZC2141, *Nederlandse Jurisprudentie* 1997/328 following the judgment of Hoge Raad, 30 June 1989, LJN ZC4068, *Nederlandse Jurisprudentie* 1990/652. (Halcion)

the conclusion made by the experts. Thereby it is not necessary that these experts, within reasonable limits, communicate the essential scientific basis of their findings with reference to literature. Neither is it a shortcoming if the experts cannot be interviewed by the parties. The right to question experts can only be exercised when the experts testify as party-witnesses.¹⁸⁷⁵ The Supreme Court accepted this approach of the Court of Appeal.¹⁸⁷⁶ The fact that the experts were extremely qualified and had been appointed on mutual agreement of the parties helped.

Experts are expected to solve differences in opinion amongst themselves and not bring these into the open. The joint report that results from their appointment, is a sign of their impartiality and of the neutrality of their arguments.¹⁸⁷⁷

The appointment of an expert by the court does not restrict the parties in nominating their own experts.

In a case like Daubert the trial court would probably ask the plaintiffs to produce a beginning of proof.¹⁸⁷⁸ The evidence to be brought forward relates to the possibility that a substance can cause the damage and can thus be compared with prove of general causation. The plaintiff can, for example, use the results of in vivo/in vitro studies and epidemiological, toxicological studies.

When the beginning of proof of a causal link is submitted the burden of proof would in toxic court cases most probably shift to the defendant.¹⁸⁷⁹

On the other hand, lacking any proof on the potential of the chemical to cause the damage, there is, by Dutch standards, no reason to shift the burden of proof

¹⁸⁷⁵ Hoge Raad 20 September 1996, LJM ZC2141, *Nederlandse Jurisprudentie* 1997/328 following the judgment of Hoge Raad, 30 June 1989, LJM ZC4068, *Nederlandse Jurisprudentie* 1990/652. (Halcion)

¹⁸⁷⁶ Hoge Raad 20 September 1996, LJM ZC2141, *Nederlandse Jurisprudentie* 1997/328 following the judgment of Hoge Raad, 30 June 1989, LJM ZC4068, *Nederlandse Jurisprudentie* 1990/652. (Halcion)

¹⁸⁷⁷ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. U.C. *Davis Law Review*, p. 988.

¹⁸⁷⁸ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. U.C. *Davis Law Review*, p. 989.

¹⁸⁷⁹ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. U.C. *Davis Law Review*, p. 992.

and the claim would be denied.¹⁸⁸⁰

If scientific studies have demonstrated that the chemical is toxic and can lead to harm, general causation is proved. The, as in the US, specific causation should be established by the submission of evidence that the chemical caused the damage of this specific plaintiff.

In cases where the burden of proof is shifted to the defendant, this defendant has to prove that he did not cause the damage, if he wants to escape liability.

Full certainty on a causal link is not necessary, the case can be decided on a preponderance of probabilities.¹⁸⁸¹ The assessment of causation can be made by the court if the conclusions of the expert are considered convincing and if there are no concrete indications of other potential causes.¹⁸⁸²

For example, when an employee claimed physical impairment because she had to work in an office with two smoking colleagues, the Dutch Supreme Court decided that a court can conclude on the basis of an expert opinion that the complaints increased by passive smoking. The causal link between the smoke and the damage can be accepted despite the lack of objective medical data. It is up to the trial courts to assess the facts of the situation¹⁸⁸³ and the opinions of the experts.¹⁸⁸⁴

6.2.2 The Milward saga: a new standard?

Twenty years after the first Daubert ruling, US courts still struggle when evaluating the liability of expert testimonies. Now the Milward case has been described as a fresh look at the issue of causation in toxic tort.

Milward is different. The two main reasons are: firstly, it recognises explicitly the weight of evidence methodology and secondly, it formally recognises that

¹⁸⁸⁰ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. U.C. *Davis Law Review*, p. 990.

¹⁸⁸¹ VAN KAMPEN, P., & NIJBOER, H. (1997, Summer). Daubert in the Lowlands. U.C. *Davis Law Review*, p. 993.

¹⁸⁸² In this case the Advocate General was convinced that the chance for another cause was theoretical. He furthermore referred to the principle of '*res ipsa loquitur*'. Hoge Raad 13 July 2012, LJN BW3265, *Nederland Juristenblad* 2012/1696

¹⁸⁸³ Hoge Raad 9 January 2009, LJN BG4014, *Nederlands Juristenblad* 2009/193.

¹⁸⁸⁴ Hoge Raad 12 March 2010, LJN BK9158, *Nederlands Juristenblad* 2010/661.

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experts can disagree, making judgement and interpretation a necessary tool when making causal determinations.¹⁸⁸⁵

But let us start at the beginning.

A refrigeration technician, Brian Milward, developed Acute Promyelocytes Leukaemia (APL) and brought action against chemical company alleging negligence. He claimed that he contracted APL by his routine workplace exposure to benzene-containing products. Brian's leukaemia is extremely rare.¹⁸⁸⁶ It is a subtype of acute myeloid leukaemia (AML), which is also rare. (3.5 cases per 100 000 persons per annum). APL is in part caused by the chromosomal translocation of a gene, namely the retinoic acid receptor-alpha gene. Although extensive research was conducted, it is still not clear what causes the genetic translocation.

The District Court excluded Milward's expert witnesses. The opinion of the toxicologist Dr. Smith was rejected on analytical gaps. The other expert opinions were rejected on the basis that the evidence indicating a correlation between benzene and (other types of) AML was not sufficient. The conclusion was:

"A suggestion may give rise to a plausible hypothesis, but not a reliable inference."¹⁸⁸⁷

The court found the evidence wanting and found for the defendants.

The plaintiffs appealed.

Is it possible to prove a specific cause of disease following the Daubert standard without supporting evidence from peer-reviewed epidemiological studies? The defendants used Daubert to claim that the expert testimony is not admissible. Evidence that does not directly test the hypothesis in question can never support

¹⁸⁸⁵ GREEN, M. (2013, April). Pessimism about Milward. *Wake Forest Journal of Law and Policy*, pp 41-64.

¹⁸⁸⁶ APL is characterized by a deficiency of mature blood cells in the myeloid cell line and an excess of immature cells called promyelocytes. Source Milward versus Acuity Specialty Products Group, Inc., 639 F.3d 11 (United States Court of Appeals, First Circuit March 22, 2011).

¹⁸⁸⁷ Milward versus Acuity Specialty Products Group, Inc., 664 F. Supp. 2d at 137 (United States District Court, D. Massachusetts July 31, 2009).

an inference of general causation, they argued.¹⁸⁸⁸ The analytical gap can be too wide, as was said in *Joiner*.¹⁸⁸⁹

What did Dr. Smith exactly brought to the court? Relying on his knowledge and experience in the field of toxicology and molecular epidemiology, he considered five bodies of evidence drawn from the peer-reviewed scientific literature on benzene and leukaemia.

Firstly, Dr. Smith considered the near-consensus among governmental agencies, experts, and active researchers in the field that benzene can cause AML as a class. Secondly there is evidence that the aetiology, or origins, of leukaemia indicating that all types of AML derive from a genetically damaged pluripotent stem cell. Thirdly, toxicology studies established that metabolites of benzene cause significant chromosomal damage at the stem cell level in the bone marrow; the type of damage that is known to cause APL and other types of AML. Fourthly, Dr. Smith considered two sets of studies concerning the inhibition of a cellular enzyme known as topoisomerase II that is essential for the maintenance of proper chromosome structure and segregation. Fifthly, a small set of epidemiological studies that provide data on the relationship between benzene exposure and subtypes of AML were taken into account.

Furthermore Dr. Smith explained that AML is a class of leukaemia and all subtypes of AML likely have a common aetiology, and that it is known that benzene cause AML. With that knowledge about AML (whereof APL is a subtype) and all of the evidence showing an increased risk factor for APL, combined, although not statistically significant was consistent with causality, there is no ground for excluding a causal link.¹⁸⁹⁰

The District Court excluded Dr. Smith's testimony on three arguments relating to sufficiency and biological plausibility. Insufficiency is not the same as unreliability. Neither is the fact that another explanation might be right sufficient

¹⁸⁸⁸ GOLD, S. (2013). A fitting vision of science for the courtroom. *Wake Forest Journal of Law and Policy*, p. 8.

¹⁸⁸⁹ *General Electric Company versus Robert Joiner*, 522 U.S. 136 (Supreme Court of the United States December 15, 1997).

¹⁸⁹⁰ *Milward versus Acuity Specialty Products Group, Inc.*, 639 F.3d 11 (United States Court of Appeals, First Circuit March 22, 2011).

to exclude a testimony.¹⁸⁹¹

The District Court also misunderstood the weight of the evidence methodology employed by Dr. Smith. The court treated the separate evidentiary components of Dr. Smith's analysis atomistically, and failed to assess the combination of all the information in the separate components. Dr. Smith treated each body of evidence as a ground for the subsidiary conclusion that it would, if combined with other evidence, support a causal inference. However, courts have frequently excluded the entirety of an expert's opinion because each line of evidence the expert relied upon, when examined individually, was insufficient to establish causation.¹⁸⁹²

The Court of Appeal was explicit: the absence of quantitative weighting factors is not an absence of scientific reasoning. Weight of evidence is not inherently unreliable, but accepting the method is only correct when the expert provides transparent and detailed explanation of exactly how he weighed the evidence.¹⁸⁹³ There exists no algorithm for applying the Bradford Hill guidelines to determine whether an association truly reflects a causal relationship.¹⁸⁹⁴ However, these guidelines can only be used if an association between two variables is clear, and not attributable to chance.¹⁸⁹⁵ Bernstein remarks that such an association is normally based on epidemiological studies, studies that are lacking in the Milward case.

Concerning the epidemiological evidence the Court of Appeal noted “that the limited epidemiological evidence was at the very least consistent with, and suggestive of, the conclusion that benzene can cause APL”. In view of the rarity of APL it would be very difficult to perform an epidemiological study of the causes of APL that would yield statistically significant results. Distinguishing this

¹⁸⁹¹ Primiano versus Cook, 598 F.3d 558 (United States Court of Appeals, Ninth Circuit April 27, 2010).

¹⁸⁹² General Electric Company versus Robert Joiner, 522 U.S. 136 (Supreme Court of the United States December 15, 1997), Stevens, J., dissenting in part; Merrell Dow Pharmaceuticals Inc. versus Havner, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997).

¹⁸⁹³ BERNSTEIN, D. (2013, November). The misbegotten judicial resistance to the Daubert revolution. *Notre Dame Law Review*, pp. 62-64.

¹⁸⁹⁴ Restatement (Third) of Torts: Liability for Physical and Emotional Harm, Chapter 5. Factual Cause, § 28 Burden of Proof (2012), comment c).

¹⁸⁹⁵ BRADFORD HILL, A. (1965, January 14). The environment and disease: association or causation. *Proceedings of the Royal Society of Medicine: Section of Occupational Medicine*, p. 295.

case from situations in which numerous powerful epidemiologic studies found no association, the little epidemiological evidence available is subsidiary to other arguments leading to the inference of a causal link.¹⁸⁹⁶ Epidemiological evidence is then not the leading evidence.

Last but not least, a new case has been added to the Milward sequel. On 6 September 2013 the District Court ruled in the remanded case.¹⁸⁹⁷

In those proceeding the expert Stewart was asked to quantify Milward's exposure to benzene. Stewart used thereby the REACH tool developed to measure complying with the regulation and peer reviewed by independent, leading experts from the industry, research institutes, and public authorities. The court referred in detail to the methodology and reasoning applied by Stewart when working with the tool. On the argument against the REACH tool on its inadequacy to prove specific causation, the 2013 court answered that variability in individual exposure circumstances is inevitable. Consequently the testimony was admissible and the fact finder should assess the importance of the study in relation to specific causation.

The second expert, Butler, was considered inadmissible. Her testimony lacked substantive content and was considered not reliable enough, mainly because the 'linear no-threshold' analysis has been rejected as a reliable means of proving specific causation.¹⁸⁹⁸ The other argument was that Butler did not have the expertise to establish the reliability of the studies favourable to Milward over others reflecting significantly increased risk only at higher cumulative exposure levels.

The District Court however does not see what evidence Butler's approach attributes without the benefit of established, tested, and reliable methods of analysing specific causation.

The verdict was that Milward cannot establish that it was more likely than not that his leukaemia was caused by exposure to benzene. Defendant's motion was

¹⁸⁹⁶ GOLD, S. (2011). The "reshapement" of the false negative asymmetry in toxic tort causation. *William Mitchell Law Review*, p. 1578.

¹⁸⁹⁷ Milward versus Acuity Speciality Products Group (United States District Court September 6, 2013).

¹⁸⁹⁸ Milward versus Acuity Speciality Products Group (United States District Court September 6, 2013).

granted.¹⁸⁹⁹

The result is the same as before, but the arguments are different, the issue of 'weight of evidence', so important in the appeal judgment is only mentioned once. The outcome is similar to the one that was reversed in 2011. The question is now, if an appeal is submitted, how that court will analyse the 2013 judgment and what arguments they will use in arriving to their decision.

Milward is also an example of the changes in the scientific study of environmental toxins since the Supreme Court's trilogy of expert testimony decisions. Some of the research used in the Milward case could not have been conducted when *Joiner* was decided in 1997. Gold believes that the development of these sciences will likely confront courts with new assemblages of weight of the evidence to consider.¹⁹⁰⁰

Although Green expresses pessimism about the case's potential for 'more intelligent, coherent, and rational causation assessments in future toxic tort litigation'.¹⁹⁰¹ The first reason he sees is the tension between the scientific process and the adversary litigation context. The second one is that courts will still have to control the weight of the evidence. This will be similar to what courts do now when assessing expert witness testimonies in toxic cases and determining if that evidence is sufficient to permit a reasonable inference of general and specific causation.¹⁹⁰² Interpretation and judgement will still be required.

6.2.3 What about standards created on the basis of experience

Until 1993 all evidence should be 'generally accepted' in the scientific society before it could be submitted in court.

¹⁸⁹⁹ *Milward versus Acuity Speciality Products Group* (United States District Court September 6, 2013).

¹⁹⁰⁰ GOLD, S. (2013, Vol.3 Issue 1 April). A fitting vision of science for the courtroom. *Wake Forest Journal of law & policy*, pp. 1-39.

¹⁹⁰¹ GREEN, M. (2013, April). Pessimism about Milward. *Wake Forest Journal of Law and Policy*, p. 41.

¹⁹⁰² GREEN, M. (2013, April). Pessimism about Milward. *Wake Forest Journal of Law and Policy*, p. 64.

Then Daubert came, the first case of the Daubert trilogy. The trial judges, as the gatekeepers, became responsible to assess scientific evidence and declare it reliable before it could be admitted in court.¹⁹⁰³

In the Joiner case two elements were added to the Daubert standard. Firstly, the issue with admissibility is not whether studies (in case the animal studies) are methodologically admissible to establish causation, but whether these studies are sufficiently supported. Methodology and inferred opinion have both to be considered in deciding to the reliability and fit of the evidence. There is a difference between methodology and conclusions, but it is impossible to judge methodology without relying on some substantive scientific conclusions.

As from the Kumbo case Daubert became applicable to all expert testimony, regardless of the field of expertise. It is the specialized knowledge that is of importance.

