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# Faculty of Business Economics

## Master of Management

***Master's thesis***

***AI in the food industry***


**Jade Daems**

**Elien Ann Marie Vavedin**


Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Strategy and Innovation Management

**SUPERVISOR :**

Prof. dr. Jean-Pierre SEGERS

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This paper would not have been brought to a successful ending without a few people who supported us in this research journey.

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This thesis is a result of the collaborative efforts of many, and we are grateful to everyone who contributed to its development.

Jade Daems & Elien Vavedin

**Executive Summary**

1. **Research purpose**

This thesis explores the potential of AI in the Flemish food sector and looks at the role of senior management in influencing the adoption of new technologies within their organizations. The focus is specifically on small and medium-sized enterprises (SMEs), as they make up most of the Flemish food sector **(OECD, 2011; Matt & Rauch, 2020)**.

Flemish SMEs are facing challenges such as rising costs, stricter regulations, and rapid digitalization **(Grosso & Falasconi, 2018)**. AI offers potential solutions for these issues, for example it can enhance efficiency, improve supply chain management, and enable data-driven operations **(Min, 2010; O'Donovan et al., 2015; Peres et al., 2020)** However, SMEs often struggle with limited resources and lack expertise to implement these technologies **(European Commission, 2020).** A key, but underexplored factor in AI integration is the influence that senior management has on the adoption of new technologies.

The objective of this study is thus to examine how members of top management teams influence the adoption of AI in these SMEs. Additionally, this study investigates the barriers and facilitators that top management perceives in the adoption of AI. The study also explores the potential that senior management sees in AI aiding sustainability efforts, in alignment with the 12th SDG (Sustainable Development Goal), which focuses on ensuring sustainable production and consumption patterns.

With the insights gained from this research, this thesis proposes several recommendations for implementation to improve the adoption of AI into the Flemish food sector to strengthen its performance on a global scale.

2. **Research Methodology**

This study uses a qualitative research approach. Our research questions were the following:

Main research question: How do the attitudes of senior management affect the acceptance of AI in the Flemish food industry?

- SQ1: What are the key drivers and barriers to AI adoption in Flemish food SMEs?
- SQ2: How does the mindset of senior executives affect AI integration in Flemish food-focused SMEs?
- SQ3: How can AI adoption in Flemish food SMEs contribute to sustainability in alignment with SDG 12?

In total, twelve semi-structured interviews were conducted, consisting of eleven members of top management teams in Flemish food SMEs and one professional specialized in sustainability reporting.

## 3. Results

**Main research question: How do the attitudes of senior management affect the acceptance of AI in the Flemish food industry?**

The attitudes of top management play a significant role in the acceptance of AI in Flemish food SMEs.

While many top managers recognize the potential of AI, their implementation decisions are often shaped by factors such as past experiences, age, personal beliefs, risk aversion, and other personal characteristics. Most senior managers adopt a cautious, follower-oriented approach in their SMEs. There is often hesitation to adopt until a certain technology's usefulness is established. Key barriers, such as cost concerns, lack of in-house expertise and the "black-box" principle, further reinforce this hesitancy.

It can be concluded that the attitudes of top management play a crucial role in either facilitating or obstructing the adoption of new technologies. Therefore, gaining the support of senior leadership is a vital step toward achieving broader AI integration in the sector. In the following sections, we offer recommendations for industry leaders, policymakers, and other stakeholders to help shift the mindset of both current and future managers, thereby encouraging wider adoption of AI into the Flemish food industry.

**SQ1: What are the key drivers and barriers to AI adoption in Flemish food SMEs?**

Currently, in Flemish food SMEs, AI is mainly used in support processes, for example, in administration. Top management believes that in the future, AI will also influence their core business, production. In production, they identify it as a technology that will optimize machine performance, can aid in reducing human error through predictive maintenance, and can increase quality through automated quality control.

Despite these perceived benefits, senior management perceives several barriers that hinder broader AI adoption. The most significant barriers are the perceived high cost of implementation and the potentially low ROI. Workforce resistance appeared as another challenge identified by senior management, they thought that laborers are untrusting of new technologies since they are scared to lose their jobs due to being replaced. This is reflected in studies of **Ghobakhloo (2020)** and **Suleiman et al. (2022),** which identify a reduced need for low-skilled labor. Two other challenges are the lack of in-house data and the lack of knowledge of AI in SMEs. Lastly, a significant barrier is the "black-box" principle. As top management doesn't know where their information, such as recipes, will end up once they enter it into AI systems, they are scared it will be misused or leaked.

**SQ2: How does the mindset of senior executives affect AI integration in Flemish food-focused SMEs?**

The attitudes of top management teams (TMT) play a pivotal role in determining whether AI is adopted. Although many senior managers acknowledge the potential of AI, their decision-making is often shaped by personal traits such as age, past experiences, and risk aversion. This aligns with the Upper Echelons Theory by **Hambrick & Mason (1984)**, which explains that organizational outcomes reflect the values and cognitive biases of senior management.

Interestingly, many respondents claimed to be comfortable with change. However, deeper reflections revealed that there were varying interpretations of what this meant to them. Some viewed change as something positive, while others saw it as a "necessary crisis." These diverging perspectives resulted in varying attitudes toward new technologies, including AI.

Most senior managers described themselves as "followers" rather than "pioneers." They would rather observe first before implementing. This cautious approach is often linked to past failures, their age, or background. Additionally, senior management associated a financial risk with being an early adopter, further discouraging them from taking a first-mover approach.

While there is a generally positive outlook toward AI, hesitation remains due to the previously mentioned barriers.

**SQ3: How can AI adoption in Flemish food SMEs contribute to sustainability in alignment with SDG 12?**

Sustainability is an increasingly important topic in the SME landscape. Respondents reported implementing sustainability practices such as recyclable packaging, solar panels, and certifications like Fair Trade. In Flemish food SMEs, it became apparent that sustainability is often seen as a strategic decision. Sustainability practices are often influenced by market pressure. As one manager noted, not meeting sustainability standards could negatively impact business performance, since clients tend to favor partners committed to environmental responsibility.

Moreover, it became apparent that regulatory frameworks form a big motivator to implement sustainability practices. For example, due to the Corporate Sustainability Reporting Directive (CSRD), SMEs have been getting increased demands for ESG (Environmental, Social & Governance) data. Although SMEs do not (currently) have a reporting requirement, they do feel the "trickle-down" effect, as they need to provide this data for their larger clients. This creates an enormous administrative burden for these SMEs.

When asked about the potential of AI in this reporting, respondents showed interest but remained hesitant. Some saw AI as a way to reduce the administrative burden, while others raised concerns about data accuracy and the need for human control, which would still make it a time-consuming effort.

Interestingly, senior managers made no other linkages between AI and how/if it could aid them in their other sustainability practices.

This study offers valuable insights into how top management attitudes shape AI adoption in Flemish food SMEs. It identifies key barriers and enablers and explores AI's potential to reach sustainability goals. The findings offer actionable recommendations for supporting digital transformation and inform stakeholders on fostering responsible, future-proof innovation in the sector.

## 4. Critical Considerations and Recommendations

Some limitations were found in conducting this study.

**Changing Landscape**

AI is a fast-developing technology, with new technologies such as DeepSeek being released during the study. Regulations are also constantly changing, such as the EU's "Omnibus" packages, which aim to simplify sustainability reporting requirements, but these may still evolve before implementation.

**Specific Geographical Focus**

This research was conducted in Flanders, Belgium, which limits the generalizability of this study.

**Limited Number of Interviews**

Twelve interviews were conducted, eleven out of twelve respondents were members of the top management team of Flemish food companies, and one was the CEO of an ESG reporting tool. This narrow sample size limits the generalizability of the results of this study.

**Lack of female respondents**

The study had a male-dominated sample (eleven males, one female), reflecting the higher proportion of men in senior roles. This gender imbalance could impact the findings.

This study also proposes some recommendations for policymakers and industry professionals to ease the barriers to AI integration into Flemish food SMEs.

**Stimulating AI in education and lifelong learning**

Integrating AI into school curricula could spark interest in AI-related fields, addressing the shortage of workers skilled in AI in the food industry.

Additionally, providing AI training to employees, including top management, could close the skills gap, reduce resistance, and improve understanding of AI in their roles.

**Lack of transparency of AI applications**

To gain the trust of senior management, AI systems need more transparency into their decision-making process. Senior management needs confirmation that their data will be handled confidentially, for example, through a formal contract or laws.

**Improving data collection in-house**

Many SMEs lack digitalization. SMEs should focus on digitalizing key operations by, for example, installing IoT sensors to gather relevant data. This data will need to be stored in a secure database and can be used for future AI use.

**Administrative burden of CSRD reporting**

Policymakers should simplify or reduce the administrative burden of sustainability reporting for SMEs, as clients often demand extensive data. The EU's Omnibus packages aim to reduce administrative complexity, but these have not been accepted.

**Table of Contents**

**List of Abbreviations**

| Abbreviation | Meaning |
|---|---|
| AI | Artificial Intelligence |
| AGI | Artificial General Intelligence |
| ANI | Artificial Narrow Intelligence |
| ASI | Artificial Superintelligence |
| CDO | Chief Digital Officer |
| CFO | Chief Financial Officer |
| CIO | Chief Information Officer |
| CKO | Chief Knowledge Officer |
| CMO | Chief Marketing Officer |
| COO | Chief Operating Officer |
| CSO | Chief Strategic Officer |
| CSRD | Corporate Sustainability Reporting Directive |
| CTO | Chief Technology Officer |
| ESG | Environmental Social Governmental |
| GHG | Greenhouse Gases |
| HDI | Human Development Index |
| HSDI | Human Sustainable Development Index |
| ICT | Information Communication Technologies |
| IoT | Internet of Things |
| IPCC | Intergovernmental Panel on Climate Change |
| LLMs | Large Language Models |
| MDG | Millennium Development Goal |

| | |
|---|---|
| ML | Machine Learning |
| R&D | Research and Development |
| RBV | Resource-Based View |
| ROI | Return on investment |
| SA | Strategic Asset |
| SDG | Sustainable Development Goal |
| SDI | Sustainable Development Index |
| SMEs | Small and Medium Enterprises |
| TBL | Triple Bottom Line |
| TMT | Top Management Team |
| VUCA | Volatile, Uncertain, Complex, Ambiguous |

## 1. Problem Statement

The Flemish food industry is a vital sector within Belgium's economy. It is known for its strong export activity, rich agricultural base, and innovative capacity **(Invest in Flanders, 2023; Fevia, 2024).** Small and medium enterprises (SMEs) represent a large share of the business landscape within this sector **(OECD, 2011; Matt & Rauch, 2020)**. However, these food SMEs face substantial challenges, including rising costs, more and stricter regulations, and an increasingly digital and global market **(Grosso & Falasconi, 2018).** These challenges threaten the competitiveness of the Flemish food industry.

In response to these challenges, Artificial Intelligence (AI) can be proposed as a potential solution to some of these issues. AI can optimize supply chains, enhance predictive maintenance, and improve inventory management and quality control. These systems can contribute to more sustainable and efficient business practices, making them more competitive **(Min, 2010; Yan et al., 2017; Peres et al., 2020).** The demand for firms to adopt sustainable practices has intensified due to rising societal expectations and stricter regulations **(Tyler et al., 2024)**.

Unlike large corporations, which often have the capital and in-house expertise to adopt such technologies, SMEs operate under more constrained conditions. They usually have limited financial resources and a shortage of specialised staff to implement these technologies **(European Commission, 2020).**

One key factor influencing AI adoption in food SMEs is the attitudes of top management teams (TMTs) toward AI. Research by **Firk et al. (2022)** suggests that the configuration of the TMT plays an important role in driving innovation and technology adoption in an organization. As key decision-makers, TMT members' beliefs, experiences, and strategic outlooks can significantly influence the willingness to invest in and experiment with emerging technologies **(Lo et al., 2020).** When TMT perceives AI as overly complex, costly, or threatening to existing workflows, they may deprioritize or entirely resist its adoption.

This study addresses the gap in understanding the interplay between the attitudes of top management, organizational readiness, and external factors in shaping AI adoption in Flemish food SMEs. By highlighting drivers and barriers, this research offers practical insights for key stakeholders in the food sector, such as policymakers, technology providers, and SME leaders, to support a smoother integration of AI within these food SMEs. Adopting AI into these SMEs will enhance their efficiency and strengthen their competitiveness in the global playing field. Ultimately, this study contributes to the broader conversation on digital transformation in traditional industries.

## 2. Literature Review

### 2.1 Introduction

This literature study provides a comprehensive overview of the evolution of the discipline of Artificial Intelligence (AI), after which its (possible) applications are discussed. Furthermore, the potential applications of AI in the food industry are presented, and potential barriers and enablers that these SMEs might face when implementing AI are discussed. This paper also takes a closer look at the potential for AI to advance sustainability efforts and what these efforts would look like for food SMEs. Moreover, the ecosystem in which food companies operate is presented, which includes the triple helix model. This ecosystem is put forward to understand the interplay between the industry, academia, the government and other players.

For this literature study, information was gathered about artificial intelligence, the food industry, potential AI applications in the food industry, sustainability, innovation, and top management teams. These sources came from Google Scholar and several books. For this research, many search terms were used, including but not limited to:

| | | |
|---|---|---|
| AI | AI benefits | Top management team |
| Artificial intelligence | AI adoption | Sustainability |
| Artificial intelligence | Food industry | Sustainable development goals |
| AI implementation | Flanders food industry | SDG 12 |
| AI barriers | SME | Innovation |
| AI opportunities | SME definition | Responsible innovation |

Table 1: Search Terms Literature Study

### 2.2 Innovation

#### 2.2.1 Definition

The concept of innovation was first introduced in 1942 by the Austrian political economist Joseph Schumpeter **(World Economic Forum, 2021).** Schumpeter divided innovation into five categories: introduction of a new product or a qualitative change in a current product (i), process innovation new to an industry (ii), opening of a new market (iii), development of new sources of supply for raw materials or other inputs (iv) and changes in industrial organisation (v) **(Śledzik, K., 2013, p. 90).**

The Oslo Manual by **OECD & Eurostat (2005)** narrows Schumpeter's definition of innovation to make the concept more concrete. They specifically clarify product innovations (i) and process innovations (ii). Product innovations involve creating new or significantly improved products with distinct characteristics from earlier versions. In contrast, process innovations focus on developing new or enhanced methods of production **(OECD & Eurostat, 2005, p. 49).**

### 2.2.2 Radical, Disruptive, and Incremental Innovation

Radical innovations focus on entirely new solutions, targeting customers with simpler needs and redefining the market. **Dahlin & Behrens (2005)** state that a successful radical innovation is novel (i), unique (ii), and has an impact on future technology (iii) **(p. 718)**.

In his book "The Innovator's Dilemma," **Christensen (2015)** defines disruptive innovation as technologies that cause a market disruption. This type of innovation occurs when a new product, despite being inferior, replaces an established product in the market. For disruptive innovations, the existing product typically exceeds most customers' needs, with the old business model emphasizing high-end features **(Edwards-Schachter, 2018).**

A third form of innovation is incremental innovation, which is small improvements to existing products, processes, and services **(Bhaskaran, 2006)**.

### 2.2.3 Openness of the Firm

Firms can pursue both closed and open innovation.

In closed innovation, all activities are carried out within the firm itself. This includes everything from creating new ideas and conducting research and development (R&D) to producing and distributing the products generated by those ideas **(Chesbrough, 2003).**

In contrast, more and more firms are pressured to become more open. Chesbrough identified two trends that might be the reasons for this shift. One is the rising costs of R&D, and the other is the briefer product life cycles **(Chesbrough, 2007).** The open innovation paradigm says that firms should not only be focused on ideas developed inside the firm (internally focused) but also pay attention to ideas generated outside the firm (externally focused) since these could be beneficial to the company and its technology goals **(Chesbrough, 2003).** The degree of openness of a firm can enhance its value creation by utilizing more external ideas, which in turn boosts its capacity for innovation **(Laursen & Salter, 2006; Chesbrough, 2007).**

The book **Reinventing Innovation** by **Ramge & Laguna de la Vera (2023)** deepens the concept of open innovation by highlighting that open innovation depends on a collaborative environment, where knowledge and data are exchanged as public goods. Moreover, the study stresses that open innovation doesn't only depend on internal and external idea exchange, but also calls for laws, regulations, or government initiatives that allow for open innovation to thrive, such as open data access and fair patents.

## 2.3 Artificial intelligence

When talking about innovations, an important concept is Artificial Intelligence (AI).

### 2.3.1 Definition and Origin

At the Hanover Fair in 2011, the theory of Industry 4.0, also called "The Fourth Industrial Revolution," was introduced by a team of scientists working for the German government. Industry 4.0 follows previous industrial revolutions typified by steam-powered mechanization (i), electricity (ii), and information and communication technologies (ICT) (iii) **(Culot et al., 2020)**. However, the fourth industrial revolution differs since it refers to the shift from machine-dominant manufacturing to digital manufacturing **(Oztemel & Gursev, 2020).**

**Lasi et al. (2014)** define two development directions in Industry 4.0. On the one hand, we have the concept of "pull." Pull refers to the need for adaptation due to changing circumstances. For example, development times become shorter. Quick innovation is key to gaining a competitive advantage for many companies. Other examples include the need for higher flexibility and resource efficiency, which are crucial to successfully competing in high-demand markets.

On the other hand, we have the concept of "push." In Industry 4.0, new technologies and processes are constantly being introduced in various industries. An example of a process stemming from Industry 4.0. is digitalization. It is "going from analog to digital" **(Yasar & Hanna, 2023)**. An example of a technology stemming from Industry 4.0 is automation, which can be referred to as "the technique of making an apparatus, a process, or a system operate automatically" **(Wollschlaeger et al., 2017; International Society of Automation, n.d.)**. Building on automation, technologies including AI (artificial intelligence), ML (machine learning), big data, Internet of Things (IoT), and cloud computing are introduced **(Jan et al., 2023)**. Lastly, mechanization, which is also related to automation, stems from Industry 4.0, which is symbolized by industrial robots that take over production workers' jobs **(Gunn et al., 1982).**

A **2020** study by **Ghobakhloo** predicts that Industry 4.0 will play a significant role in how individuals and organizations work due to its exponential growth. Computers and intelligent machines are interconnected and communicate in this revolutionary era. Machines can act fast in unforeseen circumstances while connected to the cloud, to each other, and to central control systems. This capability can lead to a decreased need for low-skilled jobs (such as factory laborers) and an increased need for workers skilled in machine learning and software engineering **(Ghobakhloo, 2020; Suleiman et al., 2022)**.

