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Innovation networks for technology-based radical innovation

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INTRODUCTION

In an increasingly competitive environment technological innovation is perceived as a possible way to realize competitive advantage. However, the mere fact of having innovative technologies in-house is no guarantee for effective competition in the marketplace. Companies that engage in the marketing of high-technology innovations are faced with very specific and complex problems (Davidow, 1986; Shanklin and Ryans, 1987; Mohr, 2001). The commercialization of new technologies or of new technological features entails the exploration of new markets and requires quite different capabilities than the commercialization of continuous upgrades of familiar technologies does (McDermott and O' Connor, 2002; Millier and Palmer, 2001). Numerous promising new technologies that originate in R&D departments all over the world never find their way to the market, let alone become commercial successes (Korac-Kakabadse, 2001). Despite the traditionally internal focus of R&D activity, growing awareness exists that the knowledge required to compete in technology markets is becoming ever more diverse (Bonner and Walker, 2004; Danneels, 2002; Sawhney and Prandelli, 2000; Gupta and Wilemon, 1990). Technological skills need to be complemented with a deep understanding of the customer's needs and usage situation (Leonard and Rayport, 1997). Numerous case studies report successful examples of incorporating such customer knowledge into technological innovations by actively organizing for interaction with users and potential customers (e.g. Kanter, 1997; McQuarrie, 1993; Souder et al., 1997).

A USER PERSPECTIVE ON TECHNOLOGY

Technology is a complex knowledge system to whose creation often several parties contribute (Chesbrough, 2003; Hargadon, 2003). Looking at technology from a user perspective can require (some) of these different parties to team up again in order to correctly and reliably translate this new technology into (customer) value.

For instance, when a promising new technology is developed within a partnership of two firms we can think of several activities besides the technological development activities where these partners need each other again to actually realize the technology's value in the marketplace. First, the partners might need to bundle their technological and market knowledge to think of whom exactly might benefit from using the technology. Then the next step would be to think of convincing arguments why that potential customer would need to switch to the new technological offer. Customers do not always value a technology by the same performance parameters as those that the inventors focused on during the technological development process. It can take several discussion rounds to come to a mutual understanding of a new technology's potential benefits. In that respect it can certainly be useful to let your technology partners be part of these discussions. Since tacit knowledge is such an important component of technology (von Hippel, 1994; Teece, 1998) involving the right partners to help you look at your technology from the user perspective can increase the likelihood of coming to a shared understanding of the technology's market value. In summary, this first example describes how partners can play a facilitating role in developing and gaining access to a market for a new technology.

Also, technology partners might need to team up for the purpose of (customer) problem solving too. Customer problem solving usually plays an important role in gaining market

acceptance for the new technology. When first trials of a novel technology in a customer environment fail to deliver the expected results its suppliers face the task of tracing down the cause of this failure. Unless the root of the problem eminently shows, logical reasoning brings us to the conclusion that the cause of the technology failure could be traced down to each of its technological components. Involving the partners most familiar with each component can clearly facilitate this search.

The underlying assumption of this section is that customers do not need 'technologies', instead they are looking for functionalities (von Hippel, 2005). Ecnonomic value of technology materializes when a fit is realized between functionalities delivered and functionalities needed. We can wonder if customers care at all about the underlying technologies that enables their functionalities. In that respect a customer being offered a new technological solution will certainly expect its supplier(s) to solve any problems that switching to the new technology might cause for him.

RESEARCH FOCUS

The realization of economic value from new technologies originates in matching functionalities delivered with functionalities needed. One way of finding out about the specific functionalities customers could benefit from is by interacting with them during the development and the commercialization of novel technologies. Potential customers naturally look at what a new technology can offer from the user perspective. Also gaining access to a customer's site opens up important opportunities for an innovating firm to perform trials and tests of the new technological offer under the most relevant conditions, namely the conditions in which a customer would consider for or against the adoption of the new technology.

Because of the important technological component in this interaction we focus on interactions with industrial customers. We assume that private consumers do not possess the necessary technological knowledge to understand radical innovations nor can they give motivated feedback on market opportunities for new technological offers.

As described in the previous section, it might be useful to involve a partner in this customer interaction process. Interesting partners could be firms who possess complementary knowledge or resources or who are for some other reason well positioned to stimulate the customer interaction process.

This brings us to a research focus on the small network that takes form when different firms cooperate to realize economic gains from a technology-based innovation with radically innovative potential. From the user perspective on technology we can see how involving potential industrial customer(s) can facilitate technology commercialization. However we broaden our focus to take into account that beside the innovating firm and the customer firm(s) other companies can possibly contribute to the innovation process. Hence we formulate our research question as follows:

"How do firms cooperate to develop and commercialize technology-based innovations with radically innovative potential?"

METHODOLOGY

There are several reasons why our research focus necessitates a case based research method. Firstly, because of the explanatory nature of 'how' questions they most often need a case based research strategy to provide all-embracing answers (Yin, 2003). Furthermore,

researching innovation networks requires the researcher to gain access to information on cooperative strategies within industries. This is a topic that firms typically regard as highly confidential information. Personal interviewing allows for the negotiation of confidentiality arrangements after which the respondent's trust is gained by strictly adhering to this mutually agreed upon way of working. Confidentiality agreements typically include protecting anonymity of persons and firms discussed as well as submitting every interview transcript to the respective respondent to provide him or her with an occasion to correct misinterpretations or mark strictly confidential passages (Kvale, 1996).

Case selection

We search for technology oriented innovation projects within large firms that entail interaction with industrial customers. This is not only the starting point for the identification of how customer interaction facilitates the technological innovation process, we also attempt to reconstruct how other firms contribute to this process. This way we identified eight cases within four large firms.

Data collection

For data collection we mainly rely on semi structured interviews with experts. Respondents include corporate managers, project managers and technical staff of innovation teams. For the eight cases 21 interviews have been conducted with 20 respondents. Each interview took between 2 and 4 hours. In total, this results in about 52 hours of interview time. All interviews are transcribed for analysis following Miles and Huberman's (1994) guidelines. The primary collected interview data is complemented with secondary material in the form of intermediate business plans and corporate presentations. Respondents are regularly contacted by telephone

for follow-up conversations and clarification questions. If the information allows to be transferred by e-mail, this is an additional data collection method.