At the same time, the Supreme Court refused to make the four factors of the Daubert principle applicable in all cases. Too much depends on the particularity of a specific case.

An expert should in court employ the same intellectual rigor as an expert does in his area of expertise. Experts must demonstrate that their opinions are the result of methods consistent with how their colleagues in their or in a relevant field would work towards a proposition if they were put in a similar situation.

Twenty years after the first Daubert ruling, US courts still struggle when evaluating the liability of expert testimonies.

Then the Milward case was decided. It recognises explicitly the weight of evidence methodology and it formally recognises that experts can disagree. The latter makes judgement and interpretation a necessary tool when making causal determinations.

Whilst the District Court (as did many other courts) misunderstood the weight of evidence method, the Court of Appeal stated explicitly that the absence of quantitative weighting factors does not constitute an absence of scientific reasoning. Distinguishing a case with no or little epidemiological studies from situations in which numerous powerful epidemiologic studies found no

¹⁹⁰³ For the Daubert criteria, see paragraph 6.2.1.1.

association, the little epidemiological evidence available is subsidiary to other arguments leading to the inference of a causal link. Epidemiological evidence is then not the leading evidence.

Just for information, in the 'Omnibus Autism Proceeding' cases no evidence of a causal link between vaccines and autism was found. The experts looked beyond the epidemiological evidence and considered the overall evidence as a whole. Since the overall weight of the evidence was contrary to the claims of the plaintiffs, no causal link was demonstrated.¹⁹⁰⁴

These cases were very important in relation to the validity of general causation theories.¹⁹⁰⁵ It is thus not without importance that the 'weight of evidence' method was used and thus de facto recognized as valid.

6.3 Science in court: an overall appreciation

Coming at the end of Part VI, a few points are worth repeating.

First of all, proving causation in a toxic tort case cannot be done with scientific expertise. Despite the availability of scientific research and knowledge the proof of causation remains difficult and certainty cannot be achieved. Recourse is thus made to statistical calculations on probability. The expert and expert's conclusions should always be reliable and qualitatively sound.

In view of the complexity of that process, it is advisable to split proof of causation into two phases: general causation and specific or individual causation. General and specific causation are separate concepts that bring structure into the reasoning and assist in disentangling the knot.

Specific for the US is that they separate the assessment of the reliability of the scientific evidence/expert from the substantive appreciation of the studies. However a full split cannot be achieved. Substantive elements are in practice taken into consideration, because methodology and substantive reasoning and results are intertwined.

¹⁹⁰⁴ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 173.

¹⁹⁰⁵ GOLDBERG, R. (2011). Using scientific evidence to resolve causation problems in product liability. In R. GOLDBERG, *Perspectives on causation* (pp. 149-178). Oxford and Portland: Hart Publishing Ltd, p. 164.

PART VI – Scientific methodology for toxic tort

The other countries do not have a formal assessment of expert evidence before going into the substantive proceedings. In practice all do evaluate experts on their quality, experience and performance.

Because of the unavoidable uncertainty in scientific evidence, decisions made by the court are not only guided by science, judges and jurors still have to decide on the believability of the evidence and the appropriateness of a decision. Or like the French judges say it, maybe exaggerating a bit: it is all about the '*intime conviction*'.

Of course, above remarks do not give the full picture. The next and last part will appreciate the things learned throughout this study and suggest some solutions, as well as provide some food for thought.

PART VII – A joint effort to make toxic tort work

Chemicals bring welfare and health. Just think of all the chemicals in our daily life. Think, for example, of the chemicals used to transform water into drinkable water, or the pharmaceutical defeating a cancer, or the fertilizer stimulating growth of vegetables in order to produce enough food for the village. Nonetheless, chemical substances can also cause personal injury.

7.1 Toxic tort: appreciation of the findings

7.1.1 Damage by chemicals: on the edge of public and civil law

Chemicals can thus be dangerous because of their properties and their presence. Manipulation and use of such substances entail the creation of risks. Consequently toxic chemicals cannot be banned completely without important immediate disadvantageous effects on human life, health and wellbeing. In addition, without risk there is however neither life, nor evolution

Today's risks are, as Beck says, a side effect of modernisation.¹⁹⁰⁶ The risks are the result of conscious decisions. The hazards created are the result of the link between technical knowledge and the economic utility calculus.

Risk is the anticipation of damage.¹⁹⁰⁷ Risk is dubious and allusive. In itself it is not damage, but it is the precursor of damage.¹⁹⁰⁸

It happens that the risk at the basis of nowadays harm was created at a time that the knowledge of the noxious properties of the chemicals involved was limited or absent. Because science constantly evolves, the truth as we know it also changes.¹⁹⁰⁹ With new methods, come new insights. Consequently an awareness of new hazards develops. This observation is particularly relevant for many toxic tort cases with their uncertain causes, long latency periods and restricted knowledge on the aetiology of the harm. What was known at the time of the exposure is not what is known at the time of the tort claim following the materialisation of the harm.

¹⁹⁰⁶ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 25.

¹⁹⁰⁷ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 47.

¹⁹⁰⁸ See Part IV Risk versus damage.

¹⁹⁰⁹ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 116.

Although the perceptions of risks are generally different in the US versus Europe¹⁹¹⁰, this is less so for risk of personal injury created by exposure to chemicals.¹⁹¹¹ The link between non-knowledge and threat is everywhere the same. The appreciation of the risk for personal injury, for example caused by toxins, is based on incomplete scientific insights. Referring to Chernobyl, Beck described it as follows:

“[...] the lack of knowledge extends, [...], to the source of the illness, to the paths of transmission and to the latency period following an infection.”¹⁹¹²

Scientist can determine risks posed by chemicals through probability calculations. This, however, says nothing about whether these risks are real. Scientific proof of causation is thus, given above observations, not beyond doubts and gaps. The knowledge on what caused a harm to occur after an exposure to a chemical is mostly outside of the domain of laypersons and legal practitioners.¹⁹¹³ Despite these limits, science is still the best solution for complex tort cases concerning chemicals. Obviously the uncertainty on cause has an impact on tort. It makes the decision process challenging for all involved.

The resulting damage after wrongful exposure to a noxious chemical is in general considered unacceptable. Consequently individuals seek recourse. Actors causing harm are under certain conditions obliged to compensate the damage they caused. The system dealing with the reparation of harm caused by one private party onto another private party is tort. This is also the basis of this study: tort remains about singular specific relations between specific parties. Despite the fact that some stress the public role of the tort system, this is not the primary objective. Deterrence, cost efficiency and redistribution of ‘wealth’ undoubtedly have an impact on society, but are an effect of the court’s decision concerning the issue between the parties in the case.

¹⁹¹⁰ BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 197.

¹⁹¹¹ The differences are more obvious in other areas, like terrorists risk or huge environmental risks like climate change.

¹⁹¹² BECK, U. (2009). *World at risk*. Cambridge: Polity Press, p. 117.

¹⁹¹³ There is however a difference between not-knowing as the society (science) does not know versus the individual who does not know. The latter is an important element, since the not-knowing of the individual does not mean that he should not have known or should not have foreseen.

When toxic substances are involved tort is called toxic tort. The observations in the paragraph above are also valid for toxic tort. Though the increase of mass torts dealing with a considerable number of plaintiffs allegedly harmed by a toxic agent, gives tort more of a hint of public law. In fact, mass tort is not even necessary for such an impression. Toxic tort fills the gap created by the failure of general (chemical) legislation. A good example is the liability for dangerous activities (often related to chemicals) as it is now subject to strict liability. One could say that strict liability is close to public law. This category of tort aims at balancing the interests of people by supporting the internalisation of costs and distributing the costs amongst those who benefit from the risk imposition. Nevertheless a strict liability claim is still between specific parties and requires proof of exposure, damage and causation.

7.1.2 From before to where we are now: choosing a theory for finding causation

The basic causal principle in tort was for a long time the *conditio sine qua non*, meaning that without a specific fact or event the specific damage would not have occurred. The past tense in the previous sentence is no accident. Starting with the industrial revolution damages and their causing facts became increasingly complex. The augmented use of chemicals, of which some knowingly or unknowingly toxic, led to harm. Science developed and more damage could be detected. The cases involving toxins increased in such a way that toxic tort emerged as an area of tort with particular issues, mainly concerning evidence and causation. The *conditio sine qua non* test is not up to this challenge. Frequently the causal link in toxic tort is not clear. Scientific proof became necessary.

7.1.2.1 Alternative and complementary approaches

Different theories on causation were developed in an attempt to remedy the problems. A selection of those was made. Two theories were chosen because of their relevance for toxic tort: the substantial factor test and the Necessary Element of a Sufficient Set (NESS). In concreto the relevance of the theories was assessed on the basis of three criteria:

1. the ability to work with multiple potential or possible causing factors (what refers to the uncertainty of the causal link and the need for scientific information plus probability calculations),
2. the limits of science as well concerning knowledge of the aetiology of the harm as on the capacity to detect causal links and translate these into proof of causation, and
3. the performance of the tests in real life situations.

Another tool, what can hardly be classified as a theory, namely common sense or intuitive thinking is also studied. The reason is its ubiquitous presence, even in complex litigation. Common sense is a human thought process we should be aware of. It can influence court decisions in all four countries, sometimes explicitly, more often implicitly.¹⁹¹⁴ Common sense in itself is not wrong. It includes generalisations and is influenced by the social context in which the social meaning of facts is understood. It is more frequently relied on in France than in the other three countries. The freedom and authority judges have in France, as well as concepts like '*intime conviction*' increase the potential influence of common sense. The limited use of scientific evidence and the lack of transparent and detailed motivations of the judgements add to the former observation.¹⁹¹⁵ The adherence to the theory of equivalence and the adequacy doctrine is the formal basis for the practice that probabilities must be assessed by an observer who knows all the circumstances, and who is equipped with the general experience of mankind.¹⁹¹⁶

But when a case is complex, the temptation to withdraw into intuitive, common sense thinking is everywhere considerable.¹⁹¹⁷ The focus can then shift to rules

¹⁹¹⁴ Sienkiewicz versus Greif (UK) Ltd, [2011] I.C.R.391 (Supreme Court March 9, 2011); Hoge Raad 29 april 2011, *Jurisprudentie aansprakelijkheid* 2011-109, 3.4.4, note of Gouweloos. (Bouwcombinatie en Paans/Liander); Hoge Raad 17 December 2004, *Nederlandse Jurisprudentie* 2006, 147, conclusion Advocate-General Spier, note of C.J.H. Brunner. (Hertel/Van der Lugt); Fairchild versus Glenhaven Funeral Services Ltd and others, [2003] A.C. 32 (House of Lords June 20, 2002); Wright versus Willamette Industries, Inc., 91 F.3d 1105 (US Court of Appeals, Eight Circuit September 19, 1996); McGhee versus National Coal Board, 1973 S.L.T. 14 (House of Lords November 15, 1972)

¹⁹¹⁵ The French Code of Civil Procedure (article 455) states that judgements should be reasoned. In practice this motivation is not detailed.

¹⁹¹⁶ VAN GERVEN, W. (2001). *Tort Law*. Oxford: Hart Publishing, p. 453.

¹⁹¹⁷ SANDERS, J. (2001, Vol. 64). Kumho and how we know. *Law and Contemporary Problems*, p. 394; SIMON, D. (1998-1999, Vol. 30). A psychological model of judicial decision making. *Rutgers Law Journal*, pp. 1-118.

of convenience with little scientific justification.¹⁹¹⁸ Scientifically proven information is overlooked and judgments are guided by other aspects like empathy and commiseration.¹⁹¹⁹

The difference with these considerations and those based on the legal cause is that the former are part of the 'personal' conviction of the judge or juror without being backed up by societal norms as translated into the legal cause.

The fact is that common sense is in toxic tort frequently not the best solution, especially not in complex toxic tort cases. Scientific evidence relating to causation is often counterintuitive. Nonetheless, awareness of our use of common sense and a controlled application of it can help to find solutions even in difficult toxic tort cases, but it should not replace scientific evidence. Indeed unexamined common sense can and does lead to judgmental errors when a highly complex scientific insight is necessary because of factual occurrences outside of the ordinary ability to observe.

It is thus recommended to consider other means of proving causation, like the substantial factor test.¹⁹²⁰

The substantial factor theory assumes that causes may occur practically simultaneously, in the sense that more than one factual circumstance can be identified that possibly caused the damage. In such situations it is difficult to isolate the actual cause. The search is then for the most substantial cause, as most important, intrinsic, solid, etc. The former is to be understood as the requirement that a cause should have a considerable role in the materialisation of the damage. However it should not necessarily be a *conditio sine qua non*. Sometimes it is sufficient that a factor contributed more than theoretically in order for being considered substantial.

The identification of the substantial factor can replace the *conditio sine qua non* test, although it does not preclude or empty the latter. In view of the flexible

¹⁹¹⁸ Erica Beecher-Monas is convinced that this is what happen soften when (even experienced) judges are confronted with difficult and voluminous scientific evidence. BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1563.

¹⁹¹⁹ The difference with these considerations and those based on the legal cause is that the former are part of the 'personal' conviction of the judge or juror without being back by societal norms as translated into the legal cause.

¹⁹²⁰ The substantial factor test is not the same as the test of the adequate cause. See paragraph 3.2.2.1.

use of the substantial factor, it seems advisable that this theory should not blindly replace the *conditio sine qua non*. It should rather be seen as a refinement, namely as a tool to differentiate between different causes.

The substantial factor has a similar objective as the Dutch concept of (reasonable) attribution. Both allow courts to focus on other aspects than the *conditio sine qua non* test and on what they judge to be causally important for the occurrence of the damage. There is however also a difference. The substantial factor focuses on the factual circumstances, whilst the (reasonable) attribution, although based in the facts, leaves more room for the legal cause.

The downside of the substantial factor test is that it brings little guidance to the trier of fact. Additionally, because of its vagueness, it does have an implied normative connotation.

Another option is the NESS test. At first sight this 'Necessary Element of a Sufficient Set' test looks quite complex. For a full analysis of this test, I refer to paragraph 3.2.3.1, but the definition of the NESS test is worthwhile repeating:

“the condition at issue must be part of the instantiation of a fully instantiated causal law that is part of a sequence of such fully instantiated causal laws that link the condition at issue with the consequence.”¹⁹²¹

Not each factor in the set of factors needs to be independently sufficient.

The benefit of the NESS test is (at least) that it offers a coherent structure for attributing cause when the *conditio sine qua non* does not work. NESS attributes causation to very small conditions that together become substantial. In other words, the set of conditions is made up of several separate causes until the full set becomes sufficient to materialise the harm. In order to be part of the set, a, even minor, contribution to the damage is indeed sufficient.¹⁹²²

¹⁹²¹ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 298.

¹⁹²² For clarification the example of paragraph 3.2.3.1, a), i) is copied here: Imagine that a teaspoon of water is added to a flooding river. That teaspoon of water contributed to the flood. Is it the cause of the flood? If a million or more people would all contribute a teaspoon of water to a river and consequently there is a flood destroying your house, then any of the teaspoons of water contributed to the demolition. Each teaspoon is thus a cause of the demolition of the house.

Incremental causes insufficient by themselves frequently occur in toxic tort. Many chemicals become only toxic after the exposure exceeded a certain threshold. With the NESS test several defendants can be held liable in line with their contribution to the damage, instead of being obliged to hold them jointly and severally liable.