As businesses began learning about and implementing technologies related to Industry 4.0, the European Commission released a report on the Fifth Industrial Revolution (Industry 5.0). While Industry 4.0 primarily focuses on AI-driven technologies and industries, it often neglects social responsibility. Here, Industry 5.0 has its role, calling for human-centric industries to combine human intelligence with intelligent machines. In other words, people work together with machines. This way, both the strengths of the intelligent machines and humans are combined to achieve higher productivity and production quality. Moreover, in Industry 5.0, there is a higher focus on human creativity. Intelligent machines and factories are used in Industry 5.0 to express human ideas in real-world products or services **(Nahavandi, 2019; Xu et al., 2021; Golovianko et al., 2023; Wolniak, 2023).**

### 2.3.2 Subsets of AI

It is widely established that John McCarthy, a computer scientist, was one of the founders of the field of artificial intelligence, and he formally introduced the world to the concept at a Dartmouth College conference in 1956 **(Haenlein & Kaplan, 2019)**. AI is a domain of computer science and can be defined and interpreted in various ways **(Haenlein & Kaplan, 2019)**. According to **Bini (2018),** the most common definition is: "*Human intelligence exhibited by machines*" **(p. 1)**. **Sheikh et al. (2023)** add that AI is used to perceive and pursue goals, initiate actions, and learn from feedback loops **(p. 16)**. AI consists of smart machines and learning algorithms that can learn with no or minimal interference from humans **(Ng et al., 2021).**

Although big data, IoT, and cloud computing are critical in Industry 4.0, artificial intelligence is undoubtedly the leading component, enabling industries to drive automation, make real-time decisions, and enhance productivity **(Ahmed et al., 2022)**.

At first, AI was seen as an academic discipline and gained little to no attention. Some research was conducted on AI in the past decades, but no real breakthroughs were achieved. Moreover, since AI was expected to deliver more than it did in the first decades after its introduction, it was seen as a "failure." This was until 2015 when AI made its public comeback, and a computer could beat a human in a game called "Go," a board game popular in Asia. Experts thought this would never be possible due to the game's complexity. However, because of deep learning systems, imagination has become a reality **(Haenlein & Kaplan, 2019). Strickland (2021)** adds that the breakthrough of AI was also linked to the boom of the World Wide Web (WWW). While the World Wide Web was blossoming, the data generated and captured increased significantly. The growing amount of data can be used to train the neural networks of AI systems, forming a positive breakthrough in AI development.

As shown in Figure 1 below, artificial intelligence itself has multiple subfields.

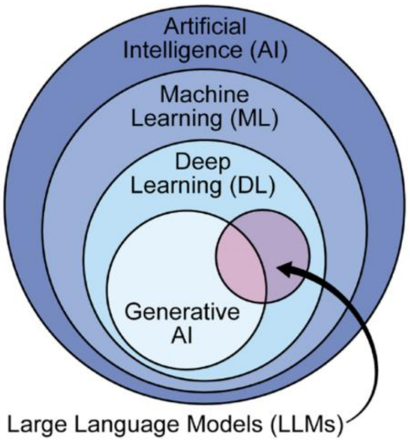


Figure 1: Fields of AI **(Shahab et al., 2024)**

Machine Learning

One AI field is machine learning (ML). Machine learning aims to create intelligent systems that can execute tasks usually done by humans, such as quickly pinpointing patterns in data, natural language processing (text and speech recognition), and computer vision **(Mahesh, B., 2020)**. The systems can perform these tasks without humans telling them exactly how **(Brynjolfsson & McAfee, 2017)**. Therefore, ML is often referred to as a "black box." Scientists know the input and get an output, but the calculations are complex and often unknown **(Farahmand, 2022).**

The main task of machine learning systems is processing data. The ML model accepts data of all kinds (input) and gives a label to the data (output). Therefore, the primary aim of ML systems is to learn from existing data. With the knowledge of this existing data, ML can build models from new, unseen data in the future **(Kneusel, 2023).**

According to **Aggarwal et al. (2022) & Rajoub (2020)**, machine learning can be divided into three categories:

1) **Supervised learning** relies on labelled data to map an input variable (x) to an output variable (y). This happens under human supervision.
2) **Unsupervised learning** helps find hidden patterns in unlabeled data without human supervision.
3) **Reinforced learning** combines supervised and unsupervised learning, where systems learn from their mistakes.

The main difference between AI and ML can be found in the difference in the goals of both systems. On the one hand, AI aims to enhance the chances of success, for example, by solving problems to increase the possibility of a desired outcome. On the other hand, ML wants to improve the accuracy of the output **(Aggarwal et al., 2022)**.

Deep Learning

Another field of AI is deep learning. Deep learning makes the computation of multi-layered networks feasible. It combines input layers with multiple extra hidden layers (the "deep" layers). Each level or layer is more abstract.

The main purpose of deep learning is to develop learning algorithms from data. No human interaction is involved in this process **(LeCun et al., 2015).** Deep learning aims to create a model similar to the human brain. Deep learning makes it possible to learn quickly from large amounts of data. Deep learning can find data connections so quickly that it is hard for humans to imitate this speed of learning **(Aggarwal et al., 2022)**.

Deep learning is used for speech recognition, visual object recognition, which identifies what an object is, and object detection systems that can identify both what and where an object is. Deep learning can be found in production processes in manufacturing industries such as the food industry. For example, DL can help industries detect failures. By identifying and notifying if an odd-shaped object passes control points **(Khalil et al., 2021).** With this example in mind, it is clear that deep learning can simplify processes significantly **(LeCun et al., 2015).** By combining the previously mentioned deep learning systems, computers, systems, and machines can communicate with each other and make decisions with little to no human interaction **(Ghobakhloo, 2020)**.

Generative AI

Generative AI is referred to as "*Machine learning technologies that can generate new content, such as text, images, music, and video, by analyzing patterns in existing data*" **(Brynjolfsson et al., 2025, p. 7).** As shown in Figure 1, generative AI has emerged as a subset of deep learning.

Generative AI is currently used in multiple applications. For example, generative AI is used in customer service by having automated chatbots to help customers with questions. Moreover, generative AI can help companies design advertising campaigns and aid in human resources processes **(Fui-Hoon Nah et al., 2023).**

Large Language Models

Large Language Models (LLMs) are a part of generative AI. It can be best understood by referring to the concepts of public distribution tools such as ChatGPT, which use generative AI to produce output **(Brynjolfsson et al., 2025)**. Where generative AI is an umbrella term encompassing the production of images, music, and video, LLM purely focuses on generating text. Making it possible to speed up the writing process **(Jo, 2023).**

### 2.3.3 Stages of AI

In AI, we can observe different stages the concept can evolve into, namely, artificial narrow intelligence (ANI), artificial general intelligence (AGI), and artificial super intelligence (ASI). These different stages are explained in more depth in Figure 2**.**

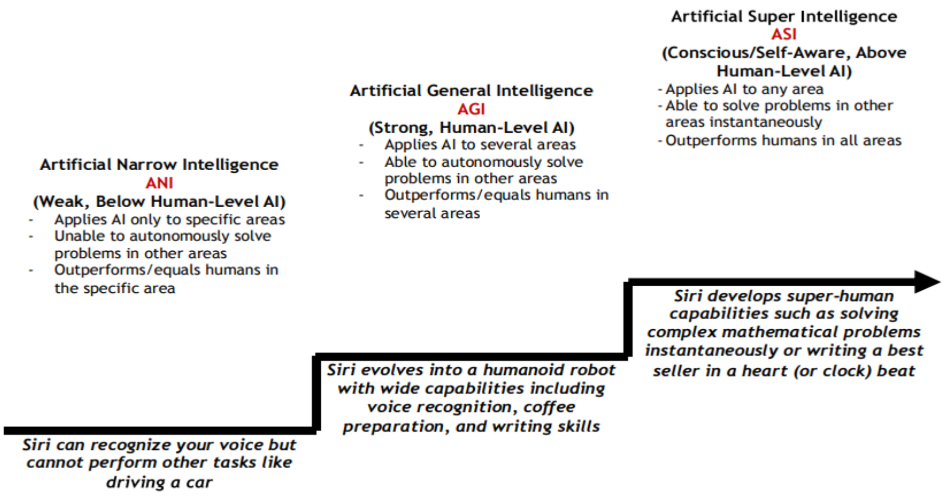


Figure 2: Stages of Artificial Intelligence **(Kaplan et al., 2019)**

Artificial Narrow Intelligence (ANI)

Nowadays, a life without AI is nearly unimaginable. Artificial intelligence is present in our day-to-day lives in unexpected ways. Think of Apple's Siri, which can recognize your voice, Facebook's "tag" system that can identify faces, and Tesla or Waymo, which manufacture self-driving software for cars **(Kaplan et al., 2019, p.16).**

All systems mentioned above work with artificial narrow intelligence (ANI), a technology that applies deep learning AI to specific tasks **(Kaplan et al., 2019). Suleyman (2023)** defines ANI as: "*The ability to learn machine-humanlike capabilities*" **(p. 8). McLean et al. (2023)** add to this explanation that ANI is task-specific and cannot be transferred to other domains in which the system isn't trained. For example, Apple iOS is trained to recognize your voice but cannot drive a car since it is not trained to perform that specific action **(Kaplan et al., 2019, p. 16).**

Artificial narrow intelligence is the form of AI that is currently most commonly used because other areas of AI are still in their early phase of development **(Saxena, 2024).**

Artificial General Intelligence

The second stage of artificial intelligence is artificial general intelligence (AGI). AGI is seen as the next generation of AI: the concept would enable systems to learn unsupervised **(McLean et al., 2023). Suleyman (2023)** describes AGI as: *"AI that can perform all human cognitive skills better than the smartest humans*" **(p. 8).** AGI has not been introduced yet, but it is highly expected to be launched for use anywhere between 2040 and 2070 **(McLean et al., 2023).**

**Kaplan et al. (2019)** add that, in the future, AGI systems could potentially think about and solve problems they were not explicitly designed for. For example, in a theoretical AGI scenario, Apple's iOS can recognize voices. Moreover, she might even be able to drive a car by generalizing earlier observations (recognizing stop signs, understanding traffic lights, …). However, as of now, these capabilities don't exist yet **(Saxena, 2024; Kaplan et al., 2019, p. 16).**

In recent years, LLMs have gained a lot of popularity. As shown by their recent work, the impressive performance of LLMs has sparked enthusiasm that they may represent AGI in this era. This can be explained by their ability to solve diverse tasks, whereas previous models were mainly focused on solving one task **(Chang et al., 2024).**

Artificial Superintelligence

A stage of AI that goes beyond AGI is artificial superintelligence (ASI). **Bostrom (1998)** defines superintelligence as: "*An intellect that is much smarter than the best human brains in practically every field, including scientific creativity, general wisdom, and social skills"* **(p. 1)**. So, ASI is expected to have new capabilities that humans don't have at all. These ASI systems use the internet as their memory and apply machine learning algorithms to big data at lightning speed. This manner of working can develop ASI systems into a "super robot" **(Nowak et al., 2018; Mainzer & Mainzer, 2020, p. 220-221)**.

A theoretical example of artificial superintelligence is an advanced version of Apple's iOS that can recognize voices and quickly solve complex mathematical problems far beyond human comprehension. Once again, such capabilities do not yet exist **(Kaplan et al., 2019, p. 16).**

The opinions about the implementation of ASI are divided. Some believe that ASI will become a brilliant general reasoning system that is not very different from the current AI systems. Others believe that ASI will be an extension of AGI or will even become more intelligent than humans **(Narain, 2019).**

#### 2.3.4 Responsible Use of AI

In the early years of this decade, the concept of "Responsible Innovation" was introduced by the European Commission. It aims to innovate while fostering society's current needs, values, and standards. This is important to mitigate risks, including overdependence on AI, biased training data, data abuse, and job losses **(Owen & Pansera, 2019; Roy, 2021).**

While responsible innovation is primarily theoretical, multiple frameworks make it more tangible. The first framework is "The Framework for Responsible Innovation" by **Owen & Stillgoe (2013).**

**Owen & Stillgoe (2013)** use four pillars to address innovation questions. The first is *"Anticipation,"* which aims to foresee potential successful technologies. Building on that, the pillar *"Reflexivity"* is introduced. Reflexivity refers to the process of self-awareness and critical reflection by innovation practitioners. Thirdly, the concept of "Inclusion*"* is introduced. Inclusion aims to include a broad range of stakeholders in the innovation process. Lastly, "Responsiveness*"* is mentioned. By being responsive, innovators remain adaptive to changing needs, challenges, and feedback during innovation.

The second innovation framework introduced is **Roy's** "The Responsible Innovation Framework" **(2021)**. Figure 3 shows how laws, market forces, and technology can form norms within the ecosystem **(Roy, 2021)**. It is important to note that this framework aims at a global-based implementation. It focuses on uniform ethical codes rather than contextual challenges. Responsible innovation is at the center of the framework. To be responsible, an innovation must be delightful and trusted (i), which means there is a good balance between creating enjoyable, engaging experiences and maintaining transparency, ethics, and user trust. Moreover, the innovation needs to be dependable and inclusive (ii), which means the system's performance needs to be consistent, and accessibility needs to be as high as possible. Lastly, innovation needs to be open and safe, which means finding the right balance between openness and public safety (iii) **(Roy, 2021).**

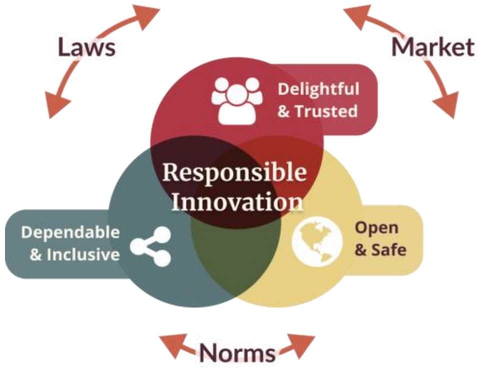


Figure 3: Responsible Innovation Framework **(Roy, 2021)**

Whereas the frameworks mentioned above focus on broad innovation, **Buhman & Fieseler (2021)** offer a narrower view of responsible innovation, mainly focused on the responsible use of AI. They add dimensions such as “to do good” to the sustainable innovation criteria. Hereby, they use AI as a tool to foster inclusion, equity, and public value creation. The overarching objective is to improve living conditions and advance societal well-being **(Buhman & Fieseler, 2021).**

### 2.4 Strengths, Weaknesses, Opportunities, and Threats of AI (SWOT)

Developed in the 1970s, the SWOT analysis is a strategic management tool that analyses a business's internal and external environment. SWOT is an abbreviation for the strengths, weaknesses, opportunities and threats to a business. This framework is essential to understand and identify a firm's strengths, take its weaknesses into account, take advantage of its opportunities, and minimize the impact of potential threats **(Gurl, 2017; Wheelen et al., 2018)**.

What follows is the SWOT analysis applied to the concept of AI and what strengths and weaknesses it has, and which opportunities and threats it poses to our society.

<u>Strengths</u>

As **Ahmed et al. (2022)** state, a strength of AI is that it can automate many processes, which allows companies to perform tasks quickly and accurately, reducing human-induced mistakes. Moreover, AI creates something called the “always-on” economy, referring to the fact that AI systems never get tired and don’t need sleep, meals, or vacations. This allows companies to work 24/7, guaranteeing, for example, continuous customer service and engagement, something the human workforce can almost impossibly achieve **(Rosenbush, 2025)**.

Lastly, AI is very versatile. The industries in which AI is applied are extensive. Think of science, infrastructure, finance, medicine, transportation and manufacturing **(Shukla et al., 2013)**.

Weaknesses

The unethical use of AI is a weakness **(Roy, 2021).** Additionally, AI data can be inaccurate, leading people to produce wrong content or generalise data, which can lead to more inaccurate results and conclusions **(Bakiner, 2024).**

Furthermore, the "black box" principle is often referred to as a weakness. Machine learning systems can perform certain tasks without humans instructing them exactly how **(Brynjolfsson & McAfee, 2017)**. Therefore, ML is often referred to as a "black box." Scientists know the input and get an output, but the calculations are complex and often unknown **(Farahmand, 2022).** This may lead to distrust by stakeholders, as they don't know how AI made a certain decision.

Moreover, AI training data might be biased **(Buhman & Fieseler, 2021)**. **Roselli et al. (2019)** define bias in AI as: "*Inclination or prejudice of a decision made by an AI system which is for or against one person or group, especially in a way considered to be unfair*" **(p. 3)**. Bias in this training can thus lead to unfair or discriminatory outcomes. For example, some groups are preferred over other groups in AI outcomes. If you upload a resume as a woman, AI will be more likely to give it a red light than when you upload a resume as a man. The bias in this training data is mainly introduced by humans or by systems created by humans **(Roselli et al., 2019; Wolf, Z. B., 2023)**.

Opportunities

The positive role of AI is not to be underestimated. AI can create "smart industries" where computers can make independent decisions based on real-time data. This can continuously inform companies about customer preferences, economic variables and position trends. These insights can allow companies to become more competitive **(Javaid et al., 2022, p. 83).**

Moreover, AI is expected to create many job opportunities across various industries **(Nübler, 2016).**

Another crucial point in which AI can positively impact is sustainability; AI can help to potentially solve the current climate crisis **(Nishant et al., 2020).** In **2024,** the **World Economic Forum** published an article claiming that "*AI is an accelerator for sustainability, but it is not a silver bullet.*" This refers to the fact that AI can aid in achieving sustainability goals, but it also has limitations. Moreover, AI can aid in sustainability efforts by, for example, making suggestions for sustainable production materials **(Mendelsohn, S., 2024).**

Threats

As mentioned, AI has much potential. However, AI also poses a lot of risks.

**Dargham et al. (2024)** give an excellent overview of common threats using ANI systems. Firstly, overdependence on AI systems means the inability of companies to rely on their own decision-making. AI can develop quick and accurate recommendations and solutions, influencing human decision-making.

Furthermore, AI is estimated to lead to the loss of around 800.000 jobs worldwide by 2030. These jobs will mainly be jobs that can be automated, such as factory laborers, bookkeepers, and secretaries **(Dargham et al., 2024, p. 76)**. **Ng et al. (2021)** add that job losses will be more severe for women. This is because the jobs that will be most affected are mainly held by women.