Data analysis

Ontological and epistemological frame

For studying the case material we adopt the ontological stance of a critical realist. Central to critical realism are 'objects' and 'relations'. Objects can be anything from simple to complex, social to material or abstract to concrete. Objects inherently possess causal powers that in relations and under certain conditions lead to certain events (Easton, 2002, p. 105). Epistemologically this means that we identify causal mechanisms by continuing to ask ourselves and the respondents about the 'why' of observed relations and mechanisms (Easton, 1998). Case based research is a particularly well suited strategy for this kind of approach.

Theoretical base: Resource dependence theory

Critical realism also means that we are aware of the fact that our knowledge of the world is theory-laden. For the study of inter firm cooperation for technology-based radical innovation we look at our cases from the perspective of the resource dependency theory as described among others by Zajac and Olsen (1993). The authors stress that in interorganizational strategies, such as these described between an innovating firm, industrial customers and other partner firms, it is important to address aspects of (1) joint value maximization, and (2) the processes by which exchange partners create and claim value. As a consequence, interorganizational strategies that have greater joint value may be more effective than going it alone, even though they may involve the use of less efficient governance mechanisms from a transaction cost perspective (Sawhney and Prandelli, 2000). In resource dependence theory firms are viewed as dependent on their environment in the sense that they depend on the

resources of the environment for continued survival in the marketplace (Pfeffer and Salancik, 2003). But firms are also seen as active managers of their own fate. Hence firms develop strategies for coping with these dependencies through coordination with the resource owners (Salomo et al., 2003). Information on industrial customers' needs and usage situations can be viewed as a resource that is owned by the respective industrial customers (Gruner and Homburg, 2000). The innovating firm increases its coordination costs by establishing interfirm linkages with these customer firms. However, these linkages do allow the innovating firm to deal with its dependence on access to relevant customer knowledge for successful technological innovation.

Method of analysis

Following the logic of Yin's (2003) multiple case study research strategy during our data analysis we iterate between within case analyses and between case analyses alternated with instances of extra data collection and interpretation checks with experts and respondents. By following a pattern matching logic we try to explain mechanisms within one case, next we project this finding to a comparable case and compare this projection to the empirical findings. If this exercise is successful we attempt if the finding holds for our other cases too. If it does not hold within one or more cases we return to (our) theory to find an explanation for this seemingly inconsistent result. This way of working is also known as theoretical replication (Yin, 2003, p. 51). Theory is considered to either hold or to fail for predictable reasons. The aim of this exercise is the development of (midrange) theory.

DISCUSSION OF EMPIRICAL RESULTS

In this section we describe the results of our data analysis. We start by providing a rich description of each of our eight cases. Every case discussion starts with an introductory paragraph to present the main features of the case context. Next, we show a graphical presentation of the interrelated firms that are involved in the development and/or commercialization of a technological innovation. These figures build on a supply chain logic of looking at inter firm relations. Organizations and firms are represented by rectangles. Straight arrows between rectangles represent material or product flows. Dotted lines with an arrow head indicate information flows. Curved arrows indicate which firm took initiative for interaction with which other firm. Within each figure the rectangles of firms that are cooperating for technology commercialization are shaded grey. Each figure is followed by an explanatory text. We identify the depicted mechanisms and elaborate on their causes and consequences. The key process studied is inter firm cooperation in the context of technology development and commercialization. Every case is viewed from the perspective of the firm that plays the dominant role in the innovation process. We refer to this firm as the innovating firm. In each figure this firm is called INNO. We have specific attention for the resources and capabilities for which each partner firm is involved in the innovation process. Typical topics in our analysis concern:

- At whose initiative did the cooperation begin?
- Is the cooperation evolving as planned? Why, why not?
- How does the interaction with other firms or organizations facilitate or hamper technology commercialization?
- etc.

Case 1: Pipe Case

Introduction Case 1

Our first three cases, namely the Pipe, Bumper and Elevator Cases, are situated within a large metal transformation firm. The cases represent three applications of a same base technology. The base technology is an advanced approach to integrating steel products into thermoplastics. Research for this steel transformation technology has been ongoing within the innovating firm since 1998. Applications for the base technology are initially internally generated for presentation to higher management. One of these initial application possibilities is to reinforce plastic pipes with steel. But it is not until the innovating firm is approached by a pipe manufacturer, later in 1998, with the request to look for a way to reinforce his plastic pipes that development activities really take off. The new pipe is aimed for use by oil companies. A field test with a first oil company is planned.