Examples of such different sources are the subsequent exposures in different jobs during one's career, or the chemicals present in several products, but also the background exposure caused by chemicals in the environment additional to the observed contact with the toxic substance.

The NESS test is thus a good solution. Still the discovery and assessment of all the contributing factors remains a challenge. Let me clarify with an example.

A person X lives nearby a chemical plant Y emitting a substance I. This substance I is sold to producers of pesticides. X is a passionate gardener and uses a pesticide containing substance I in his garden. He bought the pesticide from company A.

In his spare time X regularly drinks alcohol, but he has always refused to smoke. However he can regularly be found in the bar down the road. In this bar most customers smoke so much that it is hard to recognize somebody on the other side of the room. X's father died from cancer, so did his younger sister. After developing cancer, X files a claim on the basis that his exposure to substance I by the emissions of the chemical plant caused his disease.

It is impossible to prove that the substance I caused X's harm, although there is epidemiological evidence of an association between exposure to substance I and the specific cancer. This association was accepted by scientists to be a causal. The probability that someone exposed to substance I will develop cancer is 60 %. X cannot prove that he is not amongst the 40 % who contracted the cancer from other sources.¹⁹²³ Applying the NESS test other factors that contributed to the disease can be taken into account: the emission by the chemical plant, the pesticide of company A, the smoke in the bar, X's life style and X's family history. Each factor can be taken into account, since there is no need for it to be substantial on its own. A contribution to the disease is enough. Thereby the impossibility to carry out the *conditio sine qua non* test was circumvented.

¹⁹²³ See for example the case *McTear versus Imperial Tobacco Ltd*, 2005 2 S.C. 1 (Court of Session Outer House May 11, 2005).

The use of the test in the US courts is despite its usefulness still limited and up to the end of 2013 not found in the UK. Is this approach similar to the Fairchild principle stating that a material increase of risk is sufficient to hold the defendant liable? On the basis of the Fairchild principle, a court holds for the plaintiff if it is proved that the defendant materially increased the risk that the plaintiff would be harmed. Two remarks. Firstly, the Fairchild principle is not yet used for other cases than asbestos. Secondly, the Fairchild principle is based on fairness, and as such is no substitute for the factual proof of causation.¹⁹²⁴ The NESS test is thus clearly different. NESS can be applied in more situations and respects the objectives of cost efficiency and deterrence more.

France, still adhering to the theory of equivalence and in lesser account to the adequacy theory, uses only the *conditio sine qua non* test. There is no room for the NESS.

The Netherlands have the concept of co-operating causes. These causes are individually not sufficient, but together they lead to damage. Each cause is considered to have contributed to the damage and consequently lead to the attribution of liability to all defendants. This resembles NESS. A Dutch judge can attribute liability to the defendant(s) in overdetermined cases. Motivation of the decision is required in the Netherlands. Such a motivation could be based on the application of the NESS test, with or without a translation to (Bayesian) probability.

NESS takes several causes into account and can deliver evidence of causation.

The overall conclusion is that the NESS test is up to now the most useful algorithm for identifying causal links in complex situations. The need for such a test is in toxic tort obvious.

But the NESS test, or any other causal theory does not solve everything. If five sources of exposure to benzene are known, and the plaintiff has developed acute myeloid leukaemia, how much more certain is it then that the substance has caused the disease? There exists research proving that benzene can cause leukaemia, but did it cause the plaintiff's disease? The proof of a causal link between the source (namely the substance) and the damage remains as difficult as before.

¹⁹²⁴ See also the remarks on the principle in paragraph 7.1.5 on belief probability.

7.1.3 The differentiating particularities of toxic tort

Toxic tort has its peculiarities that distinguishes it from standard tort. These particularities have been mentioned already more than once. It concerns mainly the difficulty to prove that a chemical caused a damage and even more, that it caused the specific damage as described in the claim.

7.1.3.1 Not a separate category of tort

The differences are however not sufficient to claim that toxic tort is a separate area of tort, as is, for example, strict liability. Several arguments support the statement.

First, objectives of toxic tort are the same as in standard tort: compensation for the party wrongfully harmed, deterrence and (cost) efficiency. Claims deal with relations between private parties and toxic tort can be found in employment liability, product liability, fault liability and non-fault liability.

Secondly, the elements that need to be proved are standard: damage, a tortious act and causation. The challenges in proving these factors are on the contrary substantially different, namely more complex and defiant.

Thirdly, toxic tort fits within the litigation procedures and principles of tort concerning factual evidence, availability of experts, procedural requirements, etc. apply specific for the domain of tort the dealing with the claim. For example in strict liability the plaintiff would have to prove that he was exposed to the product allegedly causing the damage.

On the basis of these arguments it is concluded that the otherness of toxic torts originates in the difficulties to meet the requirements and conditions of proof and the necessity to use science that is not familiar to the legal practitioners.

Toxic tort is thus tort with some extra challenges. A court is required to investigate and to discover the facts of the claim. However the approach and methodology of discovering causal links differ greatly from standard tort. Proving causation is complex and requires scientific input. The ever-present experts delivering scientific testimonies is a distinctive difference with standard tort. It demands auditing the quality of the expert and the quality of the evidence, as well methodological as substantive. The following paragraphs discuss these topics.

7.1.3.2 Scientific experts and the quality of their testimonies

All four countries check experts and their testimonies on reliability. Lacking the competency to check the content of the reports, the evaluation turns to the qualifications of the expert and the methodology used. The four countries differ in the practical implementation of the former.

Lists of experts do circulate in the courts, but they are no guarantee for the quality of the experts.¹⁹²⁵

In the UK the admissibility of the experts is evaluated during the pleadings. This system has the advantage that experts are not incorrectly banned from testing in the substantive procedure. On the other hand, it increases the chance on less qualified experts, what is difficult to correct at that moment.

Economically the appointment of an expert is best done by the court. This approach limits costs and increases efficiency in the pleadings. Additionally, it restores the likely unbalance in toxic tort between the defendant and the plaintiff. Indeed, in these cases the defendants are mostly professional producers or users of chemicals, who have much more knowledge and insight in chemistry, not to mention more important financial means.¹⁹²⁶ They have access to the best experts.

Another advantage is that the court appointed expert can more easily situate the dispute without taking sides consciously or unconsciously. But, judges should still check the submitted information on its objectivity. Focus should certainly be on the translation of an epidemiological association into causation (see paragraph 5.1.2.1). Additionally courts should be aware of misfits between the characteristics of the people researched in the scientific studies and the specificities of the plaintiff. For example, children are known to take in food at higher rates per unit of their body weights than do adults.¹⁹²⁷ Consequently,

¹⁹²⁵ On concerns concerning experts in court see for example: FAURE, M., & VISSCHER, L. (2011, Vol. 3). The role of experts in assessing damages - a law and economics account. *European Journal of Risk Regulation*, pp. 385-386.

¹⁹²⁶ The issue of disclosure and sharing of information is not discussed in this study, but could certainly be a topic for further investigation.

If the case is judged under a strict liability system, the defendant, with his knowledge and financial possibilities has to prove his innocence. However one should not forget that in strict liability the initial proof of exposure is still on the plaintiff. Strict liability is a no fault liability, it does not do away with causation.

¹⁹²⁷ RODRICKS, J. (2011). Reference Guide on Exposure Science. In N. A. SCIENCES, & F. J. CENTER, *Reference Manual on Scientific Evidence* (pp. 503-548). Washington: Federal Judicial Center, p. 527.

when a child is exposed to food contaminated with a pesticide, that child will sooner reached the threshold level for the toxin than the adult. Epidemiological evidence submitted should have considered this aspect in its study design.

The US differs on this point considerably from the three countries mentioned above. An important difference is that experts are appointed by the parties. This is typical for an adversarial court system. It also warrants the pre-trial procedure. The expert and the expert evidence are checked upon before being allowed in the substantive procedure. For more details on the system, see paragraph 5.1.3.1, a).

Regardless who appoints them, experts in litigation are said to increase the complexity of the pleadings. Indeed, several court cases have lasted very long resulting in judgments that require a serious effort for the reader as well concerning understandability as length.

Toxic tort is most often very complex. Aiming at controlling the delivery of evidence, rules have been implemented with varying success. A standard approach is the evaluation of the credentials of the expert, his publications and his professional career. This is apparently not necessarily a guarantee for the quality of the expert's testimony. Assessing the evidence remains difficult.

Two aspects make the use of scientific evidence in court challenging:

1. Judges/courts admit experts into the procedure because they themselves lack the knowledge, experience or training to understand the circumstances and the elements of the causal link.
2. Judges assess the scientific evidence on its reliability and its internal logic. In all countries they are free to deviate from the experts' conclusions. Such authority increases the importance of an understanding of science by those judges.

In short, the court needs the expert's conclusions because of lack of knowledge, but the same court has to assess the reliability of the conclusions. The challenge is in the circular reasoning.

The US try to solve this with a formal system for the evaluation of the admissibility of evidence with a focus on methodology. Trial judges are required to evaluate expert and expert's conclusions on the reliability of the methods used and the logic of the opinions brought forward. This appreciation is in

principle not linked to the substantive quality of the opinion. In practice a complete split between methodology and content proves unattainable. Elements relating to the content of the opinion easily creep into the evaluation, leading to unjustified exclusion or inclusion of evidence. The latter is frequently (if not always) caused by a lack of scientific understanding. Judges are no scientists. But the selection of evidence has an impact on the judgement. Consequently the admissibility procedure is not without discussion.

The US approach is considered in the UK. Courts are already involved in the appreciation of experts (they appoint them) but during the pleadings, not before the substantive procedure. In their review report of 2011, the UK Law Commission on expert evidence in criminal proceedings proposed the implementation of a pre-trial admissibility test for scientific evidence in criminal cases, similar to the one used in the US.¹⁹²⁸ However, it was recognised that the judge could need the assistance from an expert when evaluating the reliability of scientific evidence. Although not yet proposed, some scholars advocate the benefits of the introduction of a similar pre-trial system in civil law.¹⁹²⁹

Meanwhile US practice has made clear that pre-trial admissibility test has its flaws and weaknesses. However, a perfection solution does not exist.

One of the difficulties is the artificial split between the methodological evaluation and the substantive assessment. Such an approach can be practical but should not be too strict. In fact the split is quasi unattainable. The correctness of the admissibility and/or interpretation of scientific proof depends not only on the expert and the methodology but also on the capabilities of the judges and they overall lack scientific knowledge and practice. This is bottleneck in toxic tort litigation.

On the other hand neither provide the systems in the three other countries a lot of certainty on the quality of experts. The legal requirements concerning to the quality of experts is not solid and there is no guarantee on the quality, regardless if the expert is on a 'list' or not.

¹⁹²⁸ MUNBY, J., COOKE, E., HERTZELL, D., ORMEROD, D., & PATTERSON, F. (2011). *The Law Commission: expert evidence in criminal proceedings in England and Wales*. London: The Stationary Office.

¹⁹²⁹ For example: McIVOR, C. (2013, Vol. 21). Debunking some judicial myths about epidemiology and its relevance to UK tort law. *Medical Law Review*, pp. 583-584.

The conclusion concerning the selection of experts is that formal basic criteria should be developed and implemented. Thereby the balance between reliability and substantive value should be carefully monitored, in order to not incorrectly exclude evidence. This monitoring should be done by scientifically schooled and independent experts. Giving the difficulty of this task, judges should have the option to request personal assistance on the evaluation of the expert, whilst at the same time get better grounded in science. A good basic understanding of the relevant sciences, a careful selection of experts and a broad appreciation of the state of the science in relation to the issue are factors that protect the quality of the judicial process. These ideas are further elaborated in paragraph 7.3.2.1.

7.1.4 Confusion about the value of statistics

Naked statistics are not trustworthy in court (cf. the example of the cabs in paragraph 6.1.1 and the one of the jelly bean in paragraph 6.1.3.1).¹⁹³⁰

Statistical evidence compiled and delivered by qualified scientific experts is on the contrary trustworthy. Some judges are not convinced of the former. Their mistake is mainly based in the lack of knowledge on the methodologies of science and statistics. Epidemiologists, for example, use techniques to decide that the association they found is in fact a causal link. An association is not equal to a causal link. Only after the application of additional methods, combined with relevant knowledge (ex. medicine, toxicology) the existence of a causal link is accepted. Epidemiologists are trained in this area's and thus can assess the existence of a causal link.

Besides the former, group based studies and their conclusions (based on statistical evidence) are as such not convincing evidence for an individual causal link in a case (specific causation). Additional proof related to the specific circumstances of the individual circumstances is necessary, contrary to what some courts think. Accepting only epidemiology, and thus probability, as the sole determinative proof of a causation is a mistake.

Are courts then right to mistrust statistical evidence? Yes, the problem lies in the quest for certainty leading to a misunderstanding of statistics *an sich* and of the use statistical data have in the discovery and prove of causation.

As is demonstrated by the statement made by Lord Phillips in 2012:

¹⁹³⁰ Such naked statistics are in practice rarely used in litigation.

“When a scientific expert gives an opinion on causation, he is likely to do so in terms of certainty or uncertainty, rather than probability. Either medical science will enable him to postulate with confidence the chain of events that occurred, i.e. the biological cause, or it will not. In the latter case he is unlikely to be of much assistance to the judge who seeks to ascertain what occurred on a balance of probability.”¹⁹³¹

Factual cause as expressed in statistical probability is in toxic tort most frequently the only appreciation of a causal link that is possible. Besides that certainty is not absolutely required. Belief probability (see next paragraph) and the legal cause (see paragraph 3.1.2) can provide guidance. However, legal cause considerations are separate from fact findings. Legal cause, based on a normative inquiry, can be determinative, but the probability (uncertainty) of the cause of fact should not be tied up in the final judgement.¹⁹³²

7.1.5 The necessity of belief

Proof of causation is linked to fact probability. It refers to the obligation to prove the facts of the claim. This evidence defines the factual elements of the case as they probably happened.

The standard of persuasion (or the ‘more likely than not’) is related to the belief probability and refers to the required strength of belief. Belief is necessary because of the uncertainty always present. The strength of belief is related to the credibility of the evidence that supports the facts.¹⁹³³

7.1.5.1 What is the role for belief probability in toxic tort?

Both fact and belief probability are thus necessary in toxic tort cases. The fact probability is delivered mainly by scientific evidence. Belief probability is the factfinder's confidence in the evidence about cause, but is difficult to express quantitatively. Choosing quantitative cut-off points always involves a judgemental decision. Consequently the figures expressing ‘quantitative’ values are founded in interpretation and judgement. Besides the former, it is challenging or even impossible to explain in cases with uncertain causation the

¹⁹³¹ Sienkiewicz versus Greif (UK) Ltd, [2011] I.C.R. 391 (Supreme Court March 9, 2011).

¹⁹³² FULHAM-McQUILLAN, S. (2014). Judicial belief in statistics as fact: loss of chance in Ireland and England. *Professional Negligence*, pp. 9-35.

¹⁹³³ BARNES, D. (2001, Vol. 64, issue 4). Too many probabilities: statistical evidence of tort causation. *Law and Contemporary Problems*, p. 192.

difference between granting a claim on the basis of a probability of 51 % and refusing it on the basis of a probability of 53 %. Once an association is established the cut-off points are arbitrary.