Moreover, whereas we often see research on how AI can help make industries more sustainable, another side of AI is forgotten—the sustainability of AI systems themselves. Research shows that to develop just one deep-learning language processing model, approximately 272155 kg of carbon dioxide is expelled. This equals the emissions that five cars emit in their lifetimes **(Kindylidi & Cabral, 2021, p. 2).**

Moreover, research shows that LLM models such as ChatGPT will consume 30% of worldwide energy if this trend continues. The reason for the mass carbon emissions and extensive energy consumption can be found in the training of AI systems. Training AI systems requires a substantial amount of energy. To train an LLM model with 500 billion words, 1287 MWh of electricity is needed. This is comparable to the yearly energy consumption of 121 American households.

Furthermore, ML models require vast amounts of data to be trained on, which must be stored. The data centers consume a lot of energy, and they must also be cooled. To do so, a lot of water is needed; the global demand for AI will lead to between 4.2 and 6.6 billion cubic meters of water withdrawal in 2027. This is about half of the demand for water in the UK over one year **(Li et al., 2023, p. 1; Bolón-Canedo et al., 2024, p. 1).**

Lastly, more serious threats are introduced within the emerging AGI and ASI stages. For example, the theoretical concept of a "vicious supermind." This refers to the possibility of AI surpassing human intelligence, creating competition between AI and humans. This means that AI systems can access military applications, and they would be able to wipe out humanity altogether **(Nowak et al., 2018). Makridakis (2017)** adds in his study that if the "vicious supermind" becomes a reality, humans will have little to nothing left to say in this society. They will simply become the computer's pet.

### 2.4 Digital Transformation

The "digital transformation" concept is crucial to Industry 4.0 and 5.0. The concept of digital transformation is split into three parts: digitization, digitalization, and digital transformation. Figure 4 gives a comprehensive overview of each of the stages and their meaning **(Quixy, n.d)**.

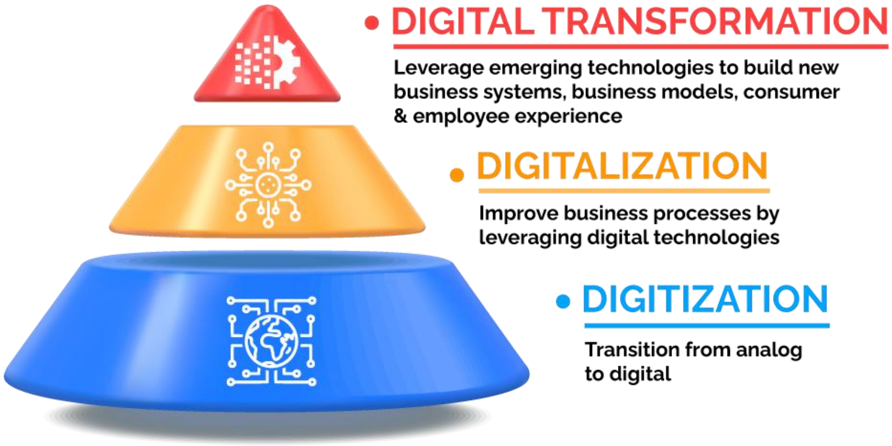


Figure 4: Digitization, Digitalization, Digital Transformation **(Quixy, n.d)**

Starting with digitization, digitization can be defined as "*going from analog to digital"* **(Yasar & Hanna, 2023)**. This process aims to allow computers to capture, analyse, and transfer data. Digitalization, the next phase, then focuses on how digital technologies can adapt existing business processes. An example of digitalization is a company setting up a webshop **(Verhoef et al., 2021).** Digital transformation, the last phase, builds on this concept and can be defined as "*using digital technologies to create new or modify existing business models and processes or to support the transformation of organizational structures, resources, or relationships with internal and external actors*" **(Plekhanov et al., 2023, p. 821).**

Digital transformation forces companies to rethink their business due to two factors. The first is changing customer expectations due to the increased ability to communicate and access diverse information sources. The second is fast innovation, which leads to established companies being surpassed by new digital firms **(Verhoef et al., 2021).**

**2.5 Triple, Quadruple, and Quintuple Helix Model**

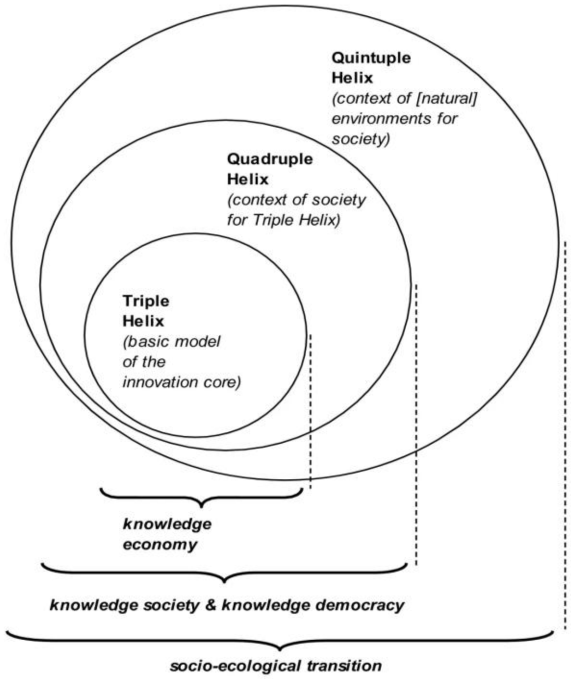


Figure 5: Knowledge production and Innovation in the Context of the Knowledge Economy, Knowledge Society (Knowledge Democracy), and the Natural Environments of Society. Modified from **Carayannis and Campbell (2012, p. 18)**, **Etzkowitz and Leydesdorff (2000, p. 112)**, and **Danilda et al. (2009)**.

<u>Triple Helix Model</u>

To see how the role of the environment can be integrated in the innovation process, it is necessary to introduce the concept of the "triple helix model." The triple helix concept explains the relationship between and roles of the government, the industry, and academia in the innovation process to foster economic and social development **(Etzkowitz & Leydesdorff, 1995)**. The focus is on a configuration between the three actors, as shown in Figure 6. In the model, academia is a hub for generating new technologies and knowledge, meaning it takes on a more entrepreneurial role. The industry is the production site, and the government is the regulatory entity **(Etzkowitz, 2003)**. This is the most basic configuration of the concept, as seen in Figure 5.

The framework shows the relationships between the three nodes and how they interact. Specifically, how they each increasingly "take on each other's role," meaning that the more they interact, the more they adopt some of the characteristics of their partners **(Etzkowitz & Leydesdorff, 1998)**. Additionally, Etzkowitz & Leydesdorff claim that combining forces and collaborating is more productive and cost-effective (**Etzkowitz & Leydesdorff, 2000).**

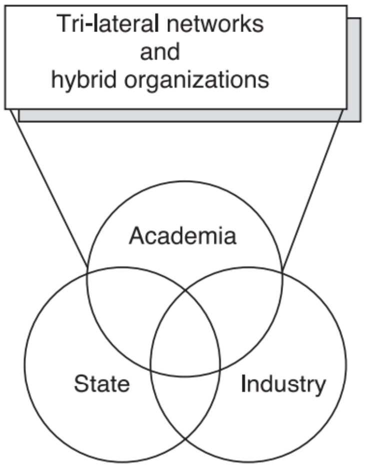


Figure 6: Triple Helix Model **(Etzkowitz & Leydesdorff, 2000)**

<u>Quadruple & Quintuple Helix Model</u>

An extension of the triple helix model was introduced by **Carayannis & Campbell (2009)**, where they added a fourth helix, dubbed "culture and media-based public." This fourth helix adds the public and civil society to the model, influencing innovation and adding another dimension, as shown in Figure 7 **(Carayannis & Campbell, 2009)**. This extension of the triple helix model thus adds the society as seen in Figure 5. In 2010, a fifth dimension was added. The "natural environment" added environmental consideration to the framework. The Quintuple Helix Innovation model now includes the importance of sustainable development and new "green" technologies. This is also visualized in Figure 5. **(Carayannis & Campbell, 2010; Carayannis et al., 2012).**

According to **Carayannis & Campbell (2010**), their Quintuple Helix model poses the following pivotal question: "How do knowledge, innovation & the natural environment relate to each other" **(p. 42)**.

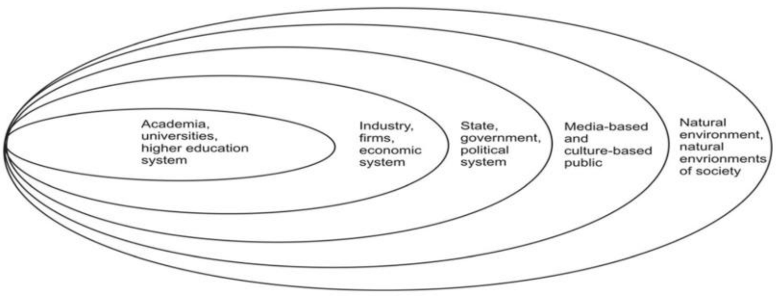


Figure 7: The Subsystems of the Quintuple Helix Model **(Carayannis & Campbell, 2010)**

**2.6 Sustainability**

The World Commission on Environment and Development (WCED), also known as the Brundtland Commission, popularized the term "sustainable development" after releasing its **Brundtland**

**Report** in **1987**. This report provided the most accepted definition of sustainable development: *"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* **(Brundtland, 1987, p. 40)**. Encapsulating the concepts of development, current needs, and the needs of future generations **(Tomislav, 2018)**.

Sustainability can also be defined in the social context (social sustainability), economic context (economic sustainability), and environmental context (environmental sustainability) **(Goodland, 1995)**. **Goodland (1995)** also defines the goal of environmental sustainability as: *"To improve human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, to prevent harm to humans"* **(p. 3)**.

In its 2018 report on global warming, the Intergovernmental Panel on Climate Change (IPCC) warned that failing to eliminate greenhouse gas (GHG) emissions within three decades could result in severe consequences for our planet **(IPCC, 2018)**. Economic activities are the primary drivers of global warming. This is primarily due to energy-intensive production processes that rely on burning fossil fuels (such as oil, coal, and gas) for energy. The resulting climate change has severe environmental impacts, including increased extreme weather events like floods and droughts **(Chichilnisky, 1997; Hirabayashi et al., 2008; Karl et al., 2009).**

The effects of climate change are already being felt globally, but it also impacts the business environment. As stated by **Henisz, Koller & Nuttal (2019)**: *"Every company uses energy and resources; every company affects and is affected by the environment"* **(p. 1)**. Thus, sustainability is gaining importance in today's business landscape. According to **Costanza & Patten (1995)**, the basic idea of sustainability can be defined as: *"A system which survives or persists"* **(p. 193)**.

### 2.6.1 Triple Bottom Line Framework

Triple bottom line (TBL) is a term coined by **John Elkington (1994)**. TBL is a framework that measures a firm's performance based on social, economic, and environmental or ecological pillars. These pillars are often called "people, profit, and planet." Figure 8 shows the TBL framework as three overlapping rings, indicating the overlap between the categories. The TBL approach considers how the company contributes to the economic system and how much environmental and societal value it generates or diminishes **(Elkington, 1997; Goel, 2010).** Table 2 below illustrates potential reporting measures a firm could include in its TBL.

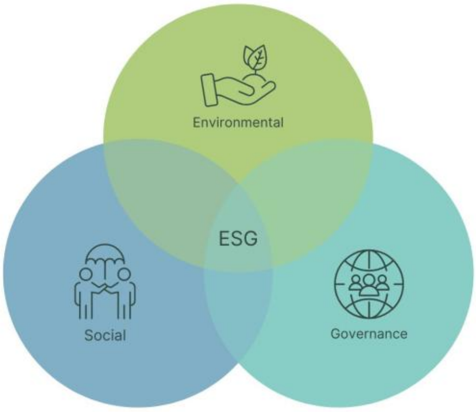


Figure 8: Triple Bottom Line Framework **(Elkington, 1994)**

| **Economic measures (Profit)** | **Social measures (People)** | **Environmental measures (Planet)** |
|---|---|---|
| Amount of taxes paid,<br>employment,<br>business diversity factors. | Health and well-being,<br>quality of life,<br>charitable contributions. | Water consumption,<br>greenhouse gas emissions,<br>the amount of waste sent to the landfill. |

Table 2: Triple Bottom Line Framework **(Slaper & Hall, 2011)**

To make it easier for firms to be more sustainable, focusing on the future of their business and the world around them by implementing sustainable development into their business practices and strategies, sustainable development can be translated into 17 Sustainable Development Goals or SDGs.

### 2.6.2 Sustainable Development Goals

Definition

In 2015, in New York, at the United Nations Summit on Sustainable Development, all states of the United Nations adopted the 2030 Agenda for Sustainable Development **(United Nations, n.d.).** The Sustainable Development Goals' agenda is to fight against several global challenges, such as climate change, poverty, and inequality **(Carpentier & Braun, 2020).** The sustainable development framework comprises 17 goals linked to 169 targets **(Stafford-Smith et al., 2017)**.

The Agenda for Sustainable Development extends the previous Millennium Development Goals (MDGs). In the MDGs, 48 indicators on topics such as poverty reduction, education, gender, equality, disease control, sustainability, and global partnerships were introduced **(World Health Organization, n.d; Hák et al., 2016)**. As the 2015 MDG Agenda came to an end, the Sustainable Development Goals (SDGs) were introduced. The central overlap between the MDGs and the SDGs is the link between both goals' economic, social, and environmental aspects. Moreover, the MDGs and the SDGs focus on doing well on these three pillars for current-day and future generations **(Stafford-Smith et al., 2017).**

**Halkos & Gkampoura (2021)** give a clear overview of the Sustainable Development Framework's 17 goals.


Figure 9: The Sustainable Development Framework **(United Nations, n.d.)**

The SDG framework provides a valuable tool for companies to tap into global problems. Many companies will work on several SDG goals, as they are no longer seen as a mere "profit mechanism." A **2023** study by the **World Economic Forum** reveals that 98% of CEOs believe it is their duty to make their business more sustainable. This number increased by 83% compared to 2013. This implies that businesses nowadays should also comply with environmental and societal standards. However, SDG implementation is not mandatory for companies; how they apply SDGs in their operations is their own choice and often depends on consumer pressure and regulatory pressure **(Grainger-Brown & Malekpour, 2019; Sodhi et al., 2022; Rademacher et al., 2023)**.

The difference between the SGDs and other development agendas can be found in the multifaceted and overarching scope of the goals **(Pradhan et al., 2017).**

<u>SDG 12</u>

In this study, SDG 12, which emphasizes the importance of sustainable practices in the food industry, plays an essential role.

According to the Food and Agriculture Organization of the United Nations, each year, around one-third of all food produced intended for human consumption is lost or wasted **(Gustavsson et al., 2011)**. The UN Sustainable Development Goal framework addresses this food waste issue in SDG 12: "*Ensure sustainable consumption and production patterns"* **(United Nations, 2015)**.

The objective of this SDG is to focus on two aspects of production and consumption:

1. Promoting more efficient production processes **(Bengtsson et al., 2018).**
2. Reducing the overall food consumption **(Bengtsson et al., 2018)**.

**Gasper et al. (2019)** give an overview of SDG 12 with its eight main categories: implementing the framework (i), production efficiency to the use of natural resources (ii), food production and supply-related losses (iii), management of chemicals and waste (iv), sustainable corporate practices and reporting (vi), sustainable public procurement (vii), and information for sustainable lifestyles (viii) **(p. 85)**.

In 2018, the government of 71 countries and the European Union officially reported their efforts and progress in implementing SDG 12. These reports include, for example, macroeconomic policies and regulatory measures. To help the participating UN countries achieve SDG 12, the United Nations and the European Union have introduced 925 policy initiatives, including production and trade policies **(United Nations, 2018; Mensah et al., 2024).**

One example of such a policy is the Farm to Fork initiative of the European Commission, which includes the realisation of a European-wide network of protected areas on land and at sea. The Farm to Fork strategy aims to halt biodiversity loss. This way, it wants to live up to SDG 12.1 "Implementing the framework" and 12.2 "Production efficiency to the use of natural resources" **(Fetting, 2020, p. 15).**

Another initiative introduced by the European Union is the EU platform on food losses and waste. This platform forms the bridge between public EU institutions, such as EU member states, and actors in the food value chain, such as end users and non-governmental organisations. It supports plans to describe measures to decrease food waste, share best practices, and assess the progress that has been made **(Goodland, 1995; European Commission, n.d; Garske et al., 2020, p. 8).**

Whereas these indicators and initiatives form a solid foundation for SDG 12, research shows that the SDG strongly influences production issues but fails to tap into consumption issues. This problem can be linked to the broad scope of SDG 12; it is impossible to consider all eight SDG categories when coming up with concrete actions **(Mensah et al., 2024).**

In addition, **Amos & Lydgate (2020)** explain that the implementation of SDG 12 is the hardest in the so-called consumption economies. These economies are primarily found in the European Union, where the research of this paper occurs, but also in the United States and China **(World Population Review, n.d; Amos & Lydgate, 2020)**. Furthermore, research by **Pradhan et al. (2017)** shows that SDG 12 is the SDG that is the highest associated with trade-offs. For example, in order to adopt sustainable practices, investment costs can be quite high, which in turn impacts profits. This means that to achieve this SDG, other SDGs are likely to suffer. This shows the complexity of implementing SDG 12 **(Zhu et al., 2022).**

<u>Sustainable Development Index</u>

The Human Development Index (HDI) was introduced by anthropologist **Jason Hickel**, while there was a persistent focus on GDP (Gross Domestic Product) to measure development. In this process, social or human dimensions were often not kept in mind. The HDI calculates the geometric mean of three indicators: life expectancy at birth, education, and income **(p. 1).** Whereas the HDI is widely implemented by, for example, the United Nations Development Program's annual reports, it lacks an important factor, namely, an indicator of sustainability **(Hickel, 2020).**

Since there was a need for an index that kept life expectancy, education, income, and sustainability in mind, the Sustainable Development Index (SDI) was introduced in 2019 by the anthropologist Jason Hickel **(Hickel, 2020).**

The SDI builds on the HDI concept but adds another critical dimension: environmental sustainability. The per capita CO2 emissions are included in the mean calculation to introduce this dimension into the index. Now, life expectancy at birth, education, income, and per capita CO2 emissions are placed at an equally important level **(Bravo, 2014).** The SDI thus focuses on both human development and sustainability **(Hickel, 2020)**.

Environmental footprint

The "environmental footprint" concept was introduced to compare the waste between countries and continents **(Department of Economic and Social Affairs, n.d.).** Environmental footprints measure the impact of individuals or communities on the environment and can be expressed as the amount of resources used. Moreover, they measure the rate at which waste is generated **(Nautiyal & Goel, 2021, p. 31).** According to a **Department of Economic and Social Affairs** study of **2023**, the per capita environmental footprint was ten times higher for high-income countries than for low-income countries.