Graphical presentation Case 1

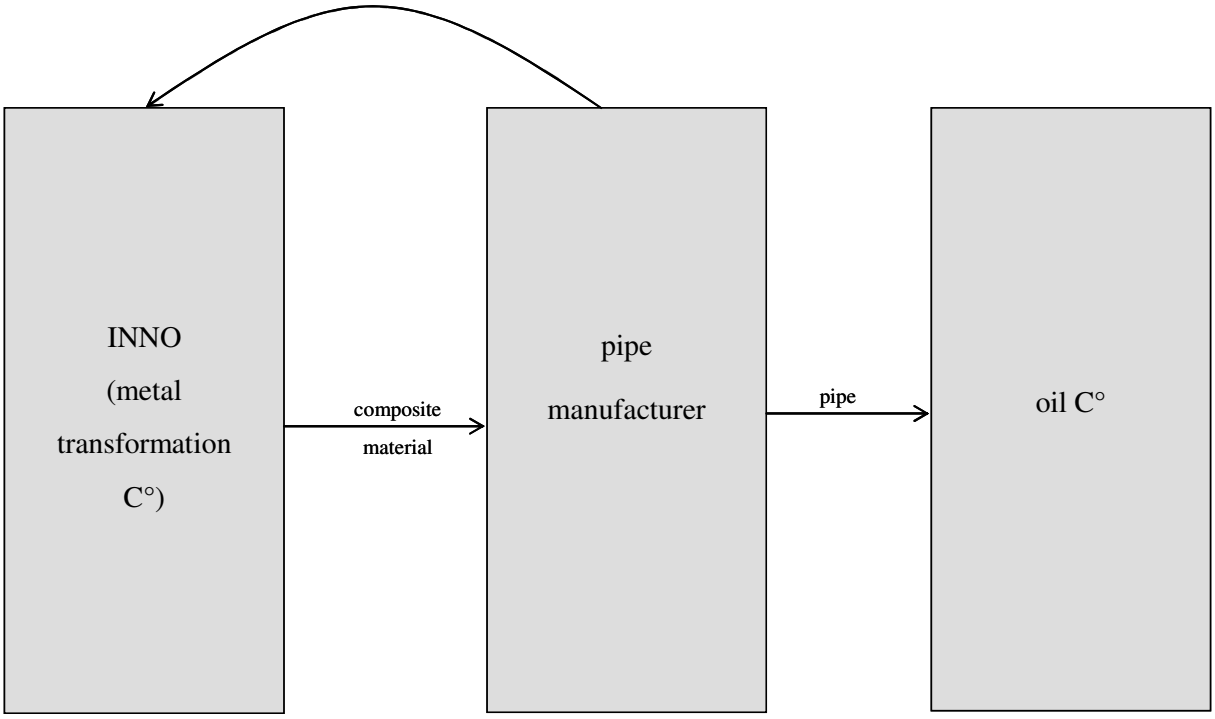

Figure 1: Pipe Case

Discussion Case 1

In figure 1, all the rectangles are coloured grey because all the depicted firms are involved in the technological development process of the steel reinforced plastic pipe. The curved arrow from the pipe manufacturer to the innovating firm shows that the first took initiative for cooperating with the latter. In close interaction the composite material is fine-tuned and the first innovative pipes are manufactured. The innovating firm plans to involve three oil companies in the trials and tests of the newly developed pipes. The new pipe is more expensive than the currently used steel pipes, but it is easier to assemble and has lower maintenance costs. Furthermore steel pipes show corrosion problems and the new pipe does not. Oil companies currently face one dominant pipe supplier so they would welcome a second supplier because that would lower their dependence on their current supplier. However, the oil companies also face some important restrictions. They are being evaluated on cost per unit of output. Participating in the testing program initially only adds to costs. And because the oil companies demand all sorts of warrantees concerning durability of the pipes they have to agree on leaving a testing installation on their site for about 1 to 1,5 years. The innovation process is also slowed down by a shortage of resources for the project in the pipe manufacturing firm. The high concentration in the oil production industry is also considered as a limiting factor.

Case 2: Bumper Case

Introduction Case 2

A second initially foreseen application of the metal transformation technology is located in the automotive industry. Both governmental emission restrictions and a growing demand of insurance companies for car designs that incur and cause minimal damage at the event of a

crash, make the use of plastic bumpers less desirable. End of 2001 a bumper manufacturer approaches the innovating firm with the request to improve the properties of his plastic bumper by enforcing it with steel. The innovating firm links this request to the existing research project and decides to partner with this bumper manufacturer to develop a steel reinforced bumper. Development activities have been ongoing for 3 years now and several bumper manufacturers are getting involved. The first crash tests with an automotive OEM are on their way.

Graphical presentation Case 2

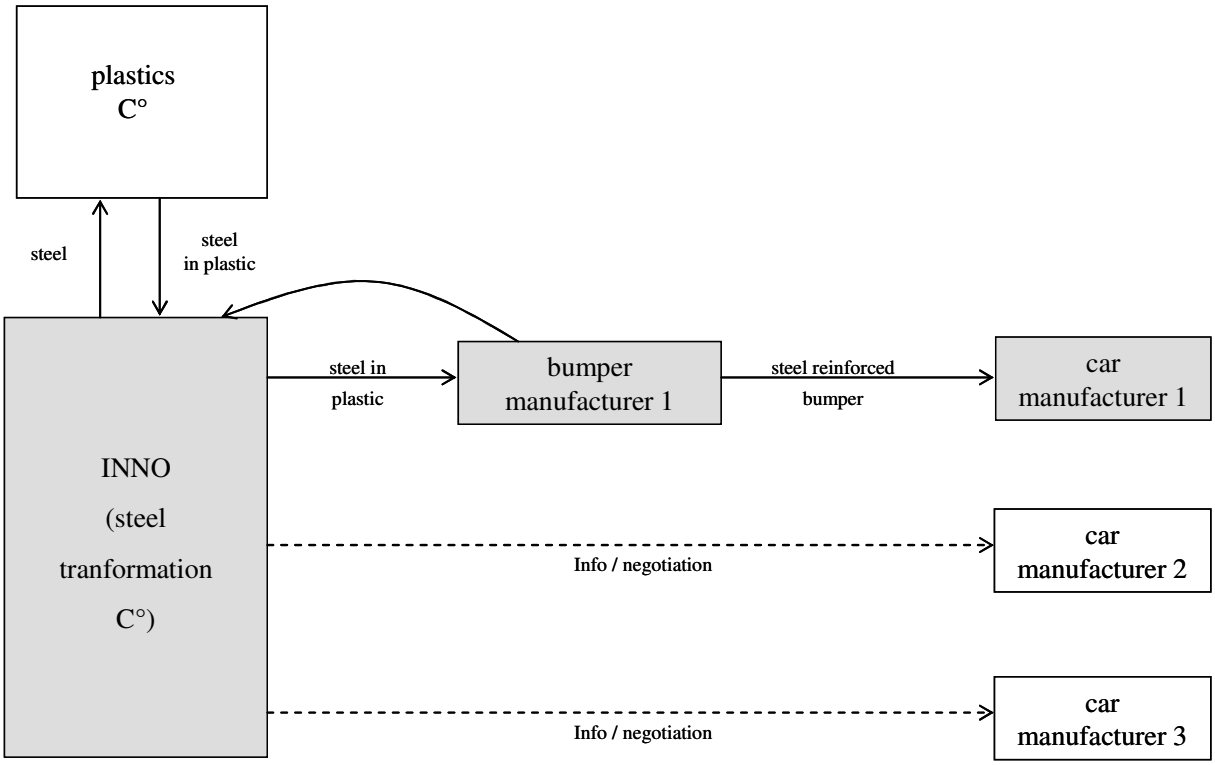

Figure 2: Bumper Case

Discussion Case 2

When the bumper manufacturer approaches the innovating firm the latter recognizes the opportunity and is quite confident that it has the technological skills to make the innovation happen. However, since the bumper manufacturer is perceived as a relatively small firm it is negotiated that the innovation will be developed in joint ownership and that a free license will be given to those who are willing to cooperate in the development activities. Since the car

manufacturer is the owner of the bumper mould he has to give permission for the bumper manufacturer to proceed in the joint innovation process. To be able to spread innovation costs the innovating firm tries to convince other car manufacturers to switch to steel reinforced bumpers too. The two dotted lines in figure 2 show that the innovating firm is currently talking to car manufacturers to convince them of the new bumper's advantages so they will urge their bumper manufacturers to produce steel reinforced bumpers.