Besides the former, setting limits creates rigid rules that are inappropriate for toxic tort with its uncertainties and particular circumstances. A case-by-case approach will always be necessary when considering certain aspects of toxic tort cases, like specific causation.

Common sense can sometimes be useful for searching and analysing the truth on condition that it is used judiciously and consciously and provides a solid basis for an inference.¹⁹³⁴

In practice the concept of common sense is (mis)used for reasons of convenience, especially when things become difficult, like analysing and deciding on the value of voluminous scientific evidence.¹⁹³⁵ Studies showed that people then take shortcuts that result in mistakes. They approach risk in ways that depart from the norms and assumptions of conventional decision analysis.¹⁹³⁶ In such circumstances, common sense reduces the specific situation to a commonality, what appears to state what is obviously useful and true at all times.¹⁹³⁷ This of course questions the value of the allegedly objective criterion of the reasonable man.

Belief in the truth of a causal link actually is based on qualitative appreciations. An example is the standard of 'more likely than not' or 'on the preponderance of evidence'. The standard is not radically different in Continental versus Common law. The formulation of the arguments differs, but both systems require the court to be convinced of the truth of the facts at issue. Thereby the courts in all four countries have the authority to decide on the basis of their evaluation of the case. Concepts like the '*intime conviction*' in France and the 'reasonable attribution' in the Netherlands are based on this freedom of the judges to be convinced by the evidence. But also in the US courts are guided by their belief in

¹⁹³⁴ MORRIS, R. (2003, Vol. 53). Not thinking like a nonlawyer: implications of 'recognition' for legal education. *Journal of Legal Education*, p. 274.

¹⁹³⁵ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, pp. 1563-1666.

¹⁹³⁶ NOLL, R., & KRIER, J. (1990, Vol. 10). Some implications of cognitive psychology for risk regulation. *The Journal of Legal Studies*, pp. 777-778.

¹⁹³⁷ MORRIS, R. (2003, Vol. 53). Not thinking like a nonlawyer: implications of 'recognition' for legal education. *Journal of Legal Education*, p. 273.

the truth. The 'preponderance of evidence' standard should not be fixed to the 'more than 50 %' statistical probability, it can be based on a 'qualitative' appreciation.¹⁹³⁸ Although, as this study showed, some courts use the more than 50% principle as the ultimate evidence that a causal link exists in the situation. Also as said before, these courts err when relying fully on that principle.

7.1.5.2 Belief as a link between evidence and the individual's harm

Both in Continental and Common law the finders of fact have to be convinced of the truth of the facts in the tort case.¹⁹³⁹ The belief should thereby be supported by specific causal evidence and not only by evidence of general causation.

Epidemiology proves statistical associations, which are then interpreted. Even when causal links can be inferred with considerable certainty, it is still an analytical step when accepting association as causation.

But a causal link on group level, does not prove one on individual level. In other words, group based evidence expressed in quantitative probabilities is not suited for specific causation. Courts have also tried to circumvent the maladjustment of epidemiological evidence for individual causation by setting limits. The requirement to expect evidence of a relative risk of 2 when using epidemiological studies in specific causation is based on a poor understanding of statistical concepts.

Firstly a relative risk of 1.0 means that the substance researched has no effect on the incidence of disease. From the moment that the relative risk is higher than 1, there exists a statistical association between the substance and the disease.

Secondly an association is not necessarily a causal link, not even when the relative risk is 2. The assumption that a relative risk greater than 2.0¹⁹⁴⁰ would permit an inference that an individual plaintiff's disease was more likely than not caused by the implicated substance is incorrect as a factual deduction.¹⁹⁴¹

¹⁹³⁸ WRIGHT, R. (2008-2009). Proving Facts Belief versus Probability. In H. KOZIOL, & B. STEINIGER, *Tort and Insurance Law 2008-2009* (pp. 79-105). Vienna: Springer, p. 88.

¹⁹³⁹ WRIGHT, R. (2011). The NESS account of natural causation: a response to criticisms. In C. GOLDBERG, *Perspectives on causation* (pp. 285-322). Oxford and Portland, Oregon: Hart Publishing, p. 208.

¹⁹⁴⁰ A relative risk of 2 is equivalent with an attributable risk of 50 %.

¹⁹⁴¹ See for example: *Merrell Dow Pharmaceuticals Inc. versus Havner*, 953 S.W.2d 706 (Supreme Court of Texas November 13, 1997).

Thirdly, statistical evidence can never proof the existence of a causal link on the individual level.

Thus, to require a plaintiff to prove general causation before he is allowed to deliver evidence of a specific causal between his exposure and his harm is incorrect. It takes the applicability of that group based evidence too far. After all an individual can be harmed by a specific chemical, no matter how unlikely that might be.

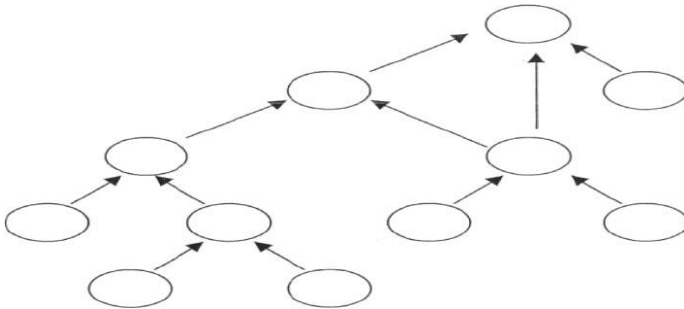
As said before, since scientific research leads to a chance and not to certainty, belief comes into the picture. The (non)existence of certainty founded in human knowledge is a fundamental philosophical discussion. We can however safely assume that in the area of science related to toxic chemicals knowledge is incomplete and certainty does not exist. Consequently judges are obliged to decide regardless of the inability to transfer proof of general causation into specific causation.

The plaintiff carrying the burden of proof has to convince the court that the facts of his case are more likely than not true¹⁹⁴², and that the substantive analysis of what happened (including causation) can be believed. Belief is achieved by persuasion. The standard of persuasion measures the court's belief in the evidence and in the inferences based on the evidence.

7.1.5.3 Translation of belief into figures

An attempt to translate belief into figures is made by calculating a number that should indicate the strength of the belief probability. This is the statistical method based on the Bayesian Theorem. Academics differ in opinion on the validity of this method. It is true, the calculations are based on a selection of, as many as possible, propositions. There is an enormous number of 'propositions' pertinent to finding facts and each proposition has to be considered in relation to every other proposition and every possible combination. See the visual presentation below.

¹⁹⁴² This is also true for strict liability, the difference is that the plaintiff will be more easily believed that the chemical caused his injury. For example, if X claims to be hurt by a known toxic chemical present in a product, then he has to prove that he used the product and that the product contained the chemical.



The circles represent propositions and the arrows represent logical relations between the different propositions. The propositions form inferences. An inference has a number of propositions, which include premises and a conclusion. Each conclusions requires a decision. Per analogy with the example of

,¹⁹⁴³

The selection of the propositions is subjective, but without filtering the calculation of the Bayesian probability becomes impossible. However, when we want to safeguard consistency amongst propositions, we should consider them all. I agree. That is the ultimate goal, but in practice as many propositions as possible should be included in the calculation. In that case, Bayesian statistics are beneficial by their visualisation of the belief and by the structure and transparency it brings to the qualitative appreciation. Like differential diagnosis does in medicine, the Bayesian approach forces to consider several different aspects that at first sight might not have been considered. Furthermore, it links these other factors to the original probability, thereby indicating the impact of these extra considerations.

Unless the statistical and/or scientific evidence is very compelling a court cannot infer its belief in the truth of the factual and substantive evidence for proof of specific causation.

Generally the distinction between fact probability and belief probability should be respected. Thereby no particular strength of belief should be imposed.

When decision making is particularly complex, a sequential process of structuring and restructuring are beneficial. This process should be flexible and

¹⁹⁴³ BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. Yale Law Journal, pp. 1535-1681.

dynamic. In Chapter 7.2 an example for the structuring of toxic tort is elaborated.

7.1.6 Coherence as a basic need

Referring to the need to choose firstly a method to discover the facts of the case and secondly to select the relevant possible or probable links between these facts and the damage, incoherence is a real threat to the toxic tort litigation.

Coherence is linked to the rule of law, and more specifically it supports several principles of that rule of law. All persons, institutions and entities, including the State, are accountable to laws that are equally enforced and independently adjudicated. Equality before the law, accountability to the law, fairness in the application of the law, legal certainty, avoidance of arbitrariness and procedural and legal transparency are fundamental.¹⁹⁴⁴ This principle is internationally recognized, also by the four countries in the study.

Coherence does not imply that decisions should be the same, but it refers to a red line across all toxic tort cases. This line should consist of respect for and adherence to the relevant principles. What leads to the following question: what principles? These should be the principles of the category of tort in which the liability for the chemical is claimed.

Principles in relation to proof of causation cannot be fixed into a formula. In view of the in many cases persisting uncertainty, the basic principle could be that the court should be convinced of the rightness of its conclusions and should carefully explain and communicate its arguments and basis for these conclusions. In fact this suggestion clearly aligns with the rule of law.

7.1.7 Concluding remarks

Today's risks are inherent to our way of life. This does not imply that risks should not be controlled. Damage as the materialisation of risk should be managed and whenever possible be prevented. But damage does occur.

When recovery for such damage is sought through toxic tort, some hurdles have to be taken.

¹⁹⁴⁴ The description of the rule of law is based on the consultation of different definitions, but namely on the one as adhered to by the United Nations.

The deficiencies of the *conditio sine qua non* test for find the factual circumstances in toxic tort led to the development of more suitable tests. Both the substantial factor and the NESS test are good alternatives, but the latter is the best. The NESS test is however still considered complex, and not much used in practice.

Having said that, both tests focus on the factual circumstances of a case, but are not totally free of judgment and interpretation. One can declare that describing the factual situation of a tort case is always prone to perception and human knowledge. Indeed, but the fact that neither theory tries to hid this aspect of the identification of the circumstances, is an advantage to theories that claim to consider all. Moreover, the former is not possible because of the (infinite) number of possible causing facts. A conscious selection is better. The NESS test scores better on this than the substantial factor test and is thus preferred.

But also with these new methods, the discovery of causal links will be, because of the uncertainty in toxic tort, partially based on common sense or intuitive thinking. In itself the conscious use of common sense is not wrong, and certainly helps when 'belief' is necessary in the search for the truth as hidden in the evidence and facts. On the other hand, common sense is not the best tool in toxic tort. Due to the complexity of such case, the use of common sense increases for reasons of convenience. In such complex circumstances recourse to intuitive thinking leads to errors. The evidence needed in the case should be primarily based on scientific knowledge and research. Keeping the former thoughts in mind, a next step is taken: what practical advises help courts in complex toxic tort. This part of the study aims at giving an idea of what is and what can be, with all the restrictions and limitations a researcher has. As in other sciences, these conclusions are not cut in stone, but hopefully a step forward in meeting the challenge that chemicals create to human health.

The former observations can give the impression that toxic tort is a separate category of tort. It is not. Toxic tort can be found in all categories of tort. The distinction is based in the particular challenges, especially concerning the proof of causation. Science is an essential partner in toxic tort cases.

What science is most frequently used in toxic tort? The answer is undoubtedly epidemiology and statistics. Of course epidemiology uses statistics in order to find association between exposure and injury or disease.

Evidence is delivered by experts, who submit conclusions based on specialised research. Both experts and conclusions should be of high quality and high reliability. Judges will have to assess this. This is a particular challenge for the judicial system. After all experts are appointed to assist when the courts lack knowledge. But the same courts have to evaluate the expert and the expert's evidence. Logically all four countries exercise some quality and reliable checks. Mostly these audits relate to experience, education, and methodology. However, the US have a formal system. The trial judge has to evaluate expert and scientific evidence on its methodological reliability before the information is admitted in the substantive proceedings. In practice the distinction between method and content is difficult to sustain. That, combined with the lack of scientific knowledge judges normally have, leads to errors. The system is thus not without discussion, but the formalisation of the assessment has its benefits. The quality of the process could still be improved by educating judges in the basic aspects of science.

Statistics and science are nowadays regularly misinterpreted and misunderstood by the courts.

Because of all these challenges and the persistence of uncertainty, courts will have to base their decision on what they are convinced of, what they believe happened. Belief can be a difficult concept, at least in some countries. France does not have much problems with it, using the concept of '*intime conviction*'. The Netherlands have their reasonable attribution and the UK use the concept of the ordinary man and fairness.

The US, on the contrary, attempts are made to translate belief in to numbers. The essence of this quantification is the incorporation of several individual aspects of the plaintiff into a statistical formula on probability. The result is consequently called: belief probability.

This approach can be compared with the tool of differential diagnosis as used in medicine, but without the numbers.

There a quite some diverse approaches and coherence in toxic tort litigation is a real challenge. Room for improvement is available in all four countries.

Coherence can be achieved by setting high level principles that are usable in as many as possible circumstances.

First of all, toxic tort should abide by the principles of the category of tort in which the claim is filed.

Secondly, in view of the persisting uncertainty, courts should be convinced of the rightness of their decisions and should carefully explain and communicate their arguments and the basis for these conclusions.

On the basis of these observations, some advices are given in the following chapters. These would make the discovery process more manageable and more transparent.

7.2 Facilitating the process

7.2.1 Structure helps to see the wood for the trees

Toxic tort is not only challenging in the factual and legal substantive aspects, but the complexity frequently leads to confusion, misunderstandings and errors.

Structuring can remediate these flaws to a certain, but significant extent. It increases transparency and understandability. This is no different for causation in toxic tort. Categorising causation makes the complex toxic tort case manageable and more transparent, what on its turn facilitates conclusions.

All legal systems require proof of factual causation: can the chemical cause the harm (general causation) and did it cause the harm to the victim (specific causation). Since the answer to the factual questions is in toxic tort rarely sufficient to base a decision of liability on, it is equally useful to make a distinction between cause-in-fact (factual evidence) and legal cause (the normative appreciation of evidence).

Four situations can be identified.

	Cause-in-fact	Legal cause
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General causation	x	-/+
Specific causation	-/+	x

X = strong link, -/x = weaker link

The matrix is a bit artificial, but one can assume that general causation is mainly related to factual findings. Specific causation is ideally also based in facts, but in toxic tort the legal cause is important for liability decisions in the individual case.

In standard tort cases the court first appreciates the facts and the evidence of causation and then reaches a decision that is/can be influenced by legal policy, value, interpretations.

Causation is linked to the factual situation. Can the chemical cause the disease? Was the plaintiff exposed? Did the exposure result in damage? However, except for signature diseases, causal uncertainty is present when chemicals are thought to be the cause of harm. Hence the use of statistics and probability.

General causation can be proved by epidemiological research, namely when an association between a chemical and a condition is found using statistical calculations. These statistics are considered factual: a relative risk of more than 1 demonstrates an association between a specific exposure and a specific result.¹⁹⁴⁵ The appreciation of the quantitative association in relation to the existence of a causal link is less factual. For example, the Bradford Hill Criteria, uses factors like plausibility and analogy. Or the transfer of conclusions based on *in vivo* toxicological experiments to humans. Therefore the table shows for general causation a strong link with the factual situation, but also a weaker link with legal cause.