Industry 4.0 and SDG Compliance

**Hassoun et al. (2022)** state that Industry 4.0 can help create smart factories. Smart factories are: "*Fully connected manufacturing systems, mainly operating without human force by generating, transferring, receiving, and processing necessary data to conduct all required tasks for producing all kinds of good*s" **(Osterrieder et al., 2020, p. 1)**. These smart factories can help decrease food waste through high resource efficiency. This allows businesses and governments to achieve SDG 12: "Ensure sustainable consumption and production patterns" **(Mehrpouya et al., 2019; Alhammadi et al., 2023).**

However, research by **Vinuesa et al. (2020)** shows that AI not only affects compliance positively. The study also indicates AI's possible negative effects on compliance with the SDG goals.

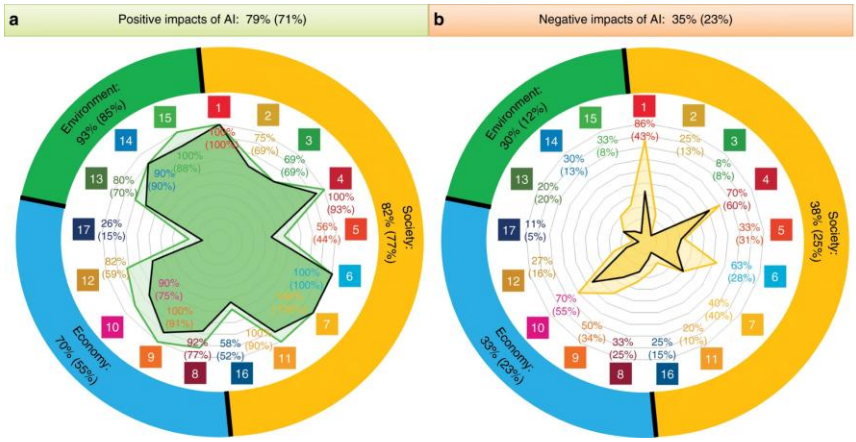


Figure 10: AI Acting as Enablers and Inhibitors of SDGs **(Vinuesa et al., 2020)**

Figure 10 shows how AI can have both a positive (left) and negative (right) effect on SDG compliance **(Vinuesa et al., 2020).** The circle is divided into three main segments: society, environment, and economy. Each SDG is then linked to a segment that best represents its essence. For example, SDG 12 is linked to the economy segment.

The numbers in the inner circle indicate how much AI influences each specific SDG. For example, for SDG 12, AI has an 82% positive impact, which indicates that AI can, for example, aid in reducing food waste. However, AI also has a 27% negative impact on SDG 12 compliance. The numbers on top (79% and 35%) show us AI's overall positive and negative effects on SDG compliance **(Vinuesa et al., 2020).**

As mentioned, the specific SDG addressed in this paper is SDG 12. This SDG is found in the "economy" segment. A positive net balance of AI technology can be perceived in the economy segment, referring to the adverse effects of AI being outweighed by the positive effects of AI. This positive balance is linked to increased productivity due to AI implementation. However, the negative impact of AI in this category must not be underestimated. By enabling AI systems in the economy, inequality between low and middle-income countries may rise significantly. These sources of inequality can be found in unequal data access (i) and more jobs for the educated (ii) **(Vinuesa et al., 2020).**

### 2.6.3 Environmental, Social, and Governance (ESG)

Another sustainable development principle for firms is the ESG principle: It incorporates environmental (E), social (S), and governance (G) considerations into a company's business strategy. At its core, it is a framework investors use to evaluate responsible investment decisions. However, many companies have started using the ESG framework to improve their reputation **(Arouri et al., 2019; Henisz et al., 2019; Gillian et al., 2021).**

According to **Ribando & Bonne (2010)**, companies that adopt strong ESG policies reduce their environmental impact, demonstrate social responsibility, and uphold best practices in corporate governance.

### 2.6.4 Regulatory Issues

However, the increasing awareness surrounding sustainability and sustainable practices has also brought about some difficulties, especially regarding the changing regulatory environment. Multiple regulatory frameworks were developed and introduced to achieve the climate change goals of the European Union.

### 2.6.5 The Green Deal

The European Green Deal, or Green Deal, was proposed by the European Commission at the end of 2019 to advance the climate agenda of the European Union. In a paper by **Siddi** from **2020**, he described the Green Deal as: "*a roadmap of key policies for the EU's climate agenda, based on which the Commission has started and will continue to develop legislative proposals and strategies from 2020 onwards*" **(Siddi, 2020, p. 4)**.

### 2.6.6 The Green Deal Industrial Plan

The Green Industrial Plan was introduced in February 2023. The objective of this plan is to accelerate the transition of the European Union to become climate-neutral by promoting a favourable environment for net-zero technologies for manufacturing **(European Commission, 2023)**.

### 2.6.7 CSRD

The European Sustainability Reporting Directive (CSRD) came into effect in July 2023 as a part of the European Green Deal of 2020 **(Fetting, 2020)**. The purpose of this directive is to standardize ESG (Environmental, Social & Governance) reporting over all European Union member states. **(EU Parliament & EU Council, 2022).**

In 2024, the CSRD was implemented into Belgian law **(VlAIO, n.d.)**. The CSRD was mandatory for all publicly listed companies in the European Union (i), large companies that check 2 out of the 3 following criteria (ii):

1) 50 million EUR net sales
2) 25 million EUR balance sheet total
3) +/- 250 employees

And for some companies outside of the EU (iii), which, for example, export more than 150 million EUR in net sales to the European Union. However, the start dates for these companies to comply differed. Large listed companies with > 500 employees were required to start reporting in 2025 (wave 1), while other large companies with over 250 employees were required to start reporting in 2025 (wave 2), and listed SMEs were expected to start in 2027 (wave 3). Thus, non-public SMEs do not fall under this categorization and are (currently) not mandated to fulfil the CSRD reporting requirements. In February 2025, the European Commission proposed its "Omnibus" package. This package includes simplifications for CSRD reporting to reduce the administrative burden for companies and to increase competitiveness **(European Commission, 2025)**.

### 2.6.8 Circular Economy

**Boulding's (1966)** writings paved the way for the circular economy concept. He explained the idea of having a "closed" versus "open" system involving inputs and outputs. He refers to an open system as the "cowboy economy" and a closed system as the "spaceman" economy. The "cowboy economy" is reckless and exploitative, taking advantage of the earth's resources and emphasizing consumption. In contrast, the "spaceman" economy sees the world as a spaceship, where no additional resources can be extracted and no outputs (including waste) can escape **(Boulding, 1966)**. Thus, a closed loop is formed.

The **Ellen MacArthur Foundation (2013)** popularised the term and gave the most contemporary definition of a circular economy: *"An industrial economy that is restorative by intention and design*" **(p. 14).** In a circular economy, products are designed to be either reused, disassembled, and refurbished, or recycled. The Ellen MacArthur Foundation also claimed that economic growth can only come from reusing materials instead of extracting new resources. **Geissdoerfer et al. (2017)** added to this definition: "*A circular economy is a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling" **(p. 759).*** This definition is visualized in Figure 11 below. **Bocken et al. (2016)** also gave an interesting definition of a circular economy, emphasizing the role business models and business strategies play in closing the loop: *"... business model strategies that are slowing, closing and narrowing resource loops"* **(p. 309)**.

A circular economy can be compared to its opposite, a linear economy. A linear economy extracts natural resources and converts them into waste via production. The linear economy harms the environment by exploiting and extracting natural resources that cannot be restored, and the production process releases pollutants. Moving from a linear business model to a circular one is an example of business model innovation **(Sariatli, 2017; Murray et al., 2017; Bocken et al., 2018).**

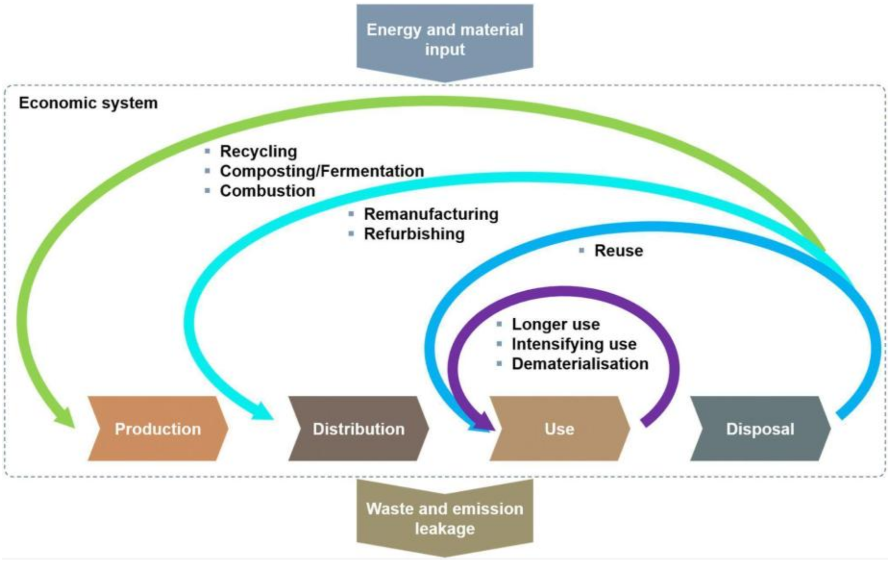


Figure 11: Circular Economy as a Visual **(Geissdoerfer et al., 2017)**

**2.6.9 Creating Shared Value**

**Porter & Kramer (2011)** gave a comprehensive definition of shared value: *"policies and operating practices that enhance the competitiveness of a company while advancing the economic and social conditions in the communities in which it operates. Shared value creation focuses on identifying and expanding the connections between societal and economic progress"* ***(p. 6)***.

In other words, shared value creates value for the company while also creating value for society. The question that remains is, how does one create shared value? According to **Porter & Kramer (2011)**, there are three ways to create shared value:

1) Reassessing markets & products
2) Rethinking productivity in the value chain
3) Constructing supportive industry clusters

<u>Reassessing markets & products</u>
Shared value can be created by rethinking products. A company must ask itself, "Is this good for my consumer?". The main focus is developing products and services that benefit society, such as more environmentally friendly products **(Porter & Kramer, 2011)**.

<u>Rethinking productivity in the value chain</u>
Implementing a "shared-value" way of thinking can address societal issues and provide new working methods that benefit both the company and society. A value chain example is the effort to reduce pollution, which was once considered an expense for businesses. However, there is now broad agreement that improved production efficiency can lead to cost savings **(Porter & Kramer, 2011)**.

Constructing supportive industry clusters

**Porter (2000)** gave this comprehensive definition of local clusters: "*Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate*" **(p. 15)**. **Porter & Kramer (2011)** also emphasized their importance: *"Clusters strongly influence productivity and innovation"* **(p. 12)**. By building clusters, the company can increase productivity, innovation, and thus competitiveness while helping to influence local communities and grow local economies, creating shared value. Discrepancies within the cluster can also impose costs on the firm; for instance, inadequate education can shrink the pool of qualified employees. Firms generate shared value by fostering these clusters, enhancing company productivity while addressing such discrepancies within the cluster **(Porter & Kramer, 2011)**.

Circular business models

The business model canvas is a visual tool supporting business model innovation **(Joyce & Paquin, 2016)**. **Chesbrough & Rosenbloom (2002)** explained the business model canvas as a tool that serves multiple purposes, such as articulating the value proposition, identifying the market segment and specifying the mechanism behind the revenue creation, defining the structure of the value chain and the firm's position in it, estimating the profit potential and cost structure of the business and formulating a competitive strategy.

**Alexander Osterwalder & Yves Pigneur (2010)** also captured these functions in their famous definition: *"A business model describes the rationale of how an organization creates, delivers, and captures value"* **(p. 14)**.

Figure 12 below shows the business model canvas (BMC) map with the nine interconnected components that **Osterwalder & Pigneur (2010)** proposed, which shows the logic of how firms plan to create, deliver, and capture value. In other words, how the revenues outweigh the costs. This canvas produces a blueprint for the firm that can help shape its business strategy. Note, it does not emphasize the environmental impact of the business model.

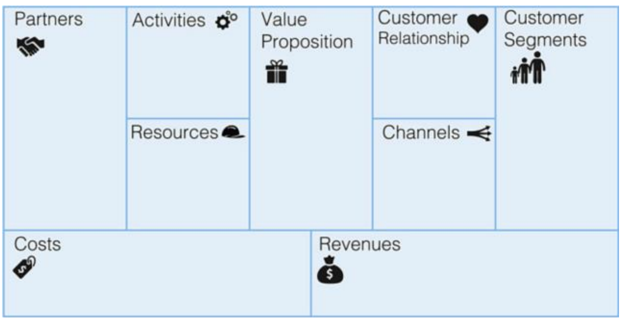


Figure 12: Business Model Building Blocks **(Osterwalder & Pigneur, 2010)**

In a **2020** review of the circular business model literature, **Geissdoerfer et al.** produced the following definition of circular business models: "*business models that are cycling, extending, intensifying, and/or dematerializing material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organizational system. This comprises recycling measures (cycling), use phase extensions (extending), a more intense use phase (intensifying), and the substitution of products by service and software solutions (dematerializing)*" **(Geissdoerfer et al., 2020, p. 7).** These four strategies are illustrated in Figure 13 below.

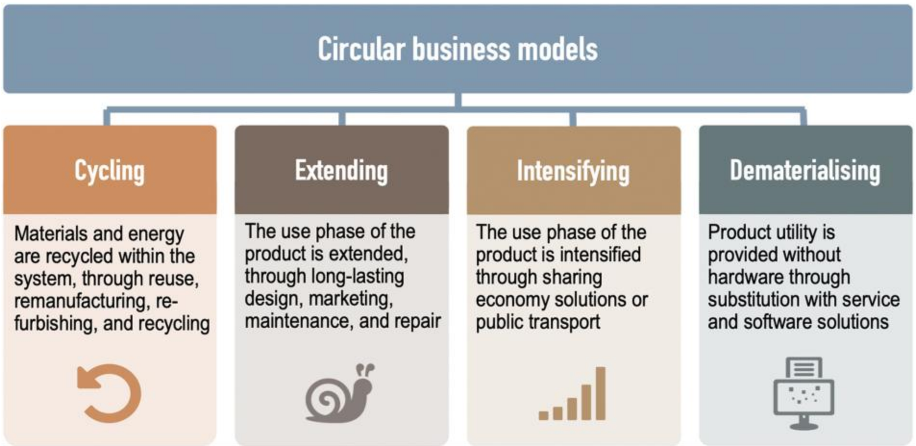


Figure 13: Circular Business Model Strategies **(Geissdoerfer et al., 2020)**

<u>Sustainable business models: the triple-layered business model canvas (TLBMC)</u>
Since the original business model canvas does not explicitly mention the impact of the business model on the environment, the triple-layered business model canvas (TLBMC) was invented. The TLBMC builds on the original business model canvas by **Osterwalder & Pigneur (2010)** by adding additional business model layers that integrate the social and environmental impacts of the business, thus explicitly integrating the economic, social, and environmental elements into the BMC **(Joyce & Paquin, 2016)**.

This tool is used to innovate business models to develop sustainable business models. The environmental layer of the TLBMC maps how and where in the business it negatively and positively impacts the environment. This is based on the life cycle approach, which looks at a product's environmental impacts from conception until "death" **(Svoboda, 1995)**. This way, firms can perfectly see the problem areas in their current business model. Its elements are visualized in Figure 14. The social layer of the TLBMC can be mapped out using a stakeholder approach, shown in Figure 15. It conceptualizes the social value the firm creates for different stakeholders **(Joyce & Paquin, 2016).**

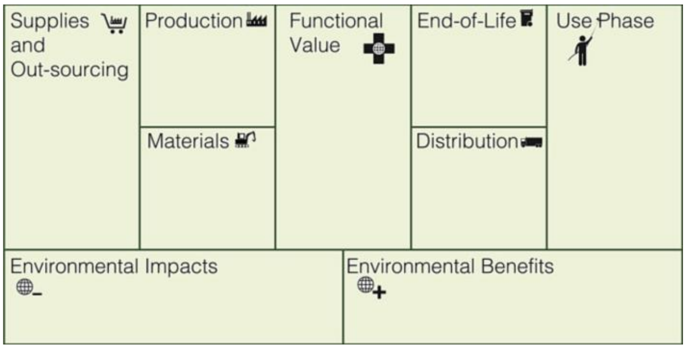


Figure 14: Environmental Product Life Cycle BMC **(Joyce & Paquin, 2016)**

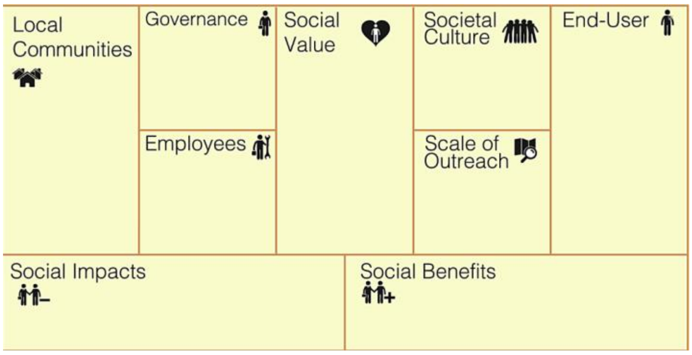


Figure 15: Social Stakeholder BMC **(Joyce & Paquin, 2016)**

**2.6.10 Greenwashing**

Environmentalist Jay Westerveld first coined the term "greenwashing" while writing an essay about the hotel industry. Hotels claimed that reusing towels was a policy to reduce environmental impact, but it was revealed to be just a cost-saving measure. Since then, the term has gained much popularity, and many scholars have tried to define the phenomenon **(Delmas & Burbano, 2011; Guo et al., 2018).**

**Delmas & Burbano (2011)** describe greenwashing as: "the intersection of two firm behaviors: poor environmental performance and positive communication about said environmental performance" **(p. 65)**. They also provided policy recommendations for managers to counteract this phenomenon, as shown in Table 3 below.

| | | |
|---|---|---|
| 1. Increase transparency of environmental performance | 2. Facilitate & improve knowledge about greenwashing | 3. Effectively align intra-firm structures, processes & incentives |

| | | |
|---|---|---|
| - Mandated disclosure<br>- Voluntary disclosure | - Gather & share info about incidents of greenwashing<br>- Reduce regulatory uncertainty | - Improve information related to environmental communication decisions<br>- Provide ethical leadership & training<br>- Align employee incentives |

Table 3: Policy Recommendations for Managers **(Delmas & Burbano, 2011)**

### 2.7 Green Artificial Intelligence

In 2019, the term "Green Artificial Intelligence" was introduced by a group of researchers from the Allen Institute for Artificial Intelligence. In Industry 4.0, there is a lot of academic research regarding AI, but in much of this research, environmental considerations are often overlooked. Green AI aims to make AI models more sustainable **(Schwartz et al., 2020, p. 54).** To achieve this, green AI includes monitoring AI's energy consumption and, if necessary, optimization to reduce energy, water, and other resource consumption **(Bolón-Canedo et al., 2024).**

This idea of green AI is relatively new. **Alzoubi & Mishra (2024)** identified six categories of tools that can make AI more sustainable. Cloud optimization (i) aims to optimize infrastructure to minimize energy consumption. Model efficiency (ii) wants to reduce the resources needed to run AI systems. Carbon footprint (iii) optimizes the carbon footprint of AI systems. Sustainability-focused AI development (iv) deploys AI solutions for environmental sustainability. Open-source initiatives (v) promote open-source tools for AI development. Lastly, green AI research (vi) focuses on solving other green AI challenges to make AI more environmentally friendly **(p. 23).**

## 3.1 Food Industry

### 3.1.1 Definition

The origin of the food sector may be found in the manufacturing industry. According to **Nagaraj (1984)**, we see different sub industries within the manufacturing industry, namely food (i), beverages (ii), hosiery and garments (iii), wood products (iv), paper products and printing (v), leather and leather products (vi), rubber and plastic products (vii), chemicals (viii), class and ceramics (ix), bare metal industries (x), metal products (xi), machinery (xii), electric machinery (xiii), transport equipment (xiv), others (xv) **(p. 6)**.