Case 3: Elevator Case

Introduction Case 3

The same innovating firm that is discussed in the first two cases is also approached by a large elevator company in 1997. The elevator company is under competitive pressure to reduce the space needed for elevator cables and machinery. For this purpose the elevator company would like to replace the round steel elevator cable with a timing belt-like solution. This is an application that the innovating firm had initially not thought of itself. The innovating firm works closely together with the elevator company to develop the elevator belt. After 3 years of joint development and joint testing the elevator company introduces the new solution to the market in 2000.

Graphical presentation Case 3

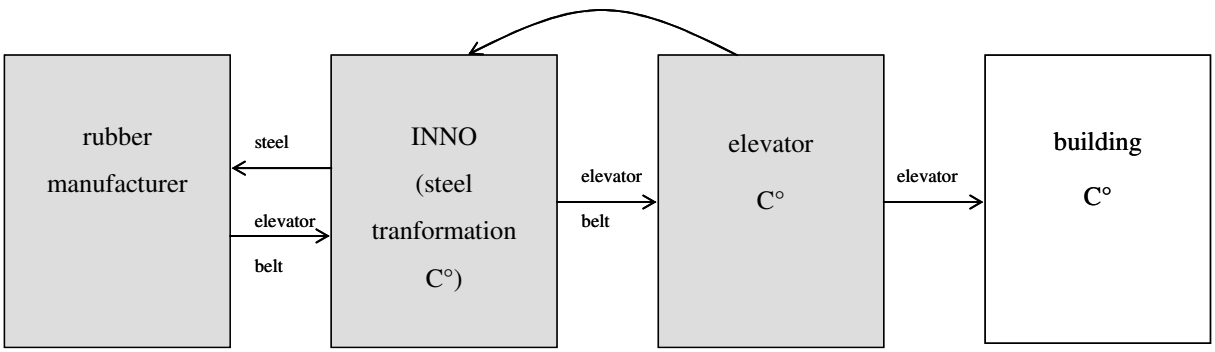

Figure 3: Elevator Case

Discussion Case 3

As figure 3 shows the elevator belt is development in a joint effort of three firms. The innovating firm perceives the elevator company as large enough to engage in a one on one partnership with for the development of the elevator belt. The elevator company already had contacts with a rubber firm that is consequently involved in the development activities. The elevator company has its own testing towers for testing new elevator systems which makes testing possible independent of end customers' infrastructure.

Case 4: Strong Fiber Case

Introduction Case 4

In 1978 an innovative production process is discovered in a large chemicals company. The production process enables production of a very strong fiber. It takes the company until 1986 to fine-tune the production process and acquire the necessary competences for fiber handling, which is not a core competence of the company. Subsequently the company invests about another 10 years to getting to know the unfamiliar industrial markets and their end markets. In 1992 the choice is made to focus on applications for ropes, nets and ballistic protection. The development team succeeds in translating the fiber's benefits into parameters relevant for the market. Production capacity is expanded but the focus continues to be on small, very lucrative segments. By now the company is sustaining commercialization of its technology by serving various market segments with a range of applications. The latest development is a high purity version of the fiber aimed at the medical market.