Concerning specific causation, the factual circumstances also need to be proved, which is difficult because of the particularities of toxic tort, like harm occurring long after the moment of exposures, multiple exposure, background exposures, etc. But even when exposure is proved, group based evidence cannot simply be used for proving an individual causal link. The plaintiff might belong to the group

¹⁹⁴⁵ Calculations based on the frequentist method are part of the cause-in-fact. Not all statistical methods are considered as factual prove. One such method is based on the Bayesian Theorem.

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that got the disease from the exposure, but he might as well belong to the group whose disease was caused by another agent. In this matter many courts err.¹⁹⁴⁶ Following examples will make clear why.

Several courts claim that more than 50 % of lung cancers in a population are caused by smoking, then the cancer of any smoking individual is more likely than not caused by smoking.

This conclusion is incorrect.¹⁹⁴⁷ The plaintiff, who has to prove his specific causation, is already 'chosen'. The (group) probability has disappeared. The plaintiff is or is not harmed by the chemical, regardless of the probability that the chemical can produce the damage.

Since evidence of general causation can in principle not be used as proof of causation between the exposure and the plaintiff's harm, toxic tort is considerably influenced by policy, which on its turn is influenced by culture and societal value.

The reasoning is visually presented in the table below.

	Cause-in-fact	Legal cause
General causation	Epidemiology: association between chemical and harm in populations and groups Statistics: probability calculations	Setting of threshold limits like relative risk of 2 or more likely than not Evaluate association as cause, for example using the Bradford Hill criteria
Specific causation	Experiments weight of evidence, differential diagnosis Probability based Bayesian Theorem	Transfer of experimental findings to humans Belief probability: preponderance of evidence

This table is of course not all inclusive.¹⁹⁴⁸

¹⁹⁴⁶ For the context see paragraph 6.2.3.1.

¹⁹⁴⁷ See the example in paragraph 6.1.3.1.

¹⁹⁴⁸ This diagram makes abstraction of the fact that most factual evidence also requires judgement and interpretation. For example: probability is accepted as factual, but it can

The mapping in the table reflects on how the separate items are generally perceived. Evidence can be gathered by the methods referred to in the table. That evidence should explicitly connect all the logical inferences in a coherent structure.¹⁹⁴⁹ Then a conclusion can be drawn following a sequence of inferences. Logic and reasoning benefit from this exercise.

This does not mean that legal practitioners should search for factual certainty (as opposed to probability). Their belief certainty can be made explicit and communicable by documenting the thought process.

“Understanding science as a process of idea construction rather than mere description makes it possible for a judge to examine the logic of the ideas about which the expert proposes to testify and how those ideas are rationally related to what they are intended to show.”¹⁹⁵⁰

When working with statistics and proving causation on the basis of probability, the two-step approach of general and specific causation is advisable. It enables the court to organise and evaluate evidence in line with its relevance and structures at the same time the search for proof of causation, whilst making the process transparent. It also makes the decision mode justifiable: factual and normative.

Knowing how to structure proof of causation, the next item concerns a topic that is basic in for the interpretation and use of scientific evidence. Legal practitioners and scientific specialist should understand each other.

7.2.2 Science and law: one world, two realities

Besides the differences in thought processes and languages, there are other distinctions. The characteristics of the evidence searched for, the use of the findings, the values that support the system and the objectives. The table below summaries these.

be doubted if the Bayesian Theorem with the inclusion of additional factors, like e.g. life style, is pure factual. The same remark goes for differential diagnosis.

¹⁹⁴⁹ This analysis is based on research in reasoning and argumentation. It is only briefly quoted here with the objective to demonstrate that it is really necessary to become aware of unconscious heuristics when dealing with such complex causation issues as present in toxic tort. WALTON, D. (2000). Argumentation and theory of evidence. In *New trends in criminal investigation and practice* (pp. 711-732), pp. 718-723 also available on www.dougwalton.ca/papers%20in%20pdf/00argumentation_evidence.pdf.

¹⁹⁵⁰ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1591.

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PART VII – A joint effort to make toxic tort work

	Law	Science
Persuaded by	Experience, specific events, information	Systematic, replicable, observation and experiments
Use of evidence	In function of the claim, seeking certainty	Critical, trying to rebut, falsity
Perspective	Truth as the ultimate goal, lasting knowledge and decisions	Knowledge and understanding, doubt and scepticism, welcoming new discoveries and questions

Legal certainty will always differ from scientific certainty. However, the role of science and toxic tort law also differs. It is important to be aware of the particularities of both sides before one can understand and appreciate the required proof of causation in toxic tort cases.

Science or *scientia* refers to knowledge. It is a systematic activity that builds and structures knowledge in the form of testable explanations and predictions. Science is always open to falsification if new evidence is presented. Human knowledge is fallible. It is a search for knowledge, not for certainty.

Theories vary in the extent to which they have been tested and verified, as well as their acceptance in the scientific community. Whatever the scientific conclusion it is always possible that it will be refuted. Scientific conclusions can be dropped at short notice.¹⁹⁵¹ The legal inquirer should try to accept the genuine doubt rather than resort to uncritical common sense.¹⁹⁵²

Tortious liability shifts a loss caused by one party to another party on the basis of the latter’s responsibility for causing the damage. This is the essence of tort.

¹⁹⁵¹ HARTSHORNE, C., & WEISS, P. (1931). *Collected Papers of Charles Peirce*. Cambridge: Harvard University Press, § 120.

¹⁹⁵² HARTSHORNE, C., & WEISS, P. (1931). *Collected Papers of Charles Peirce*. Cambridge: Harvard University Press.

Further elaborations of tort differ, not only in line with the doctrine adhered to, but also in the practical applications of tort.

Law and economics, as a functional theory, focuses on maximizing wealth and minimizing costs. Victims should be efficiently compensated and further wrongful behaviour should be deterred. The application of this doctrine minimises the social costs as the sum of precautionary measures and expected harm. Mathematics have been developed, like the Learned Hand formula, the Kaldor-Hicks efficiency and the Pareto efficiency, but are rarely used in practice to calculate the optimum, because of their complexity and the workload they create time-consuming.¹⁹⁵³

Corrective justice, as an interpretative theory, aims at correcting harm done by one party to another. The normative ground is the duty to redress and rectify wrongs. Both rely on proof of causation.

7.2.3 Statistics and science cannot be ignored

It would help if judges have a basic understanding of scientific reasoning, and could appreciate the figures and conclusions provided by scientists as the certainty or the 'more likely than not' of the moment. Accepting that together with an increase of scientific knowledge and experience might change things. Indeed, in the UK and France, both countries tending to a dominance of the justice doctrine, the use of scientific evidence, like epidemiology is rare. Except when an important number of claims consider one specific chemical, then science is more present.¹⁹⁵⁴

The US like figures and other quantitative results. Their preference for law and economics supports the use of science in court, the proportional calculation of liability and the importance of deterrence and cost efficiency. Science is regularly used, but the understanding of it still leaves quite some room for improvement. On the other hand, many efforts are undertaken.

On the other hand it would also help if scientists explained their thought processing to non-scientists in an understandable manner, based on knowledge of the legal reasoning.

¹⁹⁵³ See the Learned Hand formula, the Kaldor-Hicks efficiency and the Pareto efficiency in paragraph 2.1.1.1

¹⁹⁵⁴ Examples are asbestos and vaccines.

PART VII – A joint effort to make toxic tort work

This brings us to the third chapter: helping judges and courts with the toxic challenges.

PART VIII. From simple solutions to more profound changes

8.1 Summarising essentials

Following are observations linked to the research questions of this study. They are based on the view that toxic tort is not a separate category of tort, but runs across different torts.¹⁹⁵⁵ Consequently the text is valid for standard tort, strict liability, negligence (including fault), and intentional tort for as much as they are related to personal injury.¹⁹⁵⁶

Although the legal system and the culture differ amongst the four countries included in the study, there are many similarities in the essential aspects of (toxic) tort. In the following paragraphs the conclusions are overall valid for all four countries, except when stated otherwise.

8.1.1 Is the actual tort system up to the challenge posed by toxins?

Based on the results of the research and the observation of the bottlenecks encountered in toxic tort, the actual tort system as such is usable. Several arguments support this conclusion.

8.1.1.1 Objectives of tort

The objectives of tort, as defined in the doctrine of law and economics and in the justice doctrine, mainly corrective justice, are also the objectives of toxic tort.

Objectives are driven by society. Two societal trends have a particular influence on toxic tort. First, there is the economic importance of chemicals and chemical industry. This leads to an important role for deterrence and cost effectiveness. Although damage by cause by chemicals also leads to a focus on fairness and equity. The attention given to the objectives of tort differ amongst the countries: France and the UK are especially focussed on (their appreciation of) justice and

¹⁹⁵⁵Since tort is about damage, risk liability, in the sense that the risk creation did not result in a material damage, is not included in this study.

¹⁹⁵⁶ Nuisance is thus excluded. Furthermore, assault, battery and intentional torts are not mentioned explicitly, but are analysed. The reason for omitting these in the text is twofold: the distinction between the types of tort is particular for the Common Law system, and especially the US, and the nature of the tort has no fundamental bearing of the proof of causation as demanded in tort.

fairness, whilst the US is much more 'law and economics' oriented and the Netherlands blend some law and economics with an important part of justice.

However, culture and doctrine differ from the practice. Courts mix both doctrines and the resulting decisions on uncertain causation in toxic tort are quite similar across all four. The distinction is mainly found in the process. The former is not illogical. It does not matter where a chemical causes damage, neither will the toxic properties and the alleged or potential injuries resulting from exposure differ between countries or legal systems.¹⁹⁵⁷

Secondly the preferences for certain categories of liability differ. Strict liability is, for example, a tort system that is most frequently used in France, because societal norms request the protection of potential victims against an unbalance based on financial means, knowledge and experience that would occur between the defendant and the plaintiff. Or in the US claims are typically based on several categories of tort at once. These differences have no impact on toxic tort, not being a separate category.

Last but not least, tort and toxic tort is about a specific party causing damage to another specific party. Through tort chemical use, distribution or safety cannot be regulated. That is the role of policies and legislation. Tort can influence societal behaviour and thereby have an impact on the evolution and social norms of a society. Class actions have a special influence, mainly because of the number of parties involved. When courts rule in these cases, the decision hints towards policy. Those decisions have a direct impact in Common law systems. In Continental law a legislative initiative would still be necessary to achieve public impact of a class action decision. Both the Netherlands and France have created policies and regulations concerning diseases resulting from exposure to asbestos, DES and infections after blood transfusion after these topics were decided in court.

8.1.1.2 Evidence of exposure, causal link and damage

These three elements always need to be proved.

¹⁹⁵⁷ The location can have an impact on the damage caused by the chemical in the sense that (for example) living nearby a chemical plant or in a rural area can be relevant.

a) Exposure

Other tests than the *conditio sine qua non* have been developed in order to remedy the failure to show with certainty what exposure took place. Both the substantial factor test and the NESS test succeed in pinpointing (alleged) sources of the exposure allegedly having caused the damage. Both tests require factual observations.

This can be particularly difficult in toxic tort cases: neither do most chemicals leave a trace of their passage through the human body, nor is their presence always visible. The first situation does not exclude the proof of exposure, the second can block a claim if exposure is in no way provable.

b) Proof of causation

Having proved exposure, the quest for the truth has not ended. Did the chemical cause the harm? This is the area where toxic tort differs mostly from other torts. The distinction between cause-in-fact and legal cause plus the distinction between general and specific causation support the analysis and reasoning. These four concepts are elaborated as valuable means to arrive at defensible decisions in chapter 7.2. The importance of a structured approach and defined phases in the search is considerable. In fact, project management tools can be used.

It is stated before: toxic tort needs science. Consequently judges and lawyers are (involuntarily) confronted with a non-familiar area of knowledge.

“I know for me, I'm a lawyer because I was bad at [science and math]. All lawyers in the room, you know it's true. We can't add and subtract, so we argue.”¹⁹⁵⁸

This is not my saying, it is Michelle Obama's. She expresses what many scientists and some judicial trained people might think. However, there are of course exceptions, but the majority of legally trained people are not familiar with science. Why would they? It is not their profession. They can always call in the experts.

¹⁹⁵⁸ Remarks by the First Lady at the National Science Foundation Family-Friendly Policy Rollout, 26 September 2011, www.whitehouse.gov/the-press-office/2011/09/26/remarks-first-lady-national-science-foundation-family-friendly-policy-ro.

Calling in the scientist does not solve the problem. Courts should understand at least the basics of the methodology these experts are working with. Courts should also – to a certain extent – be able to evaluate the conclusions submitted by these experts.¹⁹⁵⁹ Solutions to counter these difficulties exist: education, guidance, pre-trial discussions, specialised courts.

Despite the implementation of solutions, an important challenge cannot be eliminated: the inherent uncertainty of scientific evidence concerning causation in toxic tort.

c) Damage

Damage is in some cases also an issue. The establishment of an actionable harm is necessary. Discussion on what harm exactly is relates to the observation of the injury (subcellular, emotional) and the noxious character (pleural plaques, genetic change with or without impact on the condition of the plaintiff).

Increased detection of changes by new scientific means increases the amount of questions on the qualifications of the damages as innocent or noxious. This topic is not analysed in great detail in this study. The analysis of what is considered damage and what not is in itself not part of this study. It is an interesting area that would benefit from investigating, since litigation is not coherent on this issue and courts often lack the competency and means to decide in the matter.

For this research the focus is on uncertainty in the delivery of causal evidence and in the use of science to solve the issues in a way that judicial decisions within the objectives of tort are possible.

8.1.2 Important principles for working with toxic tort

Toxic tort should respect the basic principles of tort and the specific principles of the category of tort whereto the claim belongs. Some of these principles are however specifically important toxic cases and will be discussed.

8.1.2.1 No judging by hindsight

It is important that the case is judged by the standards that existed at the occurrence of the tortious act. With the often long time periods between the act and the development of the concrete damage the danger is that courts judge the

¹⁹⁵⁹ For the challenges of assessing and evaluating scientific evidence and experts, see chapter 5.1 and paragraph 7.1.3.

defendant by the standard of the time the claim. The danger of judging by hindsight is real since science evolves rapidly. What is known now, is not what was known at the time.

In combination with the former, a court should also be aware that the assessment of the knowledge that can be expected of a defendant should happen in reference to the correct time frame, but also in relation to the position the defendant was in at that time of the (alleged) wrongful act.

8.1.2.2 Take the victim as you find him

A negligent defendant is liable to a foreseeable victim for foreseeable damage. Unforeseeable damage is not leading to liability.

However an exception to the former is accepted. The eggshell principle states that a defendant is liable for all the damage caused to a particularly vulnerable victim. For a more detailed elaboration of this principle, see paragraph 2.3.3.2, a) iv).

'Particularly vulnerable' was defined compared to the ordinary man and as observable. Again the evolution of scientific methods and knowledge has an impact on this. Proving that a plaintiff is genetically vulnerable for the disease that he developed is increasingly possible and can then be reported in court.

Genetic susceptibility can be (mis)used on both sides. A defendant can claim that the damage was not foreseeable, and the plaintiff can prove a causal link between his pre-condition and the exposure to the specific chemical.

At this moment few court cases in toxic tort had to deal with this type of arguments. It is thus not possible to analyse the opinions and decisions of courts in this matter in a reliable manner. Nonetheless it is very likely, nearly certain that in the future it will become an interesting topic for research.