According to **Owusu-Apenten et al. (2022)**, the food industry (also described as the agri-food industry) can be defined as: "*a group of businesses involved with food production, converting food raw materials into ingredients or finished products, food service (catering), retail and wholesale of food"* **(p. 31)**.

**EduChange (2018)** divides the main activities of the food industry into four main categories. The first one is unprocessed or minimally processed foods. This category of food doesn't undergo any modifications after collection. Examples are eggs, nuts, fruits, and vegetables. The second group is processed culinary ingredients and includes oils, fats, salt, and sugar. These are products taken from natural sources using methods such as pressing, grinding, or refining. The third category is processed foods. In this category, group one foods are combined with group two foods to make them more flavorful. Examples include canned foods, dried or smoked meats, and tomato paste. The last group is ultra-processed foods and includes biscuits, chocolates, sauces, sodas, and so on. Ultra-processed foods are factory-made and mostly contain little or no whole foods. They are often prepared through frying or molding **(p. 1-4).**

The food industry is thus very large and contains many different types of subsectors. In this research, the focus is on one category of the food industry, which is ultra-processed foods. The scope of this research was chosen based on a **2023** study by **Vandevijvere et al.** that revealed that between 58,5% to 72,2% of all foods available in supermarkets in Flanders are ultra-processed. Therefore, ultra-processed foods form an important part of the food industry in Flanders.

### 3.2 Small and Medium Enterprises (SMEs)

#### 3.2.1 Definition

Small and medium enterprises (SMEs) make up a big part of our entrepreneurial landscape. Specifically, in the European Union, SMEs account for 99% of all companies. SMEs in Europe make up 70% of all employment **(Matt & Rauch, 2020)**.

While there is no specific definition of the term "SME," the standard mainly used to classify an SME in Europe is the number of employees and the total revenue or balance. SMEs should have fewer than 250 employees and a maximum revenue of 50 million euros. Moreover, their balance sheet total cannot exceed 43 million euros **(Malesios et al., 2021).**

Table 4 below was designed by the **European Commission (n.d.)** and gives a clear overview of different-sized firms and their staff number, balance sheet totals, and turnover amounts.

| Company Category | Staff headcount | Turnover (€) | Balance sheet total (€) |
|---|---|---|---|
| **Medium-sized** | <250 | ≤ €50 m | ≤ € 43 m |
| **Small** | <50 | ≤ € 10 m | ≤ € 10 m |
| **Micro** | <10 | ≤ € 2 m | ≤ € 2 m |

Table 4: Definition of SMEs **(European Commission, n.d.)**

While this is how the EU categorizes SMEs, it is worth mentioning that other parts of the world have different systems for categorization. For example, SMEs are defined differently in the United States. In the US, SMEs are companies with fewer than 500 employees. Unlike in the EU categorization, there is no cut-off for turnover or balance sheet total **(United States International Trade Commission, 2010).**

### 3.2.2 The Adoption of AI in SMEs

A **2024** report by the **British Chambers of Commerce (BCC)** said that many British SMEs are not using AI despite a growing acceptance of AI. In Britain, 25% of businesses currently use AI, while 43% have no plans to adopt it. Interestingly, 42% of businesses believe that implementing AI would boost their overall productivity, and only 2% think it would decrease productivity. Moreover, large companies are more likely to use AI than smaller ones **(British Chambers of Commerce, 2024).**

The diffusion of innovation is a concept developed by **EM Rogers** in **1962**. Diffusion is a process by which a certain innovation is gradually adopted **(Rogers & Williams, 1962).** The innovation adoption lifecycle illustrates the categories of adopters on a bell curve, as illustrated in Figure 16, demonstrating the rate at which these different categories embrace innovation. These different groups of adopters are defined as 1) Innovators, 2) Early adopters, 3) Early majority, 4) Late majority, and 5) Laggards. The later adopters are sceptical or even wary of the innovation and cannot handle change well. On the opposite scale, the earlier adopters have a positive attitude toward change and can cope more easily with uncertainty and risk **(Rogers et al., 2014; Hoffmann et al., 2021).**

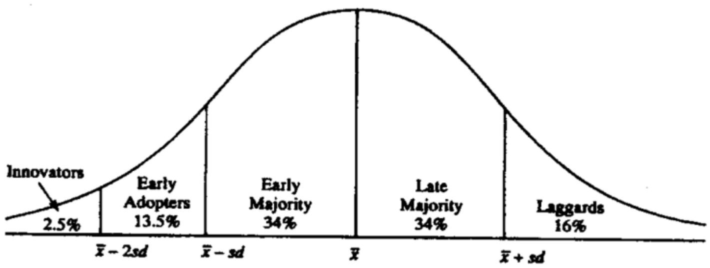


Figure 16: Adopter Categorization Based on Innovativeness **(Rogers, 2003)**

A **2021** report by the EU think tank **Bruegel** showed that AI is utilized in agriculture and manufacturing mainly for production and processing purposes, such as process automation and equipment optimization **(Hoffmann et al., 2021).** The report also found that larger firms have a higher adoption rate in comparison to small or medium-sized enterprises.

<u>Barriers to adoption</u>

A **2020** study by the **European Commission** identified a few barriers that made it difficult for companies to adopt AI. Figure 17 lists the obstacles that have been reported the most and compares non-adopters with adopters. These barriers were divided into internal obstacles and external obstacles to the company. Firstly, one of the most cited internal barriers was the need for AI skills since their current staff lack AI skills and have difficulty hiring people with the right skills. Furthermore, the cost of implementing AI is another internal barrier that makes them wary of introducing AI into their firm. Other (less observed) obstacles included the lack of internal data on which to train the AI and potential reputational damage linked to the use of AI. The external barriers included the liability that firms could face for possible damages caused by their AI, the lack of trust civilians have in AI technology, and the lack of public funding. Another external barrier included the strict laws and regulations related to data exchange **(European Commission, 2020).**

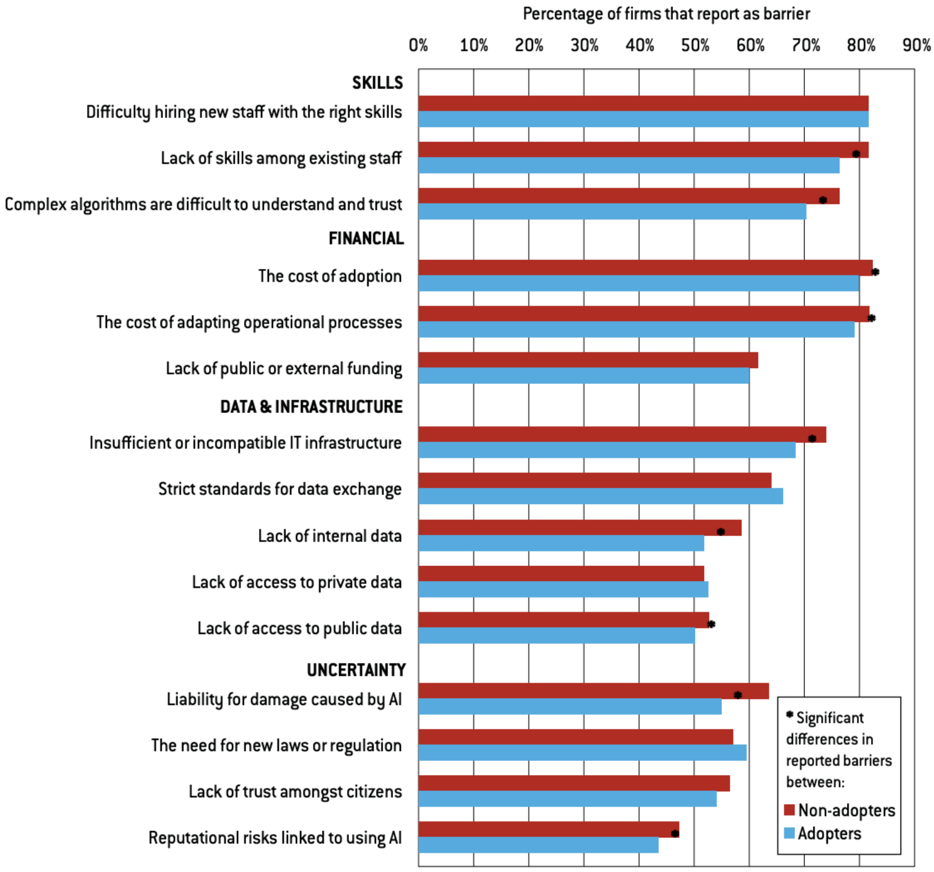


Figure 17: Obstacles in AI Adoption **(European Commission, 2020)**

### 3.3 Food SMEs

In Europe, the scope of the food industry should not be underestimated. There are 290.000 food and drink SMEs in Europe. These European SMEs account for almost 50% of turnover and 2.8 million jobs in the European food and drink industry **(FoodDrinkEurope, n.d.).**

This paper focuses on the Flemish food industry. In Flanders, there are 3094 food companies. These include SMEs and other company forms, such as large companies with over 250 employees and a revenue of over 50 million euros. These food players make up 82% of the Belgian food industry turnover. The remaining 12% of the turnover can be found within Wallonian food companies **(Food & nutrition, 2023).**

### 3.3.1 SWOT of Food SMEs in Flanders

Strengths

Flanders has a strong agricultural sector, providing qualitative raw materials to manufacturing firms **(Invest in Flanders, 2023)**. Other strengths of the food industry in Flanders are related to Flanders' geographical location. Flanders is located the heart of Europe, an ideal location for exporting firms to export to other European countries. In 2023, the food industry was responsible for 14% of the total export activity of Belgium (excluding energy) **(Fevia, 2024)**. Another strength is Flanders's importance in fostering innovations in this industry by establishing an incubator specifically for food companies to experiment with new technologies, with professional guidance, named the Food Port **(Food Port, n.d.)**.

Weaknesses

A common characteristic of SMEs is that their margins are already smaller than those of large companies in the same industry **(Nationale Bank van België, 2023)**. In the food industry, margins are already relatively low **(FOD Economie, 2023)**, so firms produce large quantities to gain economies of scale, to spread their fixed costs over more units **(Stigler, 1958)**.

Belgium is known for its high labor costs, with Belgium having the third highest labor costs in 2023, behind Luxembourg and Denmark **(Eurostat, 2024)**.

Another obstacle can be found in managing the increasingly extended supply chain and more complex relationships with suppliers, customers, and governments. Higher transparency needs can explain this increased complexity. Food must be traceable throughout the supply chain, which adds complexity for food SMEs. They must ensure that every step along the chain is closely monitored **(Jose & Shanmugam, 2020)**. For example, customers want to know exactly how/where/when their food is made. Therefore, information should be available from "farm to fork," including information on agricultural procedures on the farm and information on shipping, packaging, and storage **(Saguy & Sirotinskaya, 2014; Astill et al., 2019, p. 240)**.

The last challenge in the food industry is food waste. The food supply chain can be classified into five main stages, namely: production (i), processing (ii), distribution (iii), retail (iv), and consumption (v). In 2022, the global supply chain wasted roughly 11 million tonnes of food. This is about one-third of the food produced globally. In developing countries, this waste is primarily made in the production stage, whereas in developed countries, waste mainly refers to food that has entered the market **(Eurostat, 2024; United Nations, n.d.).**

Research by **Hoornweg & Bhada-Tata (2012)** shows that a country's income and urbanization levels highly determine the amount of wasted food. It shows that over half of global food waste originates in Europe, whereas Asia and Africa produce the least food waste. **Paritosh et al. (2017)** add that food waste will probably increase soon due to economic and population growth.

Food waste is highly troublesome for multiple reasons. Firstly, global hunger is a never-ending issue. In their Global Initiative on Food Losses and Waste Reduction, the **Food and Agriculture Organization of the United Nations** mentions 870 million hungry people worldwide. The FAO estimates that the amount of food wasted each year could feed these people four times. Moreover, food waste has big implications for the environment. It accounts for 3.3 billion tons of $CO_2$ (carbon dioxide) emissions yearly. Furthermore, when food is wasted, all the resources, such as land and water used to grow this food, are (indirectly) wasted as well **(Paritosh et al., 2017; FAO, 2011).**

<u>Opportunities</u>

A first opportunity for the food sector in Flanders is the adoption of a more sustainable, circular food production system. The adoption of such systems has the potential to heavily reduce food and resource wastage **(Rabbi & Amin, 2024)**.

Additionally, AI implementation has great potential in the food industry. Examples of relevant AI applications for the food sector include predictive maintenance, which can predict when a machine needs to be replaced or maintenance just before it breaks down, demand forecasting, quality control, and automating manual processes with robotics **(Flanders' Food, 2024)**.

Other opportunities include exports to developing economies, such as India. In March 2025, Belgium hosted a trade mission to India, bringing Belgian companies (including food companies) in contact with India's large market **(Diplomatie Belgium, 2025)**.

A last opportunity for food companies is sustainability reporting, specifically the CSRD; for example, companies can differentiate themselves and attract buyers who need their sustainability data for reporting **(Brains & Trees, 2024)**. **Porter & Van der Linde (1995)** claim that companies facing sustainability challenges can lead to competitive advantages since they are pushed to rethink their processes and products and make innovations.

A **2023** study from **BDO and Mercuri Urval**, which looked at 150 companies in 13 countries in the European Union, found that 75% of companies are embracing ESG reporting as a means of value, which indicates that companies realise that the move toward sustainability poses a lot of opportunities for growth and innovation. Also, 78% of the companies in this study indicated they had received sustainability-related questions from clients. This study also revealed that the key success factors for a successful ESG strategy are embedding sustainability in the business strategy, leadership, and employee commitment.

Threats

A current threat to the food manufacturing industry in Flanders is the labor shortage for technical staff. Additionally, the "graying" of the labor market in Flanders makes it hard to find the right candidates. In 2023, there were about 5.500 vacancies in the Flemish food industry **(EURES, 2023; Fevia, 2024)**.

Other threats include disruptions to the supply chain, for example, after the Russian invasion of Ukraine in 2022 **(SME Envoy, 2023)**.

Global climate change is also a threat to the food manufacturing sector since extreme weather conditions can negatively affect the availability of raw materials needed to produce food products **(Lesk et al., 2016)**.

The CSRD, can, as mentioned earlier, pose opportunities but also challenges, such as increased administrative complexity and cost implications. This is because of the "trickle-down effect". This means that SMEs can be a part of large companies' supply and/or value chains, which, in turn, need data for their own CSRD report. This can be a time-consuming effort for these small SMEs that do not have the resources, such as time and capital, to gather and supply all this requested data **(Algeier & Feldmann, 2023; VLAIO, n.d).**

However, in February 2025, the European Commission proposed a package of simplifications to the CSRD to reduce the administrative burden related to reporting requirements of SMEs by at least 35% before the end of the mandate (2029) and to make SMEs more competitive. The package includes changes to the CSRD that will protect SMEs from excessive requests for information for their clients' sustainability reporting. Specifically, companies with under 1,000 employees and a turnover of less than 50 million euros will be exempt from CSRD reporting. This would exempt around 85% of businesses currently under the CSRD. Additionally, the package also proposes to streamline the European Sustainability Reporting Standards (ESRS) to reduce the administrative burden **(European Commission, 2025).** Also, the package proposed that wave one, which includes large companies that don't already participate in CSRD reporting, and wave two, which includes listed SMEs, will now get two extra years to prepare for CSRD reporting **(European Commission, 2025)**. However, the complete package has not yet been approved at the time of writing this thesis.

A last threat the food industry is dealing with in 2025 is the import tariffs imposed by American President Donald Trump. On April 2nd, 2025, Trump notified the world that he would impose a tax rate of 20% on EU exports to the USA, which has been reduced to a 10% tariff as of April 2025 but is planned to increase in July 2025 to 20%. As this is a very recent development, the exact impact on the Flemish (food) industry is still uncertain. However, the tariff has already significantly impacted the European economy and its competitiveness. But the long-term impact is still unknown **(Steinberg & Anderson, 2025; European Commission, 2025).**

### 3.3.2 Dealing with Complexity

The world is an unpredictable place. Especially in the business environment, companies can be confronted with many different challenges that they have to navigate. A framework to classify these unpredictable events is VUCA, which stands for volatile, uncertain, complex & ambiguous **(Bennett & Lemoine, 2014).** By classifying these events in one of these four categories, the appropriate preparation and response can be established. In Figure 18 below, **Bennett & Lemoine (2014)** give a comprehensive overview of the VUCA framework:

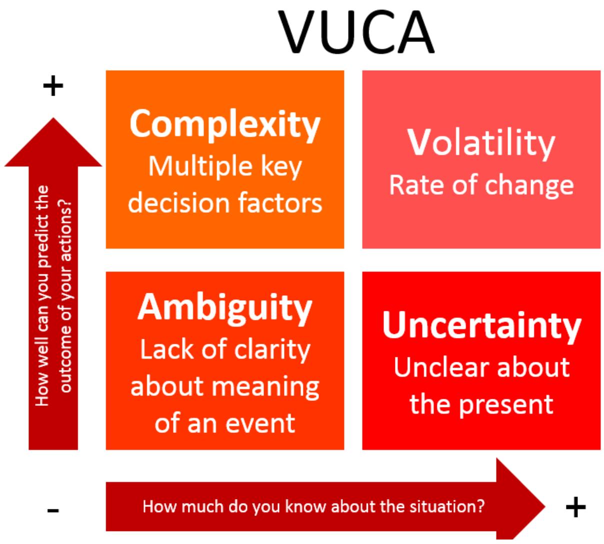


Figure 18: Distinctions within the VUCA framework **(Bennett & Lemoine, 2014).**

For example, greenhouse gas emissions and relatedly, climate change can be classified under the VUCA framework as complex and ambiguous. Complex because there are many variables at play and many different types of stakeholders. Ambiguous because its (long-term) effects are difficult to predict in an accurate way.