Graphical presentation Case 4

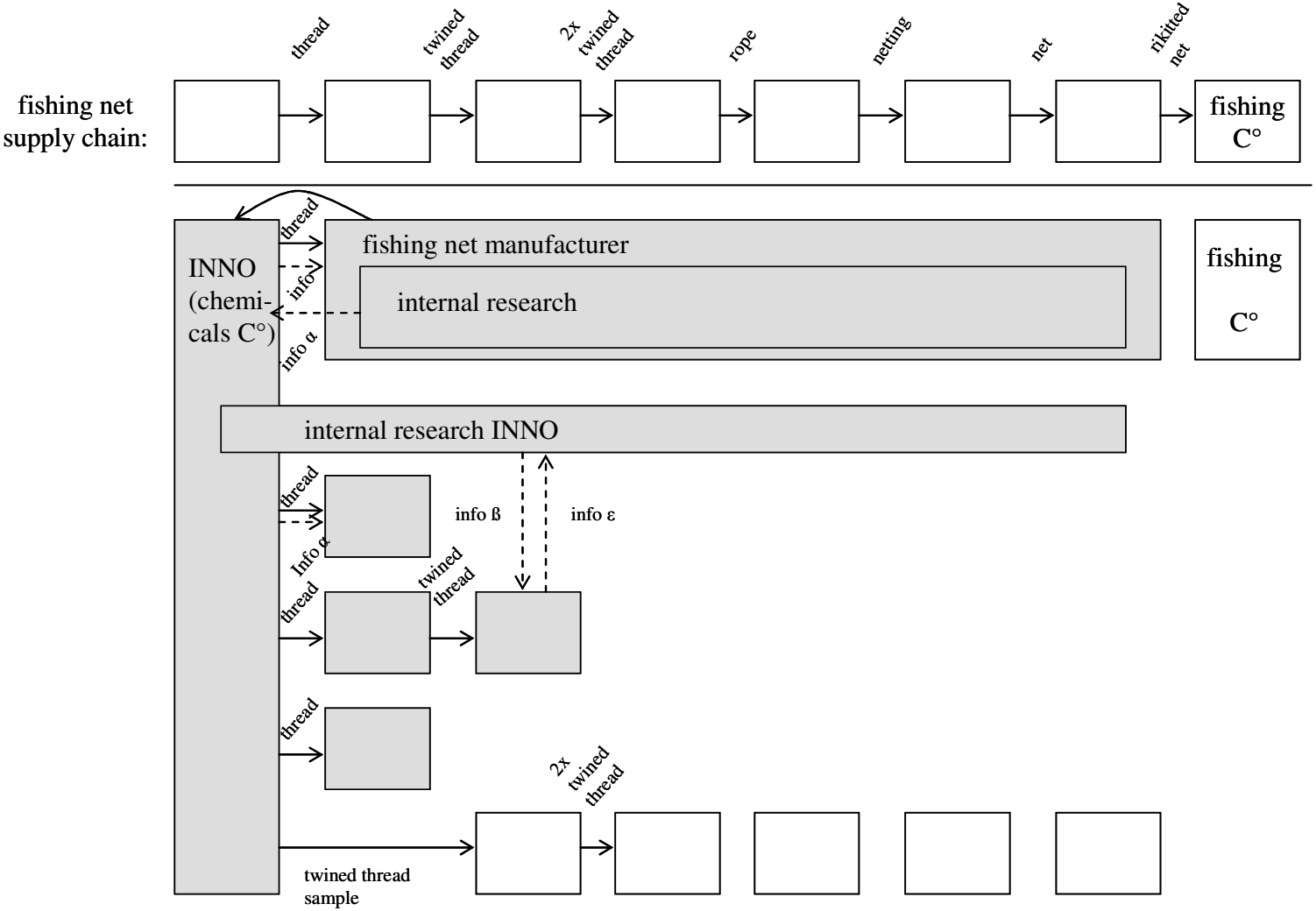

Figure 4: Strong Fiber Case

Discussion Case 4

Case 4 concentrates on an application of the strong fiber for the production of fishing nets. In the very early days of the fiber's invention the innovating firm is approached by a fishing net manufacturer that wants to produce nets out of the new fiber. The top of figure 4 depicts the whole supply chain for the production of fishing nets. The innovation network for the development of fishing nets made out of the strong fiber is presented below the horizontal line that separates it from the general picture of the supply chain. In the picture of the innovation network firms with the same functionalities as the ones depicted in the general supply chain are placed vertically straight under it. Inside the rectangle that represents the fishing net manufacturer is another rectangle that shows that the fishing net manufacturer possesses research capacity on most of the steps in the supply chain. The firm's rectangle has a width that covers the width of the total supply chain to show that it is a highly integrated firm. The innovating firm also has some research capacity on practically all the steps of the supply chain, but not as much as the fishing manufacturer has. That is why the innovating firm's research capacity is depicted by a slightly slimmer rectangle.

The development process starts with the innovating firm supplying some thread of the new material to the fishing net manufacturer along with some information on how the innovating firm thinks the material should be handled. The fishing net manufacturer does trials with the new material and shares (some) of the lessons learned (info α) with the innovating company while asking additional questions. Then internal research of the latter looks into the problems the fishing net manufacturer had with the fiber and tries to add to the knowledge on how to work with the new fiber. The technological development process iterates back and forth like this for quite some time. Simultaneously the innovating firm is working with rope manufacturers in the market. It is even sharing with them some of the knowledge (info α) gained from the fishing net manufacturer. At other times the innovating firm tries to trade

knowledge with firms in the market. It approaches firms with proposals such as 'our internal research just find out info β about how to make ropes out of the new fiber and we're telling you first, now you go ahead and share some of your knowledge with us too'. Firms were sometimes promised a lead or were offered free material to persuade them to try something out for the innovating firm who was constrained by a limited research capacity and very limited rope production equipment. When rope manufacturers' trials did not succeed they often lost interest since they are not accustomed to doing research themselves. After trials failed, which they often did in the early years, they used to tell the innovating firm to not come back until they knew how to handle the new fiber. In the mean time the large fishing net manufacturer proceeds with his research on how to manufacture nets out of the strong fiber and after about seven years they are able to introduce the first fishing nets out of the super strong fiber to the market.

Case 5: Printing press Case

Introduction Case 5

Case 5 is studied from the perspective of a large imaging company. The company focuses on the development and production of consumable chemical products that are used in imaging processes. The firm has among others a long history of making master plates for the press industry. However the digitalisation trend forms a threat to this business. The innovating firm decides to take a closer look at digital inkjet printing techniques because this could offer an opportunity for the production of an alternative consumable, namely ink. Although the digital printing technique is currently predominantly used for private and small scale use the innovating firm aims to develop an industrial application of the technique. Furthermore the innovating firm wants to develop an industrial digital inkjet printing technique that can serve as a worthy replacement for the currently threatened press technique. A manufacturer that had

been making machines for the threatened press technique in industrial markets is approached for partnering. The initial joint development agreement is reached in the first quarter of 2003.

Graphical presentation Case 5

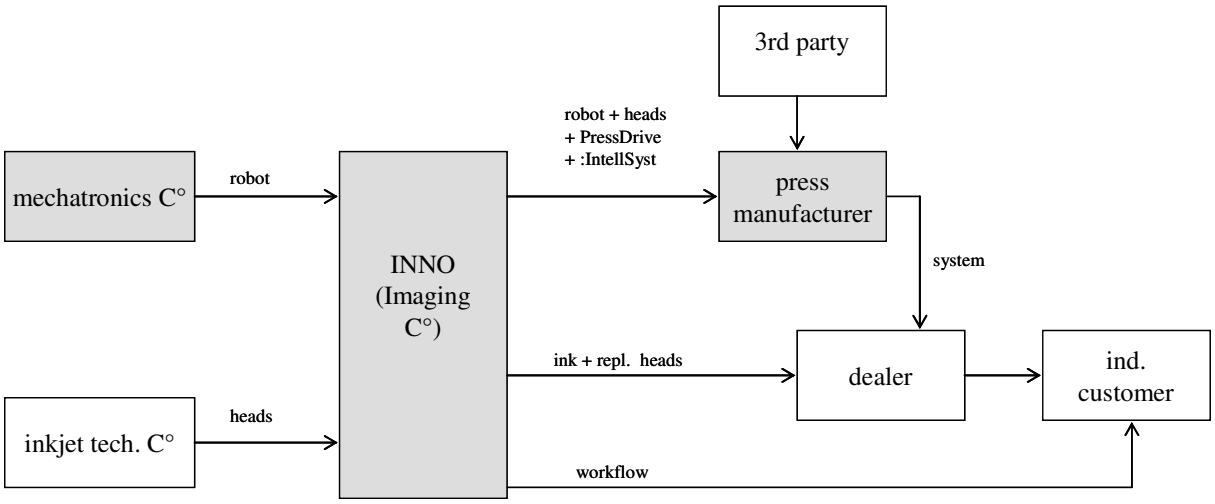

Figure 5: Printing press Case

Discussion Case 5

As the three grey marked firms in figure 5 show the innovation activities predominantly take place in a cooperation of three companies. They regularly have technical meetings where staffs of the three firms jointly discuss the development of the industrial inkjet printing technique. The white rectangles in figure 5 show what the supply chain is planned to look like. Currently seventeen European firms have done a considerable prepayment for their purchase of this novel press. However development of the machine has not been finalized yet. The first beta tests are planned to take place at the first customer's site in November 2005. Negotiations for beta testing with a second customer are ongoing.