8.1.2.3 An entitlement to correct litigation

All persons should be equal before the law, accountable to the law, but all are also entitled to fairness in the application of the law and to avoidance of arbitrariness. Therefore procedural and legal transparency are fundamental.¹⁹⁶⁰

¹⁹⁶⁰ The description of the rule of law is based on the consultation of different definitions, but namely on the one as adhered to by the United Nations.

All four countries recognise these elements of the rule of law. In practice they do not all respect them. France lacks in legal certainty (cf. the saga of Court of Cassation in paragraph 5.2.2.2), detailed motivation and transparency (cf. the sufficiency of the 'intime conviction' of the judge without requiring detailed motivation on his reasoning). In that matter the Netherlands are quite the opposite: solid motivation is obliged. Similarly the UK and the US motivate their decisions. One remark on the US though: appeal against the courts of first instances is only possible on questions of law.

An elaborated motivation in toxic tort is essential, not only for the Rule of Law, but also because of the uncertainty linked to toxic tort. Judgements are linked to 'belief'; solid motivation makes such decisions transparent and more acceptable. This is not a 'new' principle, but one that in toxic tort should be stressed and improved when not yet up to a qualitatively high standard.

8.1.3 How should causation then be proved?

The answer is lengthy and without a *deus ex machine* solution. Several proposed solutions can be put together to make the toxic tort challenge more manageable and give the resulting decisions a more solid basis than could be achieved by applying traditional approaches.

The following chapter contains several ideas and suggestions on this matter.

8.2 Suggestions for improvement

Knowing what facts to consider and how to structure proof of causation, the focus is now on the process. What scientific methodologies will be used in court? How will the evidence be delivered? Are there any suggestions that make the complexity of a toxic tort case more transparent?

8.2.1 Increase understandability and understanding

8.2.1.1 Basic communicative requirements

It is said that legal practitioners should get some basis in scientific education. That they should learn to understand the scientific logic and communication. As already mentioned in paragraph 7.2, communication is a reciprocal effort. Scientist and other specialists should as well make an effort to understand legal

reasoning and explain their findings and logic in a manner understandable for courts.

One important focal point is thereby the fact that law thinks dichotomous: either something is true or it is not, somebody is liable or he is not, X has caused Y or not. Science allows uncertainty taking into account several plausible answers, but scientists should be clear on what is more likely than not on the basis of the scientific state of affairs at the time of the case or at the time of the exposure in cases with long latency periods (e.g. mesothelioma).

Transparency of the expert's reasoning process/logic is essential.¹⁹⁶¹ This includes an explanation on how the expert reached his conclusions. The expert should also be willing to explain his logic and reasoning.

Experts should assist the court in reading reports and understanding the scientific conclusions. Judges or a courts should however not become passive, they have an active role to perform in finding the best answers to scientific questions and resolving the case.

Perfect matches between legal questions and scientifically tested hypotheses are unlikely. The susceptibility of different individuals to a particular toxic effect are far more complex than variations in, for example, a single gene. Scientific research will rarely, if ever, match a plaintiff's circumstance in all aspects. A scientist should be able to explain why a certain opinion is also valid for a specific victim of toxic tort. A perfect match should not be required. However, beyond that it is unavoidable for the court to rely on the expertise and the trustworthiness of the expert.

On the other hand, at least a basic understanding of relevant sciences by courts and lawyers is necessary. It is unrealistic to demand that an expert has to start his explanation and testimony with explaining his science from scratch. Therefore judges should be aware of scientific methodologies and of the general state of knowledge in areas of science relevant for toxic tort.¹⁹⁶² It is thereby not the objective to make judges scientists, but a basic understanding of scientific methodology and reasoning is advisable. Likewise it would be useful if scientists would become familiar with legal thinking and procedures.

¹⁹⁶¹ For aspects of reasoning see SJERPS, M., & BERGER, C. (2012, Vol. 12). How clear is transparent? Reporting expert reasoning in legal cases. *Law, Probability and Risk*, p. 319ff.

¹⁹⁶² See paragraph 7.5.

Last but not least experts anyhow filter the information they communicate, often with the intention to keep things clear. It is advisable to keep in mind that the expert has more information than he shares. The court should ask questions and make sure that the data are fully disclosed. Additionally, parties should be allowed to question the expert on his filtering of information. This is even more important since details that at first seemed unimportant can become crucial during the process. Jumping straight from the results to the conclusion is a bridge too far.¹⁹⁶³

Legal practitioners should make use of the tools and support that exist or that hopefully will be created if they do not exist. For ideas see for example paragraph 7.5 of the study.

8.2.1.2 Handling scientific reports and managing experts

The reliability of scientific evidence starts with the methodology used. This is the aspect of experts and their expertise that is most understandable for laypersons. It is also that aspect that is most audited, together with the (closely linked) qualifications and experience of the expert. (See paragraph 5.1.3 and 7.1.3)

But what if there are contradictory conclusions submitted, whilst methodologically all is correct? Courts should be able to check the substantive validity of the evidence at a minimal level. In the following paragraph some suggestions are made that ameliorate the assessment of content.

a) Assess scientific evidence on its logic

Assessing the logic of a reasoning gives an indication of the reliability of conclusions.

Logic is a common feature of legal and other sciences. Judges can use logic as the correctness of argumentation when assessing scientific opinions. Correct argumentation is the interdisciplinary study of how conclusions can be reached through logical reasoning. Typically an argument has an internal structure, comprising of a set of assumptions, a method of reasoning and a conclusion or point. Conclusions should follow logically from arguments.¹⁹⁶⁴

¹⁹⁶³ SJERPS, M., & BERGER, C. (2012, Vol. 12). How clear is transparent? Reporting expert reasoning in legal cases. *Law, Probability and Risk*, p. 325. Despite the fact that this article is about forensic science, many aspects are transferable to toxic tort.

¹⁹⁶⁴ See for more information: <http://plato.stanford.edu/entries/logic-ontology/>

“Understanding science as a process of idea construction rather than mere description makes it possible for a judge to examine the logic of the ideas about which the expert proposes to testify and how those ideas are rationally related to what they are intended to show.”¹⁹⁶⁵

b) Use valid assumptions to fill analytical gaps

It is the nature of probability and of research that characteristics are generalised. But an individual plaintiff is not completely the same as the subject of the research or as the participant in the epidemiological study. There are gaps to fill. These gaps should be filled in by the expert and clearly explained on the how and why of the assumption.

c) Thinking outside the court room: an opportunity for scientific clarifications

The more specialised and thus the more challenging to understand the submitted evidence is for the non-scientist judge, the more difficult it becomes to take a decision on quality and duly motivate it. Recourse is then easily made to formal aspects like completeness, credentials of the expert, even demeanour. In complex cases, the court should not refrain from asking explanations and require that experts communicate in an understandable manner.

The Dutch ‘preliminary expert report’ is in this matter a useful tool. An expert performs a preliminary study and collects evidence with the objective to define the correct basis for the claim.¹⁹⁶⁶ The study can also pinpoint any scientific evidence that needs more explanation and/or further investigation, and/or should be more clearly communicated.

It looks similar to what US trial judges have done in order to perform better when assessing sciences. These judges have organised pre-trial conferences and pre-trial hearings with (potential) experts on the subject of the claim.¹⁹⁶⁷

The former is not the same as assessing the belief probability of the evidence. This is still a task for the court to perform in official procedure.

¹⁹⁶⁵ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1591.

¹⁹⁶⁶ Hoge Raad 13 September 2002, LJN AE3345, *Nederlandse Jurisprudentie* 2004/18, note of H.J. Snijders.

¹⁹⁶⁷ Stephen Breyer, Associate Justice of the Supreme Court of the United States in KASSIRER, J., & KESSLER, G. (2011). *Reference Manual on Scientific Evidence*. Washington: Federal Judicial Center; National Research Council, p. 6.

d) Transdisciplinary committees on local, regional or higher level

In the US with his multiple toxic tort cases, the judiciary began to look for methods to improve the quality of the science on which scientifically related judicial determinations will rest. Interdisciplinary working committees and co-operations were the answer.¹⁹⁶⁸ Such collaboration bring additional knowledge to the proceedings, but also increases mutual understanding.

The Committee on Science, Technology, and Law is an example.¹⁹⁶⁹ It brings together

“the science and engineering community and the legal community to explore pressing issues, improve communication and help resolve issues between the two communities. [...] A major activity for the program has been the convening of a distinguished committee chosen for their knowledge and expertise and who represent a wide range of organizations including federal courts, the legal community, industry, academia, and government. [...] the committee meets twice a year in a neutral and non-adversarial setting to discuss critical issues at the interface of science, technology, and the law; to promote understanding; and to develop imaginative approaches to solving problems of mutual concern.”¹⁹⁷⁰

Let me suggest that a similar initiative could be taken at European level. It might be a task for the European Academy of Sciences and Arts, in whose vision and tasks no reference is found to law, neither could any activities beyond one on Law and ethics in 2008 be found, at least not on 13 April 2014:¹⁹⁷¹

“Future-critical topics such as environmental damage through *technology* and *industry*, *genetic engineering*, *economic globalization*, boundaries of *medical technology* are discussed at symposiums, congresses and on *interdisciplinary*, *scientific working parties*. Ethical principles in scientific discussions are fundamental. No one topic is discussed abstractly, but its

¹⁹⁶⁸ For example: The Federal Judicial Center is collaborating with the National Academy of Sciences through the Academy’s Committee on Science, Technology, and Law.

¹⁹⁶⁹ A recent project, ahead of the issue becoming a problem is their forum for discussions about scientific, technical, ethical, legal, regulatory, security, and other policy issues associated with synthetic biology.

¹⁹⁷⁰ <http://sites.nationalacademies.org/PGA/stl/index.htm>.

¹⁹⁷¹ The European Academy of Sciences (EURASC) is purely focussed on science and technology. Therefore it is not mentioned as a potential candidate for a ‘committee on science and law’.

PART VIII – Solutions and changes

impacts on cultural, ethical and consensual values and developments are always considered. Science and research are viewed in terms of their autonomous freedom and, conversely, in terms of their possible dependence on commissioning authorities, economic constraints and humanitarian objectives. The influence of globalization and of worldwide information and communication aesthetics is also critically discussed.¹⁹⁷²

e) Reference manuals

Many scientific guidances exist in the US. The Reference manual on scientific evidence is one good example. It is written by a transdisciplinary team, and specifically aimed at helping legal practitioners in their close encounters with science.¹⁹⁷³ Several topics are covered. For example statistics. Subtopics are data collection and the explanation why the design of a study is the most important determinant of its quality, information on the various kinds of study concerning their usefulness, basic statistics, and the logic of statistical inference, emphasizing foundations and disclosing limitations.¹⁹⁷⁴

The focus is on the important scientific and technological disciplines likely to be encountered by courts. Thereby it is stressed that the reference guides are not meant to instruct courts, but to assist them with managing cases involving complex scientific and technical evidence.¹⁹⁷⁵

Such manuals are helpful, but maybe too elaborated for use in the Continental Law system and the UK, because of their mainly court appointed experts and the active inquisitorial role and high authority of the judges. This is an important difference with the rather passive role of the US judge. Still, the development of guidances adapted to the particularities of a system is recommended.

¹⁹⁷² (Emphasis added), www.euro-acad.eu/about-the-academy/duties-and-responsibilities (accessed on 13 April 2014).

¹⁹⁷³ KASSIRER, J., & KESSLER, G. (2011). *Reference Manual on Scientific Evidence*. Washington: Federal Judicial Center; National Research Council.

¹⁹⁷⁴ KAYE, D., & FREEDMAN, A. (2011). Reference Guide on Statistics. In J. KASSIRER, & G. KESSLER, *Reference manual on scientific evidence* (pp. 211-302). Washington: Federal Judicial Center & National Research Council of the National Academies, p. 213.

¹⁹⁷⁵ WHITACRE, D., & EADS, K. (2013). *Defending Pesticides in Litigation*. www.Westlaw.com: Thomson Reuters.

It is the practical approach towards the tasks of the judicial system in toxic tort that the cultural differences are the most obvious.¹⁹⁷⁶ The appointment of experts by the court reduces the need for such elaborated and multiple manuals, although some reference manual would be useful in the three countries of the study outside the US.

8.2.1.3 But, what if experts disagree and present contradictory evidence?

Who to believe? Complicated philosophical discussions are held with the purpose to find a method helping the scientific layperson to choose the truth when experts are contradicting each other. Most of these discussions will not be repeated. This study focusses on pragmatic solutions. Still, two proposed ideas are worth mentioning.

The first states that a non-expert should believe the testimony that is supported by the scientific community and delivered by the person who is less likely to be biased.¹⁹⁷⁷

The second is a bit more complicate. That approach focusses on evidential sources that can be used by non-experts to determine which expert to believe.¹⁹⁷⁸ Some of these 'sources' are quite evident. The first refers to the arguments the experts present as support for their opinion. The second considers an additional agreement of other expert(s) for one of the conflicting opinions. The third option consists in the consultation of 'super' experts, who could solve the dilemma. 'Super' experts are those experts that have a particularly solid and respected expertise in the area, or are linked to highly valued institutions. The Fourth is an option that requires some insights in the relevant scientific domain and the curriculum of the relevant experts, namely the expert is assessed in relation to his potential bias in relation the issue.

¹⁹⁷⁶ For example. Another interesting manual is the Annotated Manual for Complex Litigation. This guidance is a logical consequence of the role US courts have in their Common Law system. Detailed instructions on how to plead, how to organise a defence, etc. are not rare. Sometimes they are even elaborated for a typical subject, for example when it is regulated in a specific act. The 'manual' on 'Defending Pesticides in Litigation' is a good example thereof. See HERR, D. (2013). Annotated Manual for Complex Litigation. www.Westlaw.com: Thomas Reuters.

¹⁹⁷⁷ JONES, W. (2002, Vol. 36). Dissident versus loyalist: which scientist should we trust? *The Journal of Value Inquiry*, pp. 511-520.

¹⁹⁷⁸ GOLDMAN, A. (2001, Vol. 63). Experts: which ones should we trust? *Philosophy and Phenomenological Research*, p. 89.

Still:

“whenever a non-expert is called to make a decision between conflicting scientific testimonies under these conditions (roughly equal sincerity and credentials), his decision will inevitably be arbitrary from an ‘epistemological’ point of view, and then [...] will be arbitrary from a ‘legal’ point of view.”¹⁹⁷⁹

Thus the issue is still not solved? The rule of law requires epistemic non-arbitrariness in legal reasoning.¹⁹⁸⁰ If a court cannot decide who to believe in a way that is not non-arbitrary, then the choice is not legally justified.¹⁹⁸¹ Furthermore such a decision breaches the norm of intellectual due process. The conclusion of Ribeiro is that:

“in the face of conflicting scientific expert testimonies, one possible route [...] is to accept that what counts as a good criterion varies according to context. [...]. We should admit fallibility.”¹⁹⁸²

Above information retrieved from different scholars, leads me to refer to the belief probability, on condition that the belief probability and the related inference are based in a solid insight of the case at hand and the science used. Furthermore it is not because experts draw diametrically opposed conclusions, that a study is not valid. It frequently only means that the experts have filled in the gaps, which are always present in research, with different assumptions.

Summarizing: in order to assess the scientific basis of the expert's conclusion, it is necessary to examine theory, data, assumptions, methodology and legal considerations.