However, greenhouse gas emissions and subsequently climate change can be mitigated by waste management techniques **(Bogner et al., 2008).** Waste management is a concept that includes the handling of all kinds of waste. **Demirbas (2011)** defines waste management as: *"The collection, transport, processing, recycling or disposal, and monitoring of waste materials"* **(p. 1280).** The purpose of waste management is to create clean living conditions and maximize the recycling of waste, which aids in the mitigation of emissions **(Demirbas, 2011).**

Food banks are an example of waste management in the food supply chain. Their mission is: "*To contribute to reducing food insecurity mainly through the prevention of food loss and the support and development of food banks in countries where they are most needed*" Food banks want to reduce supply chain waste by recovering surplus foods from various links in the supply chain, such as agriculture, food processing, and food manufacturing **(European Food Banks Federation – FEBA, 2024).**

Another example of waste management can be found in composting. Composting is *"the controlled conversion of degradable organic products and wastes into stable products with the aid of microorganisms"* **(Ayilara et al., 2020, p. 1)**. Composting transforms products that were meant to be waste into compost, which farmers can use to, for example, fertilize crops **(Schaub & Leonard, 1996)**.

The second concept that taps into the issue of food waste is "lean manufacturing." Lean manufacturing refers to minimizing eight types (pillars) of waste in the manufacturing process: overproduction (i), waiting (lost time) (ii), excess transportation (iii), over-processing (iv), excessive inventory waste (v), defects (vi), unnecessary movements (vii), and insufficient use of employee potential (viii). Lean manufacturing is closely related to the so-called "spaceman theory" introduced earlier, where both systems focus on reducing complexity and increasing efficiency. In this study, the concept of lean manufacturing is looked at through the lens of the food manufacturing industry **(Dora et al., 2013; Leksic et al., 2020, p. 88)**. While waste management handles waste after production, lean manufacturing primarily focuses on preventing waste from forming in the food supply chain altogether. It is also important to note that the workforce's skills, expertise, and culture are critical factors for successful lean manufacturing implementation **(Dora et al., 2013, p. 156)**.

Besides that, lean manufacturing lessens waste, but it can also increase efficiency, leading to increased product value and cost efficiencies **(Henao et al., 2019)**.

Implementing lean manufacturing is often tricky because of smaller workspaces and established layouts of food SMEs. Suppose food industries want to comply with pillar eight of lean manufacturing: "Reduce unnecessary movements of employees." Food companies would need to make significant changes to the layout of their factories, which would be very costly **(Käferstein & Abdussalam, 1999; Dora et al., 2016)**.

### 3.3.3 Use of AI in the Food Industry

Some interesting research has been conducted concerning the use of AI in the agri-food industry. **(Wuest et al., 2016).** What follows is an overview of the most valuable uses of machine learning in the food industry.

<u>Manufacturing</u>

**Wuest et al. (2016)** explained why machine learning techniques can be attractive to manufacturing firms: *"These data-driven approaches can find highly complex and non-linear patterns in data of different types and sources and transform raw data to features spaces, so-called models, which are then applied for prediction, detection, classification, regression, or forecasting"* ***(p. 2)***.

Industrial AI

Industrial AI refers to applying artificial intelligence, specifically within the manufacturing sector. Its goals include generating value by reducing waste, enhancing product quality, boosting operator efficiency, and shortening ramp-up periods **(Peres et al., 2020)**. **Peres et al. (2020**) also outlined the major application areas of industrial AI:

1) Process optimization

Using AI for process optimization can be beneficial since AI can give insights for optimal decision-making. Specifically, the areas of interest have been increasing energy efficiency by predicting energy consumption, production optimization, and anticipating demand using demand forecasting **(O'Donovan et al., 2015; Qin et al., 2018; Liang, 2019; Peres et al., 2020; Chien et al., 2020).**

2) Quality control

Determining the quality of products that a firm produces is essential. AI can help this process by detecting real-time quality mishaps **(Peres et al., 2020)**. This can be realized by using computer vision. It can do tasks such as object recognition and quick image processing to then classify different products based on quality (for example, based on surface roughness) **(Chinnam, 2002; Ribeiro, 2005; Vedaldi & Fulkerson, 2010; Çaydaş et al., 2012).**

3) Predictive maintenance

Downtime of machines can increase costs for a company since the whole production process can be affected by one malfunctioning machine. Predictive maintenance focuses on keeping these machines up and running by planning maintenance according to whether and when the machine will fail. This can reduce maintenance costs **(Yan et al., 2017; Peres et al., 2020)**.

4) Human and robot collaboration

Human-robot interaction (HRI) may reduce the risk of injury. It can make the jobs of human workers easier and more efficient by implementing robots to do some of the more challenging/dangerous work instead of humans **(Peres et al., 2020; Tannous et al., 2020)**.

Smart Manufacturing

Smart manufacturing, also named intelligent manufacturing or advanced manufacturing **(Li et al., 2017; Arinez et al., 2020)**, has emerged since the enormous rise in the amount of data (Big Data) produced via the introduction of the IoT. The rise of Big Data in the manufacturing industry is because manufacturing plants have installed intelligent sensors, which generate large amounts of data, unlocking another avenue to explore data analytics in the firm **(O'Donovan et al., 2015; Marr, 2016)**. **O'Donovan et al. (2015)** defined smart manufacturing comprehensively: *"The* *pursuit of data-driven manufacturing, where real-time data from sensors in the factory can be analyzed to inform decision-making"* **(p. 2).** They also mentioned other technologies that could be considered smart manufacturing, including machine learning. When analyzing and processing these large amounts of data, new knowledge can be discovered, leading to optimized manufacturing processes, which is intelligent manufacturing **(Kim et al., 2022)**.

Figure 19 below illustrates how the IoT sensors go from capturing data, to processing it, to pursuing some kind of action.

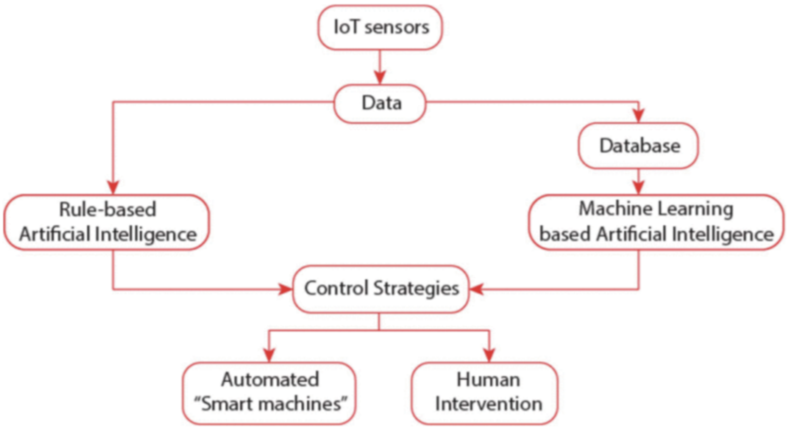


Figure 19: From Data to Action **(Misra et al., 2020)**

The main objectives of smart manufacturing are similar to those of industrial AI, namely, maintenance (machine uptime), maximizing productivity, and thus reducing costs. It seeks to enhance process efficiency and promote environmental sustainability, recognizing that inefficient machines can consume much more energy. However, AI technologies can disadvantage smaller firms over larger ones since they have scale effects **(O'Donovan et al., 2015; Mihet & Philippon, 2019).**

**In 2010, Chand & Davis** published an article outlining the three steps to adopting smart manufacturing:

1) Phase 1: Data integration

Integrating data within companies and across industries can improve cost efficiency and environmental sustainability.

2) Phase 2: Data modeling & simulation

Data modeling and simulation will optimize decision-making and production.

3) Phase 3: Innovation

The last phase will trigger innovations in processes and products, stemming from the new insights gained from manufacturing intelligence.

Supply chain management (SCM)

AI has been applied in supply chain management (SCM) to tackle challenges such as inventory optimization, procurement processes, location planning, transportation logistics, and scheduling complexities **(Min, 2010)**.

1) Inventory management

By forecasting demand, the cost of inventory management can be reduced. Traditionally, inventory management is based on mathematical decision rules and management expertise. A subset of AI, named expert systems, can improve this system by prediction and improved decision-making **(Min, 2010)**. Expert systems are knowledge-based systems that give advice or solutions in a way similar to how experts in the field would, which is why expert systems are primarily used in fields where human expertise is necessary for the solution **(Lucas & Gaag, 1991)**.

2) Transportation logistics

Transportation logistics problems can be broad; for example, problems can range from load bundling to scheduling issues. Because of its wide scope and combinational nature, the best AI application for this field is genetic algorithms (GA) **(Chambers, 2000; Min, 2010)**. Genetic algorithms are *"a class of problem-solving heuristic search techniques inspired by the principle of survival of the fittest in natural evolution"* **(Naso et al., 2007)**.

3) Purchasing

Often, firms have to decide to either buy or make something, accurately named "make-or-buy decisions," but to make these decisions, there have to be several scenarios written out to compare the possibilities accurately. With these types of problems, expert systems can also help with decision-making **(Min, 2010).**

4) Demand forecasting

Predicting customer demand is extremely important, but at the same time, a very difficult thing to do since future demand can be volatile and uncertain. AI can help make demand forecasting more accurate, for example, by introducing genetic algorithms like agent-based models **(Jeong et al., 2002; Min, 2010)**. Agent-based models (ABM) or agent-based systems (ABS) are computational systems that model the behavior of autonomous, interacting agents, such as customers or companies **(Jennings, 2000; Bonabeau, 2002; Macal & North, 2005)**.

5) Order picking

Order picking refers to retrieving items specified in a customer order. AI can help make this process more efficient, for example, by optimizing the control of the automated system. Specifically, agent-based systems have been developed to handle the convoluted and ever-changing process of assembling an order since they can learn new things **(Kim et al., 2002; Min, 2010)**.

6) CRM

**Min (2006)** gave a comprehensive definition of customer relationship management, or CRM: "*CRM is referred to as a business practice intended to improve service delivery, build social bonds with customers, and secure customer loyalty by nurturing long-term, mutually beneficial relationships with valued customers selected from a larger pool*" **(p. 1)**. An agent-based approach can look at the return on investment of a firm's CRM system and aid in its quest for customer acquisition **(Baxter et al., 2003)**.

### 3.4 Top Management Teams

#### 3.4.1 Definition

The question "*Who belongs to the top management team?*" has been a significant discussion point among academics. A scientific definition for the top management team (TMT) is often not provided **(Krause et al., 2022)**. According to **Wiengarten et al. (2017),** the TMT is "*A relatively small group of executives at the strategic apex of the corporation with overall responsibility for the organization*" **(p. 1)**. It can thus be referred to as a small group of executives at the highest level of the organization overseeing the entire company.

Table 5 gives an overview of the top management team members other than the CEO **(p. 48)**:

| **Field** | **Accounting/ Finance** | **Information Systems/ Technology** | **Marketing** | **Strategic Management** |
|---|---|---|---|---|
| **Functional TMT members** | • CFO | • CKO<br>• CIO<br>• CTO | • CMO | • COO<br>• CSO |

Table 5: Fields With Research on TMT **(Menz, 2012)**

The tasks of the different top team members can be found within their specific roles. For example, the Chief Financial Officer (CFO) is responsible for accounting, financial reporting, and other business decisions **(Caglio et al., 2018).** The Chief Technology Officer (CTO) is responsible for all technology-related activities, such as product, process, and information technologies **(Adler & Ferdows, 1990)**.

#### 3.4.2 Importance of Top Management

According to **Carmeli & Tishler (2006)**, the role of the top management team can be defined as: "*Creating sustainable competitive advantage and gaining above-normal performance*." **(p. 9).**

The resource-based view (RBV) is an excellent tool for explaining the value of the TMT. RBV suggests valuing the performance of organizations in terms of resources over market activities **(Carmeli & Tishler, 2006)**. Certain firms have a competitive advantage based on strategic assets (SA), which are superior resources. In the RBV concept, SA is (1) valuable, (2) rare, (3) non-substitutable, and (4) difficult or costly to imitate. The TMT can be defined as a strategic asset if it encompasses all four criteria above **(Michalisin et al., 2004)**.

The TMT builds a substantial resource base by combining attributes such as leadership, expertise, strategic decision-making, and diversity. Diversity within TMT is one of the most discussed attributes since it facilitates communication and helps form diverse ideas, fostering innovation **(Lo et al., 2020)**. **Wagdi & Fathi (2024)** state that diverse teams encourage productivity and employee engagement. Additionally, diverse teams attract employees with a lot of potential and can retain them most of the time. Forms of diversity can be in terms of different genders, races, ages, and nationalities, or differences in functional backgrounds, industry experience, educational backgrounds, and length of service **(Wagdi & Fathi, 2024, p. 20).**

### 3.4.3 Upper Echelons Theory (UET)

In a **1984** paper by **Hambrick & Mason**, they developed the "upper echelons theory," which states that the characteristics and backgrounds of the management can partially predict organizational outcomes. This theory can help reveal why companies do what they do and have the results that they have.

Figure 20 visualizes how a top management member finds themselves when making a strategic decision. In the visualization, the members are flooded with information that is much more than they can make sense of. Figure 20 also shows that the members' perception is limited and that they only selectively perceive some events. The remaining information is interpreted through their values and cognitive framework. When combined with their values, the perception of the situation shapes the managerial perception, which serves as the foundation for their strategic decisions. Figure 20 also displays their values as influencing perception and strategic choice **(Scott & Mitchell, 1972; Hambrick & Snow, 1977; Hambrick & Mason, 1984)**.

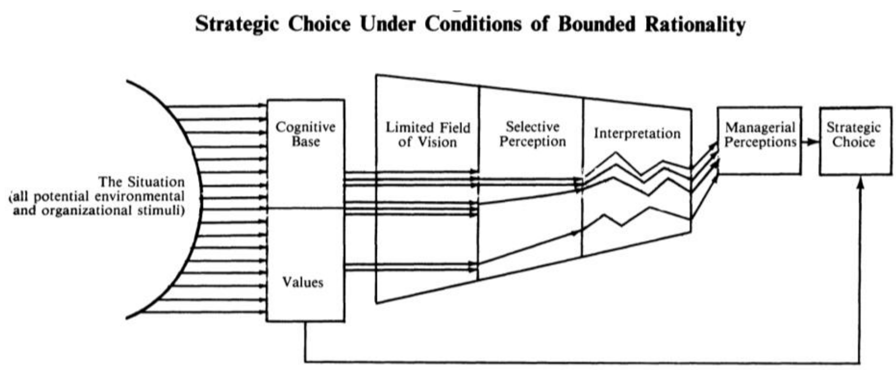


Figure 20: Strategic choice under conditions of bounded rationality **(Hambrick & Mason, 1984)**

### 3.4.4 Industry 4.0 and Top Management

A **2022** study by **Firk et al** reveals that many firms have placed Industry 4.0 concepts, such as digital transformation, high on their agenda. Whereas some companies have already undergone digital transformation, research from the Organisation for Economic Co-operation and Development (OECD) shows that only 15% of all food SMEs have taken action to adapt their firm **(INSME, 2024)**.

Figure 21 gives an excellent overview of why technical skills will become essential for top management. Technical skills are critical to understanding the digitalization process. Furthermore, technical understanding is needed to contextualize the digitalization process and lead the change **(Wrede et al., 2020, p. 1556).** Thus, in the following decade, these technical skills and understanding will be indispensable for the members of senior management to drive transformation.

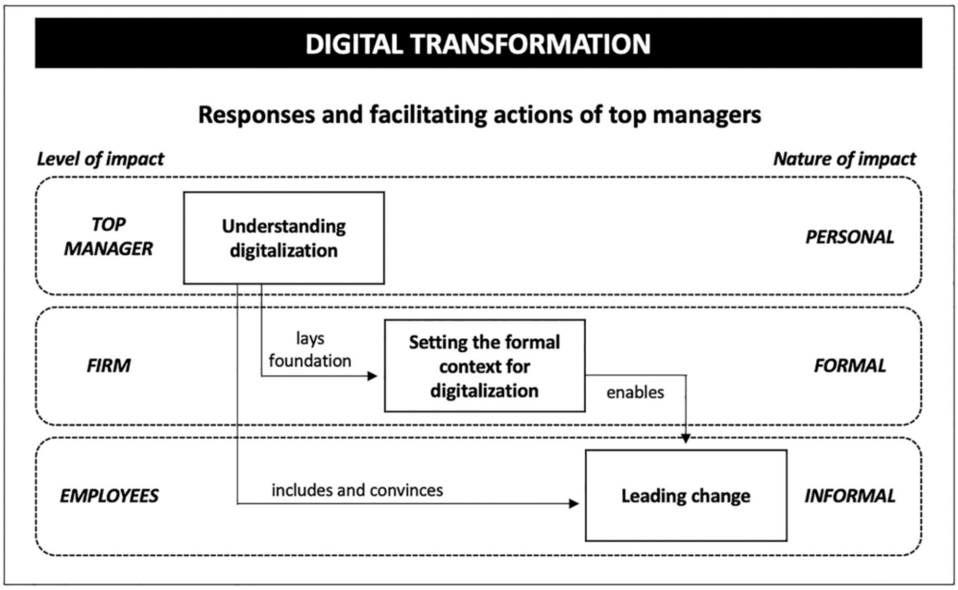


Figure 21: The Role of Top Management in Digital Transformation **(Wrede et al., 2020)**

Besides the changing skills needed to be a member of top management, the composition of the top management team often grows as new roles are introduced. In their study on digital transformation, **Wrede et al. (2020)** define these additional roles. The first new, important role is the Chief Digital Officer (CDO). The task of a CDO is to promote the company's digital transformation. A CDO must be very well aware of the digital world. The role of CDO is mainly reserved for companies undergoing digital transformation. The second important role is the Chief Technology Officer (CTO). The CTO's responsibility is highly determined by the role the CEO assigns to him. Often, they are responsible for innovation tasks and need to keep an eye on the correct funding of these tasks **(Wrede et al., 2020)**.