Case 6: Display Case

Introduction Case 6

At the beginning of 2001 a large electronics company established a partnership with an American start-up company to commercialize the latter's new display technology. The larger firm gains access to the new technology, while the start-up hopes that the reputation of the large company will facilitate commercialization of its technology. The innovating firm aims to limit the role of the start-up to that of a material supplier. The innovating firm sees itself as responsible for commercialization of the display technology. Initial efforts are focused at an application aimed at the consumer market. Main characteristics of the new display are its resemblance to paper which improves readability, its low energy use and the feature that displayed images are insensitive to the angle under which they are viewed. A drawback is the inability to display colour. The innovating firm regards it as a promising substitute for paper e.g. for journals, magazines and books, the so-called e-book. End of 2001 a joint development agreement is reached with a Japanese industrial customer, an OEM company. Development activities are initially planned to take 9 months to a year, but they actually take a little longer than two years. The e-book is launched to the Japanese market in April 2004.

Graphical presentation Case 6

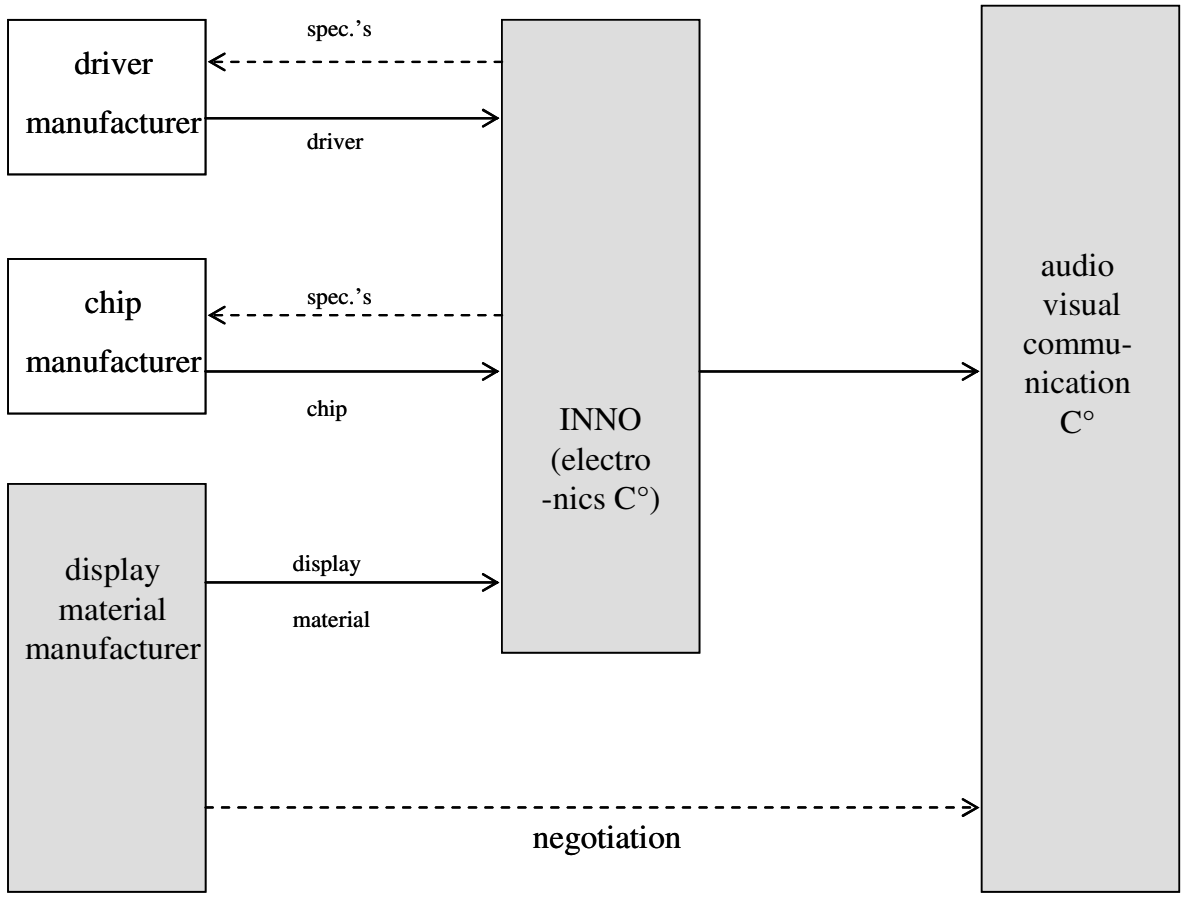

Figure 6: Display Case

Discussion Case 6

As the grey rectangles in figure 6 show the e-book is developed in a joint effort of three firms. Delays in the development process are mainly caused by technological setbacks. For instance, the innovating firm needed about a year more time than planned to be able to meet the audio visual communication company's high demands with respect to the quality of the shades of grey produced on the display. Also the display material manufacturer had considerable trouble with the reproducibility of the display material. Cultural differences also had some hampering influence on the cooperation, the display manufacturer being an American firm, the innovating firm being European and the audio visual communication company being Japanese. Furthermore the display material manufacturer is still trying to be more than just a

material supplier. So when the display manufacturer takes the initiative for negotiations with the Japanese industrial end customer without involving the innovating company relationships among the three firms are put under even more pressure.