Nobody doubts that courts want to do justice, that they take their tasks, duties and responsibilities serious. Nobody says that judges should become scientists. But still this is what de facto is demanded. Or not?

¹⁹⁷⁹ BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. *Yale Law Journal*, pp. 1535-1681.

¹⁹⁸⁰ BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. *Yale Law Journal*, pp. 1535-1681, p. 1672; RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, p. 341.

¹⁹⁸¹ RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, pp. 341-342.

¹⁹⁸² RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, pp. 341-342.

The following text includes a number of suggestions for toxic tort based on the analysis of court cases, doctrine and law in four countries.¹⁹⁸³ The suggestions are, what I believe, realistic and feasible. They will not solve the substantive elements of the issues; they will help to cope with these. After all, there is no unequivocal method or algorithm for proving complex causation in toxic tort

8.3 Toxic tort – changing perspectives

Factual appreciation of causation is considered of higher value than non-factual appreciation. Scientific evidence is seen as a better kind of evidence than inference. But even if the factual determination of causation is to a certain extent non-normative, the decision to make these facts relevant is normative.

As we have seen before in this study, many causal facts can be identified when searching for the link between a chemical and a disease. One theory has even been developed just for managing this multitude of causal facts, namely NESS. Whenever a lawyer or a judge appreciates the factual situation, he will do that in an empirical manner (non-normative) and with an appreciation and a justification (normative).

We can never take into account all causal factors¹⁹⁸⁴ (not even when adhering to the theory of equivalence). Working with uncertainty, even when it is expressed in a probability figure, involves normative appreciation.

8.3.1 The limited shell life of science

Uncertainty in scientific results are most often linked to limited knowledge. As knowledge grows, existing conclusions can become void. Courts that work by the knowledge of the present time, should not be disapproved of when later on the knowledge or the assumptions are refuted. Courts should be aware of this characteristic of science, but not be paralysed by it. A careful evaluation of uncertainties and even gaps in scientific knowledge enables a justified decision if the evidence is valid or fatal for proving causation.

¹⁹⁸³ No suggestions are given for the judging in tort in general. It is assumed that legal practitioners know these.

¹⁹⁸⁴ An example. The woman walking by the field where the farmer is spraying pesticides, is exposed to the product because of the wind, the humidity in the air, the road on which she is walking, the availability of the product, the tractor, etc.

Different methods are used to persuade a court of the existence of a specific causal link. In toxic tort the most popular are: weight of evidence, differential diagnosis, and Bayesian probability calculation.¹⁹⁸⁵ Some of these methods have been refused or accepted depending on the opinion of the court handling the case. Often the refusal to accept is based in a lack of knowledge. Overall, if scientists find these methods reliable for their research, courts should not try to second-guess this.

A court should not evaluate the scientific opinions of the experts. Judges are no scientists.

But what if there is no consensus and experts differ or scientific findings are inconclusive? Then the quest for a correct conclusion becomes very demanding.

8.3.2 The quest for truth and the use of inferences

Truth is the ultimate objective. Truth is relative and influenced by the possibilities judges have to interpret the evidence and make conclusions, but the perception of truth is also reflected in the organisation of a legal system. Both are discussed below.

8.3.2.1 Organisational tools for truth finding: culturally dependant

In the US with its adversary system the court will find for the party who in their opinion presents the most probable truth. In the UK and in Continental Law, the role of the court is inquisitor. The decision will consequently be made on the merits of the evidence presented by the parties.

In the UK and in Continental Law, the role of the court is inquisitorial. The decision will be made on the merits of the evidence presented by the parties.

In neither approach, a quantitative algorithm exists for making these decisions. Probability carries in itself uncertainty and error. Again a court should not be paralysed by this.

When all the experts' opinions are pointing in the same direction, then the judge can decide. He should not evaluate the content of scientific opinions of the experts. Judges are no scientists.

But what if there is no consensus and experts differ or scientific findings are inconclusive? Then decision-making is challenging. The belief about the facts and

¹⁹⁸⁵ See part VI.

substantive inferences drawn from the complete body of reliable evidence will have to be used to reach a judgement. Insights in scientific thinking, methods and communication are necessary, but finally the evidence has to be appreciated in a judicial manner. It is the duty a judge is legally assigned to perform.¹⁹⁸⁶

Summarising, a court should consider the extent and strength of the empirical support for the research hypothesis; the level of consistency within the underlying theory and with other theories, the acceptability of assumptions; the methodologically soundness; and whether each contributes toward a plausible theory.¹⁹⁸⁷

8.3.2.2 Truth per analogy

The probabilistic evidence used in toxic tort makes inferences unavoidable. Toxic tort is all about inference from indirect evidence.

Factual inferences are the basis of the legal arguments. Usually a multitude of factual inferences can be detected in any situation. In toxic tort these factual inferences require scientific knowledge.

Causation is the task of attributing cause and effect. Fundamentally, the task is in toxic tort an inferential process of weighing evidence and using judgment to conclude whether or not an effect is the result of some stimulus. Judgment is required even when using sophisticated statistical methods. Unfortunately, judges are in a less favourable position than scientists to make causal assessments. Scientists may delay their decision while they or others gather more data. Judges, on the other hand, must rule on causation based on existing information. A judge does not have the option of suspending judgment until more information is available.

A decision is only possible if scientists provide the court with an as complete as possible overview of the knowledge about the causal question in a court case. A solid inference of causation can only be drawn if experts are allowed to submit different kinds of evidence, like observational and experimental studies, but also data gathered with methods like differential diagnosis and weight of evidence.

¹⁹⁸⁶ Hoge Raad 8 July 2011, LJN BQ3514, *Nederlandse Jurisprudentie* 2011/311.

¹⁹⁸⁷ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, pp. 1596-1599.

Such an approach is not contradictory to scientific methodology. In fact it is in line with modern research methods.¹⁹⁸⁸ The court should however also explain its reasoning for choosing certain methodologies. After all inference of a causal link is not only based on science, but also on judicial policy. Acknowledgement of the assumptions used or not-used, of the thinking process and motives for coming to a decisions are to be made explicit, as it is required in the intellectual due process expected from scientists. The only way to tell if such errors are present in an expert's report or proffered testimony is to examine the information and the statistical inferences drawn from it, not for mathematical errors but for errors in logic.¹⁹⁸⁹ This exercise is in line with what judges do: analysing information.

“In the final analysis, assessment of evidence and causal inferences depend on accumulating all potentially relevant evidence and making a subjective judgment about the strength of the evidence.”¹⁹⁹⁰

In cases with contradictory expert evidence the judgement should be plausible and explanatory about the relation between the criteria and the choice which opinion to belief.¹⁹⁹¹

In non-deductive arguments, like differential diagnosis the premises can support different possible conclusions.¹⁹⁹² Again, the court has the task to evaluate the inferences and identify the most plausible conclusion.

Decision making is explanation based.¹⁹⁹³ Inferences should not only be based on scientific evidence and the opinions of experts, but also legal policy

¹⁹⁸⁸ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1584.

¹⁹⁸⁹ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1602.

¹⁹⁹⁰ KASSIRER, J., & CECIL, J. (2002, September). Inconsistency in evidentiary standards for medical testimony - disorder in the courts. *Journal American Medical Association*, p. 1384.

¹⁹⁹¹ RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, p. 299; BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. *Yale Law Journal*, p. 1657.

¹⁹⁹² See paragraph 5.1.2.4 on differential diagnosis.

¹⁹⁹³ ENGEL, C. (2009, Vol.33). Preponderance of evidence versus intime conviction: a behavioral perspective on a conflict between American and Continental European Law. *Vermont Law Review*, p. 451.

concerns.¹⁹⁹⁴ The court should solve the issue in a manner that is sufficiently justified and credible.¹⁹⁹⁵

This exercise fits in the legal cause of tort. Causation in law should mean what lawyers decide it should mean, not in the vague, but based in a thorough investigation and evaluation of the available evidence, combined with a good understanding of the relevant scientific backgrounds.

Indeed, what counts as a sufficient causal link for legal purposes is to be decided by the court alone. The fact that scientists define causation differently is not relevant. Once the court believes that the scientific evidence is reliable and supports the decision making process.

8.3.3 Transdisciplinary exposure during legal studies

It is probably a platitude to say that finding solutions and solving issue becomes more and more a matter of interdisciplinary work. But it is true and it is not different for law professionals. In the US and to a lesser extent in the UK, law firms have specialised in toxic tort. On the continent the search for such law firm was less successful. In the Netherlands four international law firms and in France seven mentioning this specialisation.¹⁹⁹⁶

It is unlikely that law firms who are able to handle toxic tort would not advertise this. After all, specialisation in this area requires quite some investment in time, studying and keeping up to date in an area that is not legal. Indeed, it is not because one knows a lot about chemical legislation and/or liability that one is an expert in toxic tort. The particularities of this tort, as discussed in the study, support this conclusion.

At this moment, in all four countries civil courts deal with standard tort and toxic tort. This not illogical since toxic tort crosses all categories of tort. It does create some challenges in relation to competencies of the judges. Transdisciplinary

¹⁹⁹⁴ Hoge Raad 8 July 2011, LJN BQ3514, *Nederlandse Jurisprudentie* 2011/311; BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1597.

¹⁹⁹⁵ RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, p. 299; BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. *Yale Law Journal*, p. 1657.

¹⁹⁹⁶ This search was conducted on the internet and gives only a good indication and the finding are not be considered as a scientific valuable.

experience can be provided during legal training.¹⁹⁹⁷ However, not every law student will be interested in getting involved in highly scientific or technological matters. The choice to specialise in this area should be voluntary.

Legal practitioners trained in working with scientific evidence will not immediately be available, and maybe never in sufficient numbers. Two solutions can remedy these shortages.

Firstly, a court can appoint specially trained law clerks or a scientist not involved in the case could assist the judge.

Secondly, a number of courts could specialise and handle the complex toxic tort cases for a region or a country. Such 'specialised' judges would be better positioned to evaluate and understand scientific evidence.¹⁹⁹⁸

The former combined with the observation that courts err in their review of complex toxic tort cases and that these mistakes can have a negative impact on the parties in the litigation, led to the idea of a specialised court. In other words, a 'standard' civil court would specialise in toxic tort.¹⁹⁹⁹ This court would then judge cases in that area coming from a region, a country or any other geographical area depending on the volume of toxic tort cases.

The idea is not to add some scientific experts to that court. Indeed, the multiple specialisation in science make it impossible to concentrate the required knowledge in one person. An expert specialised in a helicopter view on science as needed in court, does not have to be a scientist. This role can and should be taken up by the court. After all it is the ultimate responsibility of legally schooled judges to judge in matters that are more subjected to law than to science. The reasons therefore are twofold. Additionally adding a lay judge to the court for a matter needing both scientific and legal knowledge only increases costs of the system without necessity, when a sufficiently supported/trained judge can

¹⁹⁹⁷ Some US law schools provide specialisation in toxic tort: Widener University School of Law; Indiana University-Purdue University Indianapolis; Northeastern University; University of Florida - Levin College of Law.

¹⁹⁹⁸ In the US several states are experimenting with specialty courts or specialized judges within general courts devoted to complex civil litigation involving a good deal of expert testimony. MNOOKIN, J. (2008, Vol. 73). Expert evidence, partisanship, and epistemic competence. *Brooklyn Law Review*, p. 1036.

¹⁹⁹⁹ The idea has already been proposed in the US. However, in the area of judicial organisation the difference between the US and the other three countries is unmistakable. See for example: JURIS, A. (2010, Vol. 15). Science Court: past proposals, current considerations and a suggested structure. *Virginia Journal of Law & Technology*, pp. 1-48.

perform the task. Secondly, the 'science court' would specialise, but would also perform its standard tasks for as long the number of toxic tort is the jurisdiction allows it.

The 'science court' can focus on the quality of scientific research, data, and evidence or opinions submitted by litigants. A court aware of the state of the scientific knowledge and of the opinions accepted by the relevant scientific community increases that assessment of expertise.

Research suggests that people assess the legitimacy of a legal decision on the fairness of the procedure leading to the decision and on the accuracy of the decision.²⁰⁰⁰ These elements contribute positively to the acceptance of the judgement, regardless of the fact if the outcome was favourable for the interviewed party.

Based on these experiments Sevier proposes a few features a 'science court' should have.²⁰⁰¹ Not all are valid for the Netherlands, the UK and France, but some are worth mentioning.

Beneficial to the acceptance of a science court are: experienced, science-savvy judges and a combination of inquisitorial and adversarial elements in relation to the scientific evidence.

Perceived challenges are the selection and scope of the cases as being toxic tort claims, the selection of the judges and their qualifications.

The choice of initiatives obviously depends on the amount of toxic tort litigation. If toxic tort and the cost of the damage caused by chemicals continue to increase it is likely that more claims will be filed, also in countries outside the US. At this moment the number of toxic tort cases is relatively low in the UK, the Netherlands and France, but will this last? The strain the social security systems are under and the continued evolution of science may change that.²⁰⁰²

²⁰⁰⁰ SEVIER, J. (2014, Vol. 73). Redesigning the science court. *Maryland Law Review*, p. 801.

²⁰⁰¹ SEVIER, J. (2014, Vol. 73). Redesigning the science court. *Maryland Law Review*, pp. 802-803.

²⁰⁰² For some diseases special funds are created and assistance is provided. The Dutch 'Institute for victims of asbestos' provides financial assistance to victims of asbestos. The alimony is not a replacement for the filing of a liability claim or any other mean to hold the responsible party liable. Compensation by that liable party is the first objective. Another example is the fund that was created by pharmaceutical companies and insurances in

Look at the special funds created for some toxic damages like caused by asbestos or DES. The idea behind is that the government puts in some extra money, but that these organisation try to recuperate the money from the responsible parties. In France the government has installed a fund for indemnification of asbestos related diseases. Noteworthy is that the fund's board of directors is chaired by a magistrate of the Court of Cassation.²⁰⁰³

8.4 Toxic tort in a larger (philosophical) context

Scientific knowledge is always limited. Science does not end with a fixed result. On the contrary new finding raise new questions. Knowledge evolves, existing conclusions can become void. Courts that work by the knowledge of the present time, should not be disapproved of when later on the knowledge or the assumptions are refuted. Courts should be aware of this characteristic of science, but not be paralysed by it. A careful evaluation of uncertainties and even gaps in scientific knowledge enables a justified decision if the evidence is reliable for proving causation.

Parties use different methods to persuade a court of the existence of a specific causal link. In toxic tort the most popular are: weight of evidence, differential diagnosis, and Bayesian probability calculation.²⁰⁰⁴ Some of these methods have been refused or accepted depending on the opinion of the court handling the case. Often the refusal to accept these methods is based in a lack of knowledge. Overall, if scientists find these methods reliable for their research, courts should not try to second-guess this.

The organisation of the tort system also contributes to the truth finding. In the US with its adversary system the court will find for the party who in their opinion

order to provide DES victims with an alimony and indemnification. This initiative prevents legal claims and ads to the limited means of social insurance.