### 3.5 Visual summary

In Figure 22 below, the research is visualized as a mind map. The central circle is the centre of the ecosystem: the food industry. The triple helix model is also represented, with the government and academia as two additional nodes. Furthermore, the private sector, with VOKA as its representative, industry 4.0 & 5.0, responsible innovation, and artificial intelligence are also visualized. Lastly, the government is split between the EU and the Flemish government, which both, besides the SDGs, influence sustainability.

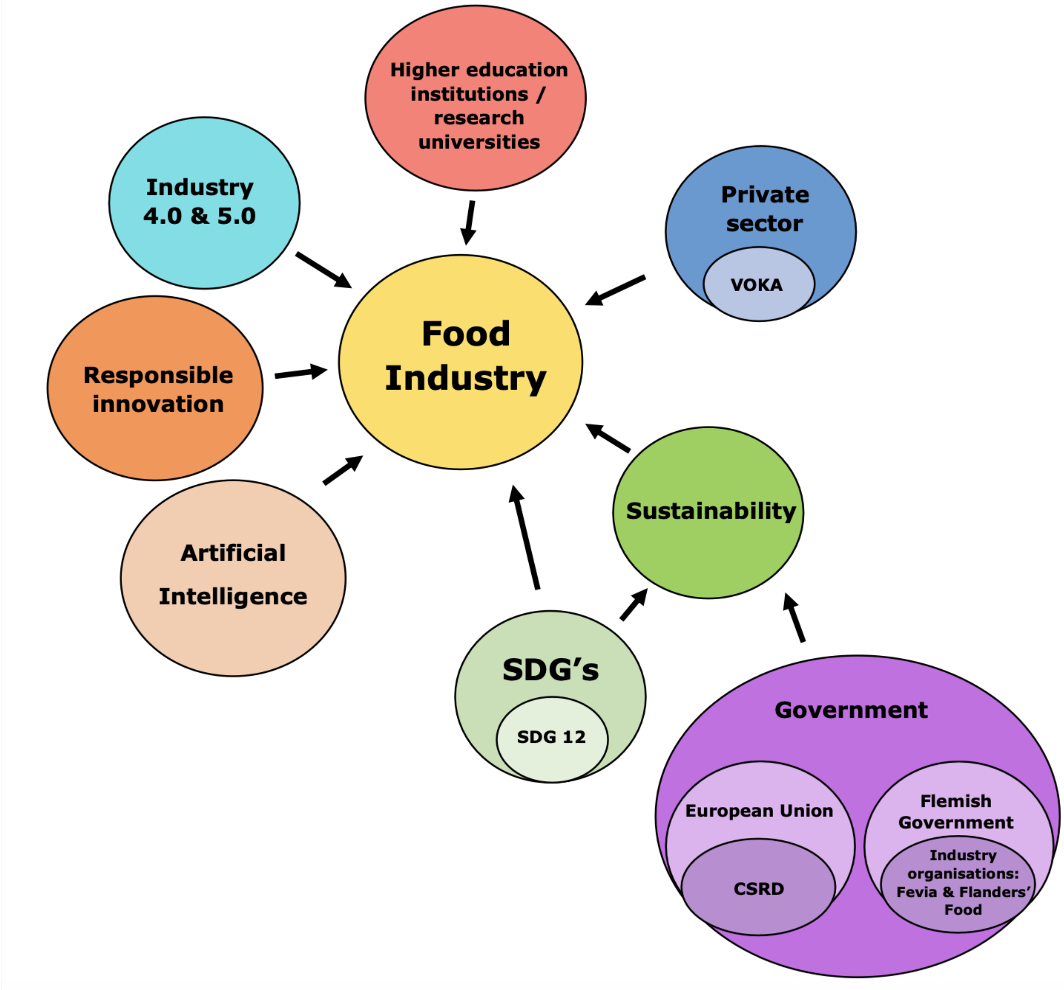


Figure 22: Visual Summary

## 4. Research Methodology

### 4.1 Research Questions

This study researches the acceptance of AI by top management in the Flemish food industry. To narrow the focus, it explicitly targets SMEs. The research looks into the factors that motivate or discourage top management from adopting AI in their company. To provide policymakers, company leaders, and others with deeper insights into the future of AI in the Flemish food industry, the following questions were constructed, with one main research question and three subquestions.

**Main research question: How do the attitudes of senior management affect the acceptance of AI in the Flemish food industry?**

**Subquestion 1. What are the key drivers and barriers to AI adoption in Flemish food SMEs?**

This research identifies factors that encourage or hinder AI adoption in Flemish food SMEs. Moreover, this question reveals the benefits top managers see in AI and its potential downsides.

**Subquestion 2: How does the mindset of senior executives affect AI integration in Flemish food SMEs?**

This question addresses the influence that top management has on AI adoption in SMEs. The study investigates whether there is a link between openness to change, risk tolerance, and the implementation of AI in the food industry.

**Subquestion 3: How can AI adoption in Flemish food SMEs contribute to sustainability in alignment with SDG 12?**

This question examines whether AI implementation in the Flemish food industry can reduce the negative impacts that the sector has on the environment.

### 4.2 Qualitative Research

In this study, qualitative research, in combination with a literature study, was used. Qualitative research allows researchers to gain deep insights into people's opinions, perspectives, actions, and social dynamics. Qualitative research is used in different fields, including anthropology, sociology, and psychology. The questions developed in qualitative research focus on three things: how people use language to communicate and interact (i), how they understand situations (ii), and how researchers find patterns in data to build a theory (iii). There are multiple categories of qualitative research, namely observational studies (i), interviews (ii), and textual analysis (iii). This study will use semi-structured interviews to understand members of the top management teams' (TMT) attitudes, behaviors, and points of view **(Fossey et al., 2002; Pathak et al., 2013, p. 192)**.

### 4.3 Methodology interviews

During the field research, twelve semi-structured interviews were conducted to gain insights into the acceptance of AI in top management in the Flemish food sector. The semi-structured method was chosen because it allows top managers to elaborate on topics they think are important **(Longhurst, 2003)**. The main objective was to learn more about the barriers to adopting AI in the Flemish food sector. Eleven of the interviewees were senior management of Flemish food SMEs, and one interviewee was the CEO of an AI-driven ESG data-management platform. Initially, ten interviewees were interviewed, but after President Trump announced his tariff plan for European imports to the USA, two more senior managers of Flemish food SMEs were interviewed to understand what impact these tariffs had on their companies and what they felt surrounding the tariffs. Specifically, these senior managers were responsible for sales and exports.

#### 4.3.1 Interview guideline

Since there were three different types of interviewees, the first being members of the top management team of Flemish food SMEs, the second being the CEO of an ESG platform, and the last being senior sales directors of Flemish Food SMEs, three different interview guidelines were constructed. The three interview guidelines were written based on the completed literature review.

The first interview guideline for the food sector was divided into six different sections, also known as clusters. The first cluster, cluster 1: Personalia, asked the respondent for their details, such as their name, age, and sex. Cluster 2: The company included questions to form a clearer view of the company and its vision and mission. Cluster 3: Their job included questions about the interviewee's job and job responsibilities. Cluster 4: Openness toward change, asked questions about their stance toward change and its importance in their company. Cluster 5: Knowledge AI contains questions regarding their knowledge of AI, if it has been implemented in their company, AI’s future in their company, and what challenges or benefits they see in AI. Lastly, cluster 6: CSRD asked the respondent about their knowledge of and opinion on the CSRD and how AI could play an important role in ESG reporting.

The second interview guideline was for the CEO of an AI-driven ESG data management platform company. This interview guideline was divided into four clusters: cluster 1: personalia, cluster 2: the company, cluster 3: their job, and cluster 4: ESG reporting. The last cluster contained questions regarding the respondent’s opinions regarding the evolution of ESG reporting in Europe, specifically regarding SMEs.

The third and last interview guideline consisted of four clusters. Cluster 1: Personalia, cluster 2: the company, cluster 3: their job. Cluster 4: Trump tariffs includes questions surrounding what impact the tariffs currently have on their company and what impact they expect these tariffs to have on their future business dealings with the USA.

### 4.3.2 Data collection

The sample was cautiously selected based on the organizational role. The sample was formed based on judgment sampling. Judgment sampling is considered "*a strategy in which particular settings, persons, or events are selected deliberately to provide important information that cannot be obtained from other choices*" **(Taherdoost, 2016)**. This sampling method was used since this study was centered around a specific group of respondents: top managers in the Flemish food industry. The connections were mainly obtained through personal and LinkedIn contacts. The researchers connected with the respondents through email and provided them with a short introduction to the study. Ultimately, twelve respondents were selected to participate in the study.

| ID | Candidate Position | Sex | Duration | Date |
|---|---|---|---|---|
| C1 | Executive board member (food) | M | 60 min 00 sec | 30/01/2025 |
| C2 | CEO (food) | M | 53 min 06 sec | 31/01/2025 |
| C3 | CEO (food) | M | 37 min 59 sec | 07/02/2025 |
| C4 | Co-CEO (food) | F | 40 min 37 sec | 10/02/2025 |
| C5 | CEO (food) | M | 54 min 45 sec | 12/02/2025 |
| C6 | CEO (food) | M | 32 min 26 sec | 12/02/2025 |
| C7 | CTO (food) | M | 50 min 07 sec | 25/02/2025 |
| C8 | CEO (food) | M | 56 min 07 sec | 27/02/2025 |
| C9 | CEO (food) | M | 1 hr 56 mins 1 sec | 28/02/2025 |
| C10 | CEO (ESG-management platform company) | M | 13 min 37 sec | 6/03/2025 |
| C11 | CSO (food) | M | 13 min 12 sec | 5/05/2025 |
| C12 | CSO (food) | M | 15 min 15 sec | 6/05/2025 |

Table 6: Interview Information

While all interviews were carried out in Flanders, the preferred method was in-person interviews. This creates an open atmosphere and allows the interpretation of non-verbal cues. Moreover, in-person interviews have more back-and-forth dialogue **(Denham & Onwuegbuzie, 2013;**

**Johnson et al., 2021)**. For some correspondents, a personal interview was impossible; hence, it was conducted online via the Google Meet platform.

All the interviews were recorded using audio. Before recording, the interviewee was asked to sign an informed consent document stating that the interview could be recorded, that the information provided would be handled confidentially and only used in the research context, and that the respondent would be anonymized using a pseudonym.

### 4.4 Data Analysis

The data was collected during the semi-structured interviews, after which the interviews were transcribed. Data transcription transforms audio into written text and is the first step in data analysis **(Bailey, 2008).** It is important to note that the relationship between the interviewer and interviewee, and preexisting beliefs and ideologies, can influence transcripts. Having as much transparency in the transcript as possible is essential to get representative research results **(Skukauskaite, 2012; Stuckey, 2014).** After transcribing the data, it is processed during "*coding*." First, open coding was conducted. This process starts with reviewing all the data line-by-line, then themes are identified, and pieces of transcription text are attributed to these themes. After the open coding, axial coding was applied to identify common themes between the codes **(Neale, 2016; Vollstedt & Rezat, 2019; Deterding & Waters, 2021).** The last step of our data analysis was creating a coding tree.

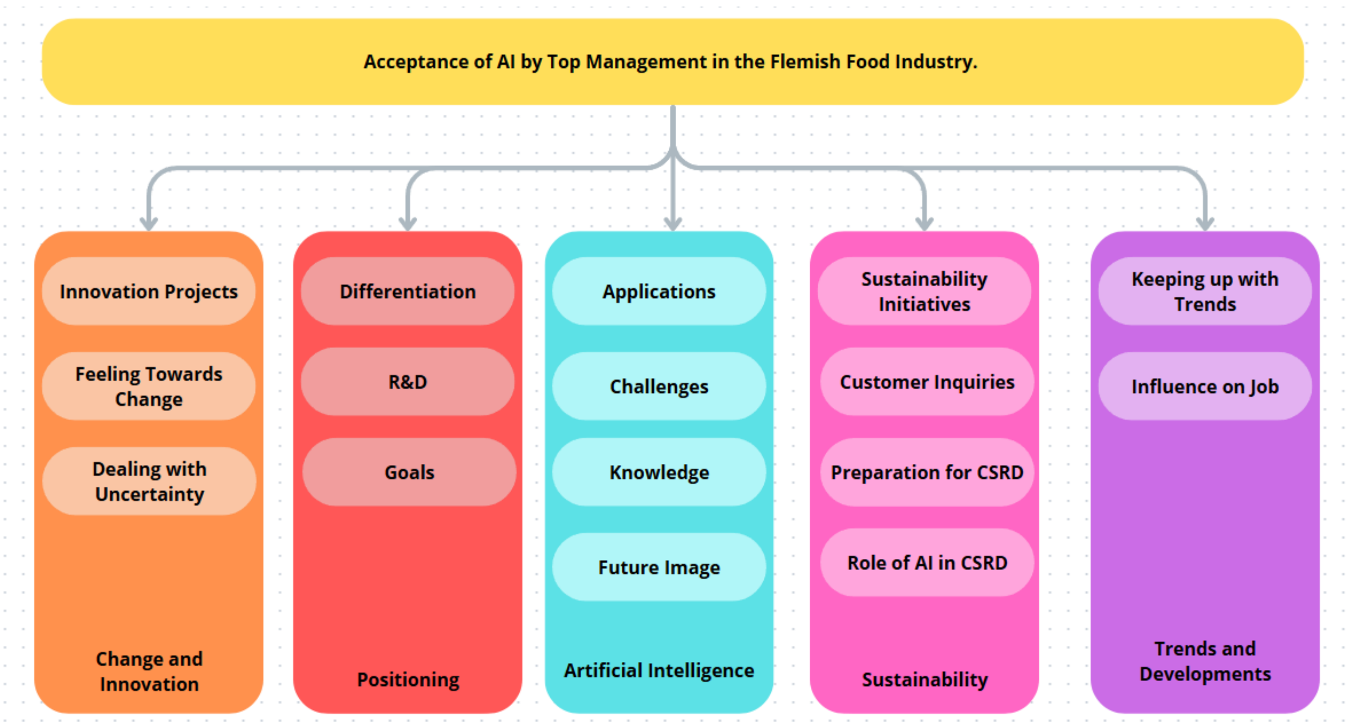


Figure 23: Coding Tree

## 5. Results

### 5.1 Attitude to Change

The attitudes of members of the top management teams of Flemish food SMEs toward change are overall positive. Most indicated they are comfortable with change; one respondent, however, mentioned that they are only comfortable with change when it doesn't bring about a significant shift in their work or company.

> *"Fantastic, I love it. The more, the merrier. Change brings opportunities." - C8*

> *"In terms of work, I think very positively." - C3*

> *"Yes, I find that very necessary. Um yeah, I can still handle that well." - C4*

> *"But if you see it coming at you and it is not groundbreaking for your company to adapt, yes, I am someone who likes it (change)." - C5*

Respondents indicated different factors that could help explain their attitude toward change. The first one is the industry in which they are active. It was indicated that the food sector is subject to many changes and that change is inherent to the industry.

> *"We are active in food. Here, so many things change fast. So yes, that is one of the criteria you must be able to deal with if you work in this sector." - C4*

The second factor mentioned is age. Some respondents mentioned their age as a factor for being either more hesitant or more open to change, specifically regarding working with new technologies.

> *"I try, given that at our age, we are less quick than our children, who get away with that a little quicker. The longer I see that if you don't do that, the more you get pushed aside. So we have to." - C3*

> *"I'm pretty young still, though. We grew up with a phone and stuff, so I never think that's a problem. I can always adjust well." - C6*

A single respondent mentioned not liking change and comparing the change to a "crisis," but also said that change is necessary. They noted that they are curious and open to new technologies because it is necessary to stay competitive.

> *"That new technology, I'm very curious about that, and I'm very open to that. That's a must in my eyes to stay relevant. Nobody likes change, including me. But it is necessary. So yes, if you recognize that need, then you can try to make a crisis into an opportunity." - C5*

Overall, members of the top management teams in Flemish food SMEs indicated that they felt comfortable toward or even invited change into their companies/lives. When delving a little deeper, some did indicate that they felt less comfortable with changes that were very drastic or impacted many aspects of their lives and/or companies. Respondents attributed their feelings toward change to different factors, such as age or characteristics of the food sector itself.

### 5.2 Keeping up with Trends

When asked about the channels through which they kept up to date with trends in the industry, respondents indicated that trade shows are their main source of keeping up to date with trends and innovations regarding new products and machines.

> *"And there (at trade shows) are also manufacturers of machines. So you go there and look at the latest developments. Also, "ruby" chocolate came on the market several years ago. Ruby is a new kind of chocolate. So you see that at fairs and things like that, you can kind of predict it." - C3*

Respondents mentioned gatherings from networking organizations like Voka or Unizo to monitor their colleagues and/or competitors. An interesting insight here is that there is often open discussion with colleagues or competitors about how they each approach trends and certain issues. They also indicated that they carefully watch their colleagues and competitors to monitor their technology/AI integration and compare it with theirs.

> *"I have a membership at Voka. There, we are in a CEO forum where we talk to people who run businesses. And in some areas, you learn. AI then also comes up there: who is already working on that? Who is doing what? What company is already far along with that? Where can we take a look?" - C1*

> *"Running into people at trade shows, calling colleagues, building a sort of network to sense those trends as well." - C9*

Another interview mirrored this, with the respondent stating that they will never be the "early adopter" of new technologies, applying a "wait-and-see approach." Interestingly, the respondents also mentioned that they tried to be the early adopter but didn't work out; thus, they stepped away from being the "first mover."

> *"You just have to embrace that. I'm never the early adopter. I'm not the one who applies it first, but I am the second. I want to first take a look at where it is already working. I've tried some things before where we were the first, but it didn't work. So you have to be able to wait and see sometimes." - C3*

Another reason the respondents give for joining networking organizations like Voka, Unizo, or others is to follow webinars or seminars on upcoming trends or technologies to keep their knowledge up to date.

> *"We do participate in various knowledge platforms and training groups. We attend a lot of training through Flanders Make, and through there, we also get a lot of information." - C7*

> *"We are also members of Fevia, Voka, and FIT (Flanders Investment & Trade), there, we also get a lot of information." - C5*

Some respondents, like C5, mentioned subscribing to magazines or trade journals specific to their product to keep updated with changes that would specifically affect their product and/or company.

> *"We are also subscribed to specialized magazines or newsletters that have more to do with chocolate, for example. Those are the things that keep us up to date." - C5*

Even though all respondents were either members of an organization, talked to colleagues and competitors, or read magazines, many still found it challenging to be aware of many new emergent technologies or their applications, referring to the smaller size of their company as the main culprit of being less informed.