Case 7: Laser Case

Introduction Case 7

The customer base of the laser centre at a large chemicals company is decreasing. In February 2002 a business development manager is appointed to work out a new future for the group. In May 2002 two of the group's R&D members discover a chemical that enables high quality laser marking independent of the characteristics of the polymer in which it is used. The inventors team up with the business development manager to commercialize this new technology. By the end of the year a patent application is written and filed and the first business plan is drawn up. Beginning of 2003 the technology is recognized as a breakthrough by leading market constituents. Several application possibilities are identified and pursued. This case concentrates on the market for laser marked ear tags for cattle.

Graphical presentation Case 7

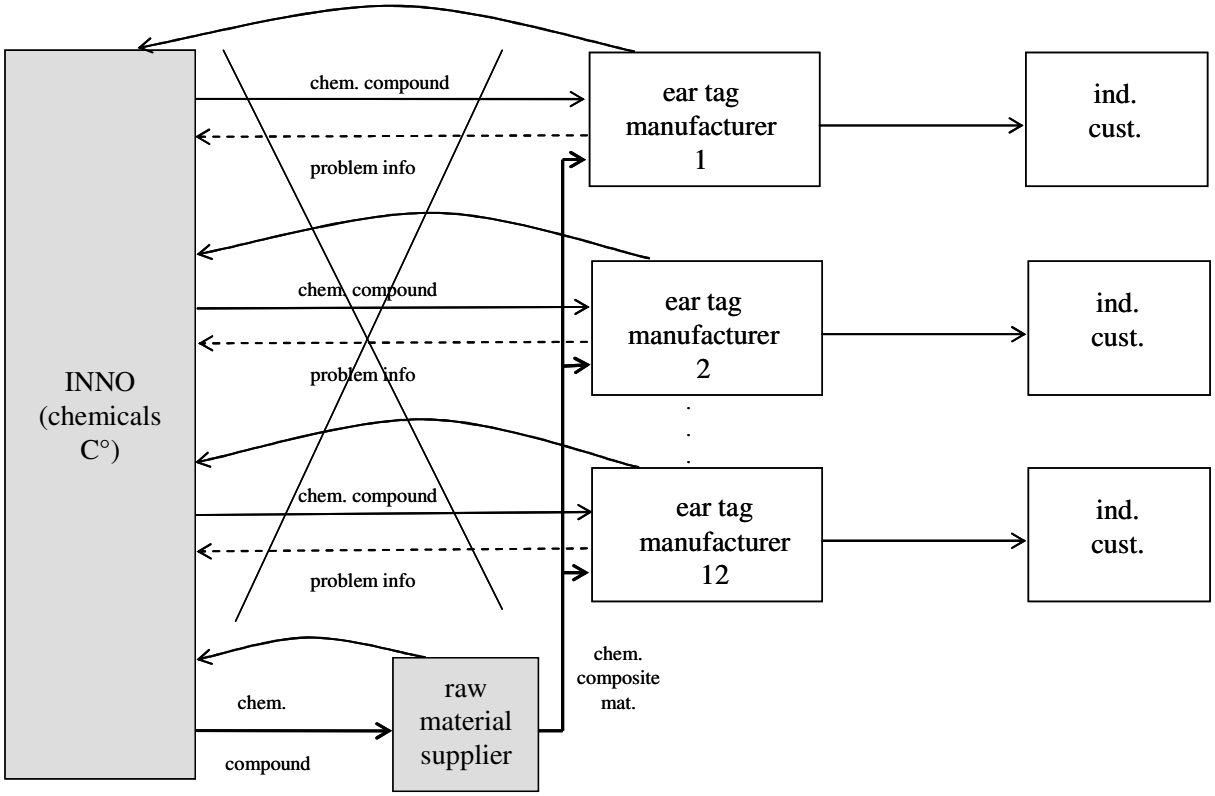

Figure 7: Laser Case

Discussion Case 7

When the innovating firm spreads the rumour about its invention several ear tag manufacturers spontaneously show interest. Eventually this results in a situation where the innovating firm is sending sample material to about twelve ear tag manufacturers who then perform trials with the material and report to the innovating firm about the problems they encounter. Next the innovating firm tries to adapt the material to find a fit with the industrial customers' need situations. However after a while the innovating firm is contacted by an interested raw material supplier who supplies material to ear tag manufacturers. Not only does this material supplier have more experience in research and more knowledge about the technical properties of various materials, also in terms of coordination costs it makes sense for the innovating firm to stop joint testing and development activities with the twelve ear tag

manufacturers and to start working with and to supply material to the raw material supplier. The ear tag manufacturers are told to contact the supplier for access to the innovative material.

Case 8: Food Test Case

Introduction Case 8

In 1999 a chemical is discovered in a large chemicals company that allows a fast, reliable and easy detection of antibiotic residues in food products. Initially diary products are considered as target market segment, but when the test does not take off there the test is repositioned for the meat market. Because of significant differences between the markets for beef, pork and poultry this case concentrates on one type of meat, namely poultry. The development team has prepared documentation material to educate the market and has experimented with the product form of its application. The food test has been commercially available to industrial customers in the poultry market since 2001. The food test is currently integrated in the official poultry meet tests used by government agencies in several countries but the development team would like to penetrate the market beyond these official agencies. Until now, however, commercial value has been materializing quite slowly.