²⁰⁰³ In France a fund for people suffering from asbestos related cancer provides an indemnification. If the person concerned accepts the proposal made by the 'Fonds d'indemnisation des victimes de l'amiante' then any other recourse for this harm becomes impossible. The fund can file a claim in tort against the alleged tortfeasor. The risk of losing the case is now with the organisation and no longer with the victim. This fund operates next to the Social security system for victims who did not contract their disease in employment relationship. The fund's board of directors is chaired by a magistrate of the Court of Cassation. The French government and the social security for workers' accidents and diseases finance the fund. www.fiva.fr (accessed 14 April 2014)

²⁰⁰⁴ See part VI.

presents the most probable truth. In the UK and in Continental Law, the role of the court is inquisitor. The decision will consequently be made on the merits of the evidence presented by the parties.

In neither procedure, a quantitative algorithm exists for making these decisions. Probability carries in itself uncertainty and error. Again a court should not be paralysed by this.

When all the experts' opinions are pointing in the same direction, then the judge can decide. He should not evaluate the scientific opinions of the experts. Judges are no scientists.

But what if there is no consensus and experts differ or scientific findings are inconclusive? Then the quest for a decision becomes very demanding.

The belief about the facts and substantive inferences drawn from the complete body of reliable evidence will have to be used to reach a decision. Insights in scientific thinking, methods and communication are necessary, but finally the evidence has to be appreciated in a judicial manner. It is the duty a judge is legally assigned to perform.²⁰⁰⁵

A decision is only possible if scientists provide the court with an as complete as possible overview of the knowledge about the causal question in a court case. A solid inference of causation can only be drawn if experts are allowed to submit different kinds of evidence, like observational and experimental studies, but also methods like differential diagnosis and weight of evidence.

Such an approach is not contradictory to scientific methodology. In fact it is in line with modern research methods.²⁰⁰⁶ The court should however also explain its reasoning. After all inference of a causal link is not only based on science, but also on judicial policy. Acknowledgement of the assumptions used or not-used, of the thinking process and motives are to be made explicit, as it is also required in the intellectual due process expected from scientists. The only way to tell if such errors are contained in an expert's report or proffered testimony is to examine the data and the statistical inferences drawn from it, not for

²⁰⁰⁵ Hoge Raad 8 July 2011, LJN BQ3514, *Nederlandse Jurisprudentie* 2011/311.

²⁰⁰⁶ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1584.

mathematical errors but for errors in logic.²⁰⁰⁷ The former is in line with what judges do: analysing information.

“In the final analysis, assessment of evidence and causal inferences depend on accumulating all potentially relevant evidence and making a subjective judgment about the strength of the evidence.”²⁰⁰⁸

In cases with contradictory expert evidence the judgement should be plausible and explanatory about the relation between the criteria and the choice which opinion to believe.²⁰⁰⁹

In non-deductive arguments, like differential diagnosis the premises can support different possible conclusions.²⁰¹⁰ Again, the court has the task to evaluate the inferences and identify the most plausible conclusion.

Decision making is explanation based.²⁰¹¹ Inferences should not only be based on scientific evidence and the opinions of experts, but also legal policy concerns.²⁰¹² The court should solve this issue in a manner that is sufficiently justified and credible.²⁰¹³

This exercise fits in the legal cause of tort. (See chapter III) Causation in law should mean what lawyers decide it should mean, not in the vague, but based in a thorough investigation and evaluation of the available evidence, combined with a good understanding of the relevant scientific backgrounds.

What counts as a sufficient causal link is to be decided by the court. The fact that scientists define causation differently is not relevant, once the court

²⁰⁰⁷ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1602.

²⁰⁰⁸ KASSIRER, J., & CECIL, J. (2002, September). Inconsistency in evidentiary standards for medical testimony - disorder in the courts. *Journal American Medical Association*, p. 1384.

²⁰⁰⁹ RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, p. 299; BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. *Yale Law Journal*, p. 1657.

²⁰¹⁰ See paragraph 5.1.2.4 on differential diagnosis.

²⁰¹¹ ENGEL, C. (2009, Vol.33). Preponderance of evidence versus intime conviction: a behavioral perspective on a conflict between American and Continental European Law. *Vermont Law Review*, p. 451.

²⁰¹² Hoge Raad 8 July 2011, LJN BQ3514, *Nederlandse Jurisprudentie* 2011/311; BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, p. 1597.

²⁰¹³ RIBEIRO, G. (2013, Vol. 12). No need to toss a coin: conflicting scientific expert testimonies and intellectual due process, *Law, Probability and Risk*, p. 299; BREWER, S. (1998, Vol. 107). Scientific expert testimony and intellectual due process. *Yale Law Journal*, p. 1657.

believes that the scientific evidence is reliable and supports the decision making process. The statement in the title is thus no permission to stay ignorant about scientific methodologies and related conclusions.

Summarising, a court should consider the extent and strength of empirical support for the hypothesis; the level of consistency within the underlying theory and with other theories, the acceptability of assumptions; the methodologically soundness; and whether each contributes toward a plausible theory.²⁰¹⁴

Doing justice is a human activity. Toxic tort is highly influenced by non-knowledge, by the perception of risks, and by uncertainty.

Mistakes like judging by hindsight, or misinterpreting statistics, or rejecting evidence without valid arguments, should not be made. One can however not expect to be perfect. With the help of other disciplines defensible judgments should be achievable.

Anyhow, courts cannot escape. Refusal to exercise their power is not tolerated; neither by the widely accepted Rule of Law, nor by the laws in the Netherlands and France.²⁰¹⁵

8.5 What about Belgium?

At the start of this study the decision was taken not to include Belgium. The main reason was the lack of material to investigate. France, as quite comparable in doctrine and codes, should provide enough similarity to extent the conclusion to Belgium.

Now at the end of the study, the overall conclusion is that the issues relating to toxic tort are the same in the four countries. The methods of dealing with liability for damage caused by chemicals differs, as can be seen in the parts of the study. However the solutions to the challenges of toxic tort can be incorporated into these different methods and different legal systems. Consequently they can also be applied in Belgium.

²⁰¹⁴ BEECHER-MONAS, E. (2000, Vol. 75). The heuristics of intellectual due process: a primer for triers of science. *New York University Law Review*, pp. 1596-1599.

²⁰¹⁵ Art. 4 of the French Civil Code: A judge who refuses to give judgment on the pretext of legislation being silent, obscure or insufficient, may be prosecuted for being guilty of a denial of justice and art. 26 of the Dutch Code of Civil proceedings: The judge may not refuse to decide.

The recent reform of the Belgian judicial system provides opportunities.²⁰¹⁶ A new article installs a committee with the objective to manage, inter alia, knowledge, quality and operational processes.²⁰¹⁷ This committee will be assisted by a department supporting its tasks.²⁰¹⁸ Another change that could have been beneficial is the increased mobility of court employees (including judges).²⁰¹⁹ However this possibility is apparently restricted to temporarily replacements of employees or structural changes in manpower needs. A 'flying' judge with expertise in scientific matters seemingly will not fit into those categories. Some opportunities were also missed when restructuring the judicial districts, namely a regional or national science court could have been implemented.

8.6 What can be concluded?

The core difficulty to prove causation is independent of the legal system where a toxic tort claim is filed. The aim of this study is not to evaluate the strengths and weaknesses of the individual system. Neither is it an inventory of country specific challenges and opportunities. The objective is to learn from different experiences and approaches in such a way that proof of causation in toxic tort becomes less of a burden.

The overall conclusion is that toxic tort will remain challenging. Fixed solutions and all-encompassing principles cannot not be formulated. The quality of the

²⁰¹⁶ Wet van 18 februari 2014 betreffende de invoering van een verzelfstandigd beheer voor de rechterlijke organisatie, *BS* 4 maart 2014

²⁰¹⁷ Art. 181 Wet van 18 februari 2014 betreffende de invoering van een verzelfstandigd beheer voor de rechterlijke organisatie:

Er wordt een College van de hoven en rechtbanken opgericht dat instaat voor de goede algemene werking van de zetel. Het College, binnen deze bevoegdheid:

1° neemt maatregelen die een toegankelijke, onafhankelijke, tijdige en kwaliteitsvolle rechtsbedeling verzekeren door het organiseren van onder meer communicatie, kennisbeheer, een kwaliteitsbeleid, werkprocessen, de implementatie van informatisering, het strategisch personeelsbeleid, de statistieken, de werklasmeting en werklasterverdeling;

2° biedt ondersteuning aan het beheer binnen de hoven van beroep en arbeidshoven, rechtbanken en vrederegerechten.

Ter uitvoering van de bij dit artikel bepaalde taken en bevoegdheden geeft het College aanbevelingen en dwingende richtlijnen aan alle directiecomités van respectievelijk de hoven van beroep en arbeidshoven, rechtbanken en vrederegerechten. De aanbevelingen en richtlijnen worden aan de minister van Justitie overgezonden."

²⁰¹⁸ Art. 183. § 1 Wet van 18 februari 2014 betreffende de invoering van een verzelfstandigd beheer voor de rechterlijke organisatie.

²⁰¹⁹ http://justitie.belgium.be/nl/rechterlijke_orde/hervorming_justitie/mobiliteit/

toxic tort litigation depends equally on reliability of the scientific evidence and on the competencies of the judge and the court.

Another fundamental conclusion is that much can be done to increase the quality of toxic tort judgements, whilst simultaneously making judges more comfortable with their complex tasks in this area. Several solutions have been proposed in this last part of the study, some easier to implement than others. The basis is, however, the recognition of the need that the courts should understand science. Education and assistance through transdisciplinary teams, personal expert assistance and reference manuals are needed. Science is continuously evolving and court should be able to remain knowledgeable in a manner that guarantees the quality and accuracy of chemical liability. Hopefully this study helps with that.

Beyond these particularities toxic tort fits into the different categories of tort and should thus adhere to the relevant standard principles.

After studying on causation in toxic tort, other interesting questions relating to harm caused by chemicals popped up. At first sight one could think that a lot is already written about the suggestions. When looking at the topics in relation to the specific issues of toxic chemicals as they impact human health and environment, this is much less the case.

* Class toxic tort actions

In toxic tort a claim is ordinarily brought by a plaintiff or a few plaintiffs. Toxic substances, however, can cause similar harm to a large number of people. When these cases are judged in the traditional settings of tort, courts have to deal with the same basic issues in case after case.²⁰²⁰ Class actions collectivise claims of victims.

²⁰²⁰ See for example: *In re: Methyl Tertiary Butyl Ether ("MTBE") Products Liability Litigation*, 528 F. Supp. 2d 303 (United States District Court, S.D. New York November 29, 2007); *Jaros versus E.I. DuPont (In re: Hanford Nuclear Reservation Litigation)*, 292 F.3d 1124 (US Court of Appeals, Ninth Circuit June 18, 2002); *In re: Silicone gel breast implant products liability litigation (MDL 926)*, 1996 WL 34401764 (United States District Court August 23, 1996); *Maiorana versus US Mineral Products Company (In re Joint Eastern & Southern Dist. Asbestos Litigation)*, 52 F.3d 1124 (United States Court of Appeals, Second Circuit. April 6, 1995); *Brown versus Monsanto e.a. (In re: Paoli Railroad Yard PCB litigation)*, 706 F.Supp. 358 (United States District Court, E.D. Pennsylvania November 28, 1988); *In re "Agent Orange" product liability litigation*, 611 F.Supp. 1223 (United States District Court, E.D. New York May 8, 1985).

PART VIII – Solutions and changes

Class actions increase efficiency by allowing cases with large aggregate damages to proceed even where individual damages are small, and lower cost of litigation because courts do not have to hear all claims individually.²⁰²¹

An interesting example of the benefits of class action is the case of Cimino versus Raymark Industries, Inc. The claims of 3,031 victims of asbestos disease filed a claim against various asbestos manufacturers.²⁰²²

On the other hand, class tort action present a substantial negative exposure to the defendants.²⁰²³ Negative publicity, shareholder anxiety, unrest amongst customers and employee are a few examples. Companies consequently tend to settle. These settlements are not without discussion.

What are the benefits and disadvantages of class actions? Do the positive aspects outweigh the negative ones? Would the system work in Europe or in Continental Legal systems?²⁰²⁴

Are class actions acceptable within the private law character of tort? How do they impact public law?

* The sharing and use of information and knowledge specifically concerning the chemical industry

One of the important challenge in toxic tort is the collecting of enough relevant information. Most often the defendant is a chemical professional/company having much more knowledge and insight in chemicals, their properties and their risk. This information is not (always) available to the plaintiff or the court. Confidential business information, intellectual property or simply reluctance to share is at the basis of not knowing. New legislation, as implemented in Europe²⁰²⁵ or proposed in the US, require professionals to prove the safety of

²⁰²¹ GIFFORD, D. (2005, Vol. 62). The challenge to the individual causation requirement in mass products torts. *Washington and Lee Law Review*, p. 893.

²⁰²² Cimino versus Raymark Industries, Inc., 151 F.3d 297 (United States Court of Appeals September 21, 1998); Cimino versus Raymark Industries, Inc., 751 F.Supp. 649 (United States District Court, E.D. Texas November 12, 1990).

²⁰²³ MANN, D., & BELLAMY, L. (2013, Vol. 60). Innovative approaches to managing mass toxic tort cases. *Federal Lawyer*, p. 71.

²⁰²⁴ See for example the Dutch law 'Collectieve Afwikkeling Massaschade' (Collective Settlements Act). For comments on this law: KORTMANN, J., & BREDENOORD-SPOEK, M. (2011). The Netherlands: a "hotspot for class actions"? *Global Competition Litigation Review*, pp. 13-21

²⁰²⁵ REGULATION (EC) No 1107/2009 of the European Parliament and Council Regulation of 21 October 2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC, O.J. L. 24 November 2009,

chemicals and to communicate safety management data. They are obliged to perform more research on the hazards of their substances, as well on short as on long term and to share this information with the relevant authorities.

Consequently a considerable amount of information is available or becomes available as a result of these rules. Availability is however not accessibility. Companies frequently make use of the possibilities to classify information as confidential or as part of intellectual property.

Can the accessible information on properties and dangers of chemicals be used as evidence of tortious behaviour? What is the legal standing of the information classified as confidential? Should this information be available for use in tort litigation? What can be done to make this information accessible? How does the interest of a private party damaged by a chemical relates to the interests society has in the benefits of these chemicals?

* The assertiveness of private parties infecting public administration and public law

Pure private initiatives lead to look-alike legislation, regulation of the activities of their members or of a sector of the industry.

Some of these initiatives are quite open-ended, others are stricter and yet others are strong by their impact on the perception of customers.

Can initiatives like Equator Principles²⁰²⁶ or the Nano risk framework²⁰²⁷ have a direct or indirect impact on liability? This question is important, but cannot be elaborated in this study and warrants a separate research.

Transnational companies and industry sectors implement their policies across countries and regions. States and legal systems do not have this power. Treaties

309/1. See also as examples: DIRECTIVE 2009/128/EC of the European Parliament and Council Regulation of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides, O.J.L. 24 November 2009, 309/71; REGULATION (EU) No 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products, O.J.L. 27 June 2012, 167/1.

²⁰²⁶ The 'Equator Principles' is a credit risk management framework for determining, assessing and managing environmental and social risk in project finance transactions and is intended to provide a minimum standard for due diligence to support responsible risk decision-making

²⁰²⁷ <http://www.nanoriskframework.com/>

PART VIII – Solutions and changes

are often difficult to implement and to enforce. What would the legal value be of such private agreements in relation to toxic chemicals?

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9.1 Litigation

9.1.1 Court cases: United States

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