Graphical presentations Case 8

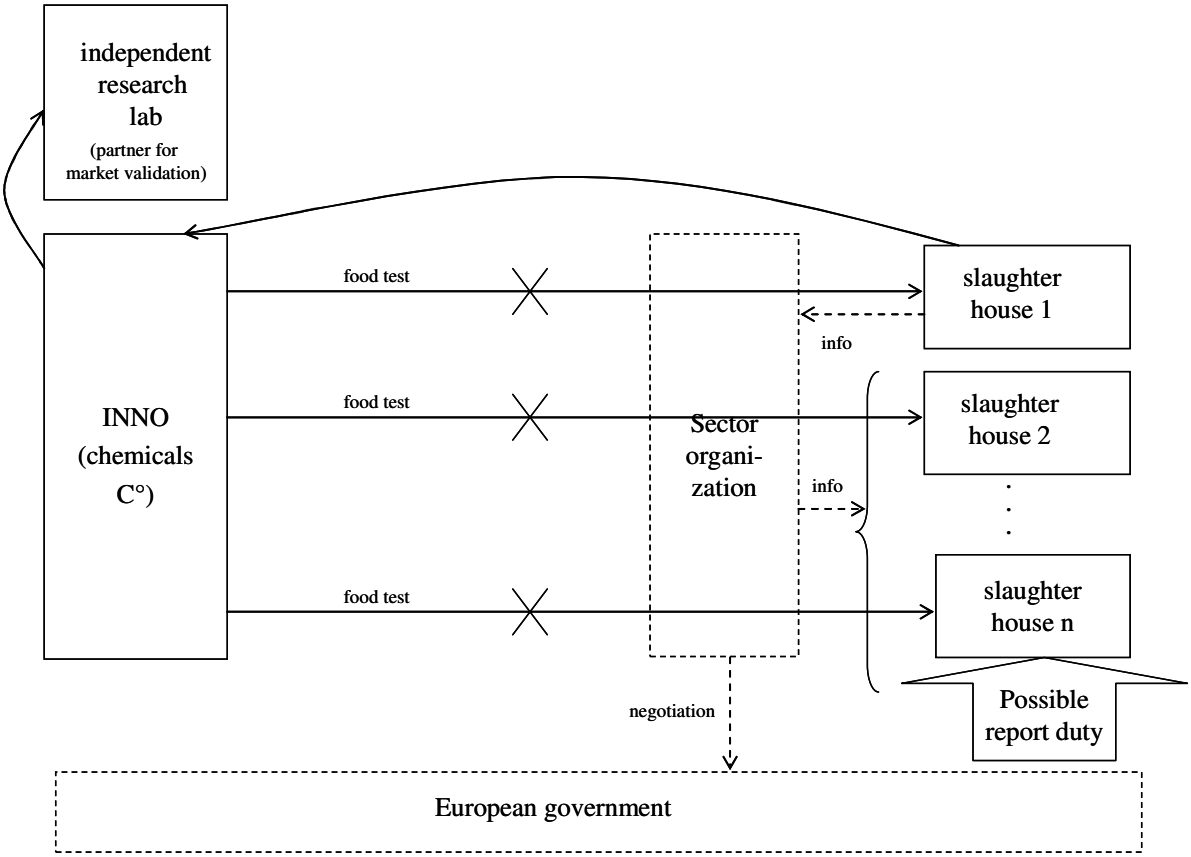

Figure 8: Food Test Case November 2004

Discussion Case 8

Figure 8 shows that the innovating company initially teamed up with an independent research lab for market validation of the newly developed poultry meat test. A first interested customer starts buying the test in 2001. The customer is one of the country's larger poultry slaughter houses. The sector organization to which this slaughter house belongs decides to ask all its members to commit to self testing of their meat by use of the newly developed easy to use and highly reliable food test. Consequently the market for the food test slowly starts to grow. End of 2004 however, rumour spreads that the European government is planning to impose a report duty on all the slaughter houses. This entails that slaughter houses would be legally obliged to report on positively tested meat and that that meat would consecutively have to be

called back to the slaughter house. Since self testing is not legally obliged slaughter houses react by stopping to do the self tests in order to secure their business. This reaction is shown in figure 8 by the strikethrough of the arrows that represent the flow of food test products from the innovating firm to the slaughter houses.

Described above is the situation in November 2004. The rumour was that the European government would impose the report duty from January 1 of 2005 onwards. When getting in touch with the innovating firm in October 2005 for an update on the situation it appears that the European government did not go through with its plans. Unfortunately by now another mechanism is slowing down sales of the food test. Slaughter houses are now shifting responsibility for self testing to the poultry farmers. The reason for this shift is not that too much meat is testing positively, quite the contrary, instead the slaughter houses no longer want to incur the costs related to self testing. Currently farmers are not yet convinced that self testing is their responsibility either. So now the innovating firm faces a situation of slaughter houses reducing their purchase of the food test but farmers not yet buying the food test. This results in yet another (temporary?) restriction for food test sales.

CONCLUSION

Even though this is an intermediate report of an ongoing research a cross case analysis on the eight cases discussed above enables us to formulate some preliminary findings on innovation networks for technology-based radical innovation in industrial markets.

As much opportunities as involving partners for innovation opens up it also adds to the number of factors that can hamper innovation beyond the innovating firm's control. If higher

management within a partnering firm cuts resources to the innovation project all partners experience the constraining effect this action has on the joint innovation process. This goes both for partners upstream in the supply chain as for downstream customer firms. So even though in most cases it is impossible for an innovating firm to have all the needed infrastructure for simulating production processes and customer environments we see that in those cases where a firm does dispose in house of such equipment it is clearly at an advantage over firms who do not in terms of being able to speed up a technological innovation process. Involving partners in an innovation process also entails the risk that partner firms do not follow agreed upon forms of conduct towards other firms in the network or in the industry. Especially with respect to spreading knowledge or engaging in other types of cooperation than those agreed upon with firms in or outside the innovation network can certainly harm the good functioning of the joint innovation process.

Industry concentration also exerts an influence on innovation networks in several possible ways. If an innovating firm finds a customer firm in a (relatively large and) concentrated industry willing to cooperate in its innovation process the innovating firm will usually not hesitate to partner with this customer firm. There are several reasons for this logic. Because of its size the customer firm is regarded as being financial able to see an uncertain radical innovation process through. Also if the customer firm is not the end customer for the innovation under development the size of an industrial customer firm is seen as a proxy of that customer's market. By linking itself to an industrial customer with a large customer base the innovating firm tries to assure his sales.

Partnering with large customer firms however also entails the risk that the customer firm has more negotiation power than the innovating firm does. This disequilibrium in negotiation power results in some cases in the innovating firm having to agree to technical specifications of the customer firm that are outside of the innovating firm's competencies, in other cases it

means that the innovating firm is expected to perform expensive testing activities demanded by the customer firm without the customer firm sharing in the extra costs.

Customer firms that are strategically threatened in the market are more prone to cooperate or even initiate a joint innovation process with an innovating firm. Examples of strategic threats include competitors gaining market share by offering new competitive solutions to the market or organizations that influence the market such as insurance companies or governments issuing regulations that make a firms offer relatively less attractive.

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