> *"But you have to be informed. That's important. I also find that to be the most challenging part of a small business. How do you know which applications already exist? That's a difficult one, actually." - C3*

#### 5.2.1 Export Tariffs United States of America

After the ten interviews were completed with members of the top management of Flemish food SMEs and an ESG expert, the Trump administration announced in an Executive Order that starting on April 5th, 2025, there would be an additional ten per cent tariff on all goods exported to the US. And on July 9th, 2025, this would become a 20 per cent tariff. After this development, two more members of the senior management of Flemish food SMEs, specifically two commercial directors responsible for export, were interviewed to ask them about the impact that these tariffs had on their business.

The first interviewee was the commercial director of a Flemish biscuit company that exports to the USA. When asked about his concerns surrounding the tariffs, they expressed some concerns:

> *"The US is our biggest market, so these new tariffs are very concerning to us. Most of our revenue comes from exports to the US."*

> *"It's also very uncertain, we don't know if Trump is going to change his mind. My clients also consider this; they don't want to "yo-yo" their prices. They don't want to pass on the costs of the tariffs to their customers. So they ask us for some effort on our side."*

The second interviewee was the commercial director of a chocolate company who also exports to the USA. This interviewee also expressed concerns about the tariffs:

> *"There are many factors that come into play when exporting, the exchange rates, the cost of cacao has also doubled, the COVID pandemic,... we are used to it. So the increasing tariffs are not something new. But the big issue is the uncertainty, it is very difficult to make a long-term strategy if you don't know if he (Trump) is going to change his mind tomorrow."*

> *"Normally, for exporting to the US, we use Ex Works, so the customer agrees to pay for all the import duties. But now they are coming to us and asking us to chip in. For big clients we will, it means to have a smaller margin. But for smaller clients, we can't."*

These two additional interviews revealed that the main issue wasn’t the tariffs themselves, but rather the uncertainty of having Trump in office. It’s challenging to develop a long-term strategy when there's constant concern that he might change his position from one day to the next.

### 5.3 Sustainability

#### 5.3.1 Sustainability Initiatives

When the respondents were asked about current trends affecting the food sector/their activities, a repeatedly mentioned pattern was the shift toward sustainability. It was largely seen as a big trend that has and will continue to impact the food industry greatly. Respondents mentioned being very aware of this trend:

> *“We see that sustainability is a huge point to the agenda in every part of the world, of course.” - C2*
>
> *“We are aware of working sustainably. We want to.” - C6*
>
> *“We talk about environment and sustainability, and we also want to do some things in an environmentally friendly and sustainable way. We also have certifications for that.” - C9*

Some respondents mentioned implementing initiatives that were focused on sustainability. Some projects focused on energy efficiency, using electricity from a sustainable source or installing solar panels. Others focus on reducing waste by, for example, using recyclable packaging. Even though respondents stated they were very aware of sustainability, some only implemented “small” adjustments to be more sustainable.

> *“... and also on energy consumption, we are looking at running more efficiently. There are solar panels installed. Some batteries are going to be added. Meanwhile, we have also switched completely to LED lighting.” - C9*
>
> *“For example, we are committed to using a minimum of 50% electricity from renewable sources.” - C8*
>
> *“So those are such plastic containers in which the truffles used to be made of gold and brown color. That's harder to recycle. So, we completely switched to the transparent ones. Those are also 100% recyclable.” -* C3
>
> *“We work with different types of packaging made from recycled materials.” - C6*

#### 5.3.2 Barriers to Sustainability

When asked about motivations to implement sustainability practices, an interesting trend emerged. Respondents mentioned that factors such as older buildings and inefficient resources made it difficult for them to implement sustainability-related changes.

*"The thing is, we're in a slightly older building. So that limits some of the efforts that we can do currently. We would like to put solar panels, but for example, our roof structure does not support the weight of solar panels." - C7*

Another frustration multiple respondents raised was the many regulations that emerged because of this rising awareness and focus on sustainability.

*"And those regulations within Europe are becoming difficult, I think." - C3*

*"The market demands it. And the regulations are not always obvious. Belgium was the first in Europe to introduce it." - C3*

*"The possible ban on packaged cookies. So the industry says we'll stop the singularly packaged cookies because that foil will fly into some creek, and then there's a little bird eating it that dies. If those guys think it should be banned, we can close the factory down." - C1*

Some respondents even mentioned implementing sustainability practices solely because their clients requested it.

*"The market demands sustainability as well. So if you don't do that, you can't sell either*." - C3

*"For some customers, we do fair trade. You also have RSBO and several other certificates. So it is customer-dependent also. What the customer wants."* - C3

In short, respondents were aware of the shift toward sustainability, and some noted implementing some changes. However, multiple factors, such as resource constraints and regulations, formed barriers to implementing sustainability practices.

**5.3.3 CSRD**

Another respondent mentioned working with an external consultant to develop a sustainability roadmap to adapt to the changing regulatory environment. They noted that even though they were small SMEs without a reporting obligation, their clients were large publicly traded companies with a reporting obligation. This refers to the fact that large companies in the EU have to report on their impact on the environment, also known as ESG (Environmental, Social & Governance) or the CSR Directive (Corporate Sustainability Reporting). So, the larger companies have to know and request the ESG data of their suppliers, in this case, the Flemish food SMEs.

*"At the end of last year, we started working with an external expert on a sustainability roadmap for our company. The final step will be to report on this to all our stakeholders. That means our employees, customers, suppliers, residents, and anyone else interested. This mainly stems from the fact that much legislation has been added and required at the EU level. We are a small company, but our clients are publicly traded companies. So they have a reporting obligation, and they naturally pull us in, too." - C5*

This last quote also explicitly mentions the reporting obligation of large, publicly traded companies. This includes the CSRD or the Corporate Sustainability Reporting Directive. Many of these SMEs were critical of the CSRD's impact on their operations. The main issue was that these SMEs needed to fill in a lot of sustainability documentation to deliver to their more prominent clients, who have a reporting obligation. This takes up a lot of time and manpower, making the workload much higher, which puts a lot of stress on SMEs, who often indicate they do not have a lot of resources to dedicate to this task.

> *"The problem is the huge administration around it (CSRD). We are now working with a major retailer that operates globally. I think we need to fill in 40 documents before we can offer anything at all. Anyway, who does that? I'll do that. But that's not my job. But we don't have 16 people who can do all that." - C3*

> *"I want one system to report everything relating to sustainability similarly. What we still see often is that all our major clients have their own template, their own questionnaire, and their own way of reporting. They are all very similar but slightly different. And that puts a very high workload on the people who have to deal with that internally here." - C5*

> *"We hold that back as much as possible because I hear from colleagues that between one and four people are working on that full-time." - C9*

Others also indicated that they are preparing for the day when SMEs may be obligated to report CSRD by hiring an external consultant to set up their own CSRD reporting specifically. However, the respondent who works for an ESG reporting tool mentioned that hiring an external consultant takes up a lot of time and is expensive.

> *"I'm not saying we have enormous expertise on that internally, but we know the guidelines, the reporting, and the type of business that falls into that. We are not there at the moment. We don't want to wait until the time comes. We have also engaged an expert to guide us in that." - C5*

> *"We are going to work with a company from Belgium called Climate Cap, and they are going to support us to help set up all this CSRD reporting so that once we get that demand from our customers, we are already ready for that." - C7*

> *"I think the biggest hurdles are time and cost. And to give you an idea, at large companies, such a consulting project will cost you between 250 and €500,000." - C10.*

An interview with a founder of an ESG-reporting company confirmed these statements, stating that CSRD-reporting takes a lot of time and effort, especially for food SMEs. Moreover, the respondent mentioned that hiring a consultant to make such reports can cost up to 500.000 euros.

> *"Normally, companies do this themselves; that costs a lot of money and also takes a couple of months for one such report." - C10*

> *"SMEs have to hire a consultant for these types of projects; it can easily cost them between 250.000 and 500.000 euros." - C10*

The respondents saw the potential of AI aiding in reporting their data for their large, CSRD-obligated clients. However, there were still significant doubts about the potential of AI being thorough enough, referring to the fact that they think that the data the AI will come up with will have to be reliable and correct, indicating that there will have to be a form of trust extended to the AI.

> *"I certainly do see opportunities to support that. That it will make it completely okay. I don't believe in that 100 per cent. Preparing 90% or so and pointing out where we need to supplement, yeah, that's a tremendous value-add that's very valuable to companies like ours." - C7*

> *"I also think it's the trend that's going to come. I don't think it's easy. Especially because you have to have reliable data that you have to be able to trust that it is correct and interpreted correctly." - C9*

## 5.4 Innovation in Food SMEs

### 5.4.1 Current/Past Innovations

Innovation in food SMEs is not very pronounced. Most of the innovation that occurs in food SMEs is product innovation. Most respondents were (solely) private label manufacturers, meaning they produce products for another company under another company's name. Thus, many innovations in food SMEs in Flanders were based on customers' requests.

> *"This week, we ran another sample by customer demand for a sugar-free product with vitamin C and natural flavoring of natural colors." - C2*

## 5.5 Top Management's View on AI

### 5.5.1 Attitude Towards AI

The overall perception of AI in SMEs' top management is positive. There is a general belief that AI will bring about good things. The benefit that AI will bring to the environment and society is brought to the forefront. In addition, the feeling of excitement and curiosity is highlighted in multiple interviews.

> *"Changes such as AI implementation excite me. I am very occupied with it and want to know exactly how everything works." - C3*

> *"I see a lot of positive things, and I see a lot of solutions. AI will be good for the environment and society. I could never be against it, no way!" - C9*

> *"There are a lot of opportunities linked to AI, and there will be more in the future. If they spread to the SME landscape, I am excited!" - C1*

While the general attitude towards AI is rather positive, feelings of hesitation and caution can also be observed. Respondents are mostly scared about AI making mistakes when generating information. Moreover, they fear secret information, such as recipes, will get leaked and end up with competitors.

> *"We work with very complex systems; if AI makes a mistake there, we can get high fees. So if it can do it perfectly, I could consider it, but for now, no." - C3*

> *"I don't know who handles my information (referring to recipes) if I put it inside an AI system. So I would never use AI in my production processes." - C4*

Whereas there is a mostly positive attitude toward AI, top managers are hesitant toward AI integration. They are afraid that AI is still in its "birth phase" and will make mistakes and leak confidential information, such as recipes, which leads to the belief that widespread AI integration in their SMEs is not on the table for the foreseeable future.

### 5.6 Interesting Applications

#### 5.6.1 Support Processes

Most respondents were interested in applying AI in two fields in their companies. The first one is the usage of AI in its support processes, such as accounting or marketing. The second one is the usage of AI in the business's core competency, which is production. According to the interviews, SMEs in the food sector currently use AI primarily in their support processes.

> *"We are currently implementing AI in some areas; for example, it is getting implemented in accounting." - C1*

AI is also being used to, for example, write the content of e-mails or other communications.

> *"80% of emails I receive are AI-generated, but I don't mind because I do that too." - C6*

The human resources department is another department where AI automates tasks. Here, an interviewee indicated that AI can aid in writing job advertisements.

> *"So I say, we are company X; this is what we need. Write me a job ad, and it's done. Otherwise, I would need an hour to write this type of text. Now it just rolls out, you make some adjustments, and it's done!" - C2*

Another area where AI often automates tasks is the marketing department. Here, a respondent gives an example of how AI can, for example, be used to edit pictures.

> *"For example, there are already many applications for editing pictures in Lightroom, allowing you to edit, manipulate, and enhance your photos easily. So for marketing, I see many positive things in AI." - C8*

Besides automating tasks, AI is often used to inspire top managers and help them brainstorm or simplify tasks. This respondent gives a good example of how AI helps them find information when exporting goods to the USA.

> "*Of course, you can get this information from VOKA or colleagues. But you'll see if you simply ask ChatGPT: "Okay, I make truffles. I do this and that; give me an overview of the three most important parts and the steps I should take to export." You'll get the right answers immediately. In just two minutes, you have a list of actions. Otherwise, you would have to call and make an appointment, and you'll still be waiting three weeks later." - C3*

A last AI support application that could help SMEs in the future is market research. For example, a company must research market conditions and export tariffs abroad. Because these terms can differ across countries, SMEs show interest in implementing AI systems that automatically check their requirements.

> *"Right now, we have to do all our documentation ourselves. For example, export duties and regulations differ between the USA and Spain. We have to figure it out ourselves, and if it gets too complicated, we need to pay a consultant to help us." - C4*

### 5.6.2 Production

Respondents mentioned that AI has not (yet) been integrated into their company's core business. However, top management believes AI will, in the future, be more prominent in their production processes.

Specifically, respondents are very interested in process automation in production. Production automation is a process in which machines can adjust themselves (for example, temperature) based on incoming data without requiring manual intervention. Respondents mentioned that this would make its processes much more efficient.

> "*If we would no longer have to adjust machines manually because they know what is coming, and they would set their temperature and guides accordingly, it would make production much more efficient." - C1*

Predictive maintenance is another AI capability that is seen as highly valuable: by predicting possible machine breakdowns and maintenance, machine downtime can be reduced, and maintenance costs can be lowered. To implement predictive maintenance, sensors must be installed, or new machines with integrated sensors should be bought. Due to its perceived high cost and the time it will take to implement, top management has not yet adopted it.

> *"I see more companies using predictive maintenance that sees things we humans don't, so yeah, it's coming. But for now, I find it way too expensive." - C4*

> *"Predictive maintenance, such as forecasting breakdowns, requires placing sensors on the machines. However, we're not there yet. It's an investment that takes time, and implementing it is challenging." - C3*

Respondents mentioned AI-controlled quality control as another AI application they were interested in. In this system, machines use computer vision to detect mishaps and check the quality more accurately, leading to increased product quality. Respondents noted that this is mainly done by humans, which is time-consuming. Moreover, it can check additional parameters, such as a specific product's exact weight, which can save costs.

> *"It can lead to better product quality, I think. So yeah, I'm convinced that AI quality control can be very useful." - C5*

> *"Products of lesser quality are thrown out. Now, it's all human control. Machine control will always select products more consistently. You will have better quality and a more stable product weight." - C3*

One respondent even takes it further and mentions that AI can lead to a zero fault percentage.

> *"Fault percentage becomes zero. The machine doesn't have to sleep or eat." - C6*

In short, respondents mentioned that AI currently mainly supports accountancy, administration, marketing, and human resources tasks. Moreover, top management often uses AI tools to help them brainstorm and simplify tasks. In the future, top managers will wish to use AI in production automation, predictive analysis, and quality control. However, they mention the high perceived cost as the biggest obstacle to implementation.

### 5.7 Enablers for AI

Respondents believe there are many opportunities linked to the broad implementation of AI. These opportunities can explain the feeling of openness and excitement. There is a consensus that AI will continue to make administrative processes, such as accounting and documentation, more efficient, freeing up time for other tasks.

> *"AI is a fantastic tool for doing my work more efficiently. Due to AI, I can do more in one day. I don't have to search 5000 pages anymore, but I can ask ChatGPT a question, which will give a clear answer." - C9*

> *"It can make processes more efficient and increase quality, I guess. So yeah, I'm convinced that it will be good." - C5*

Moreover, respondents believe that AI can help reduce costs in many areas. They mainly mention labor, administrative, and production costs as potential costs that can be lowered with the help of AI.

> *"It will be much cheaper to place robots than to pay people." - C4*

> *"If AI is implemented into production, then we can start competing with Eastern European countries, which are low-wage countries. Then we can start doing something again. Right now, they can make products for half our price because of low labor costs." - C1*

### 5.8 Barriers to AI

#### 5.8.1 Barriers to Implementation

While there are a lot of interesting applications of AI in the food industry, respondents mentioned several challenges.

The current challenges are mainly in adopting AI in their core business, production.

The first challenge mentioned by almost all respondents is the cost of implementing AI. Often, SMEs mention that they are "just" small businesses without the financial resources to implement expensive technologies. They feel that only large corporations have the budget to make these investments. The SMEs don't want to be first movers or early adopters, waiting for the larger companies to prove that the return is worth the investment.

> *"It is too early for us. Large businesses have a bigger budget for these investments, but we don't." - C8*

> *"You don't immediately see the return on your investment. So your efficiency will not automatically increase, nor will your costs immediately decrease. The ROI will be right on the edge or not quite be there." - C2*

The second challenge that is repeatedly mentioned is the motivation of the workforce, especially production employees, to work with new technologies. Respondents mention that some workers are hesitant to work with new technologies.

> *"An app to ask for annual leave stresses people out. They don't know how to work with it." - C1*

> *"For digitalization, 85% we get them going, and the other 15% remains difficult. We do see that." - C5*

Moreover, top management notices that some workers are hesitant because they fear losing their jobs and getting replaced by AI/robotics.

> *"That will bring about a lot of skepticism because people will think: "If a robot can do my job too, then I will lose it.'" - C1*

However, many respondents don't believe AI will completely take over workers' jobs. Some believe there can be good cooperation between workers on the one hand and robots on the other hand. Others state that robots will accelerate certain processes or that certain jobs will be irreplaceable by robots.

> *"We conduct tests for chemical reactions. A robot cannot conduct these kinds of experiments; we need to see how these processes react." - C3*

> *"I see AI as an assistant; it will not replace me or my workers. I think it will just make us faster. - C2*

*"For certain jobs, you will always need people, but it's just a cooperation between AI and people. Yes, you will have to use it." - C8*

A respondent explains that to get everyone on board, they must go step by step, starting with smaller applications. Their workers will need to see that these systems are there to help them and that they make their work easier. If not introduced slowly, they fear they will get a lot of resistance from the workforce.

*"You have to get your people aboard. It's a step-by-step process. We start with simple applications so they can see: 'Oh, this works well.' If you introduce everything immediately, they'll push back and say, 'Oh, we don't want this.' Then you face resistance." - C3*

Thirdly, respondents often discuss the lack of data as one of their implementation issues. Some fear they simply don't have enough data, while others don't know who will do the data management since they don't have the budget to hire dedicated employees focused on data management.

*"You need a lot of data; I don't know if we have that" - C3*

*"Who will do the data management, who?" - C8*

Fourthly, respondents believe they lack the knowledge of AI to implement it on a large scale in their company. Particularly in production processes, they find the complexity of AI integration a significant barrier. No internal AI specialists, such as CTOs or CDOs, were in the SMEs for this research. Consequently, current AI initiatives must come from top management with little to no expertise in AI.

*"I don't think we have the right people now to integrate AI." - C7*

*"I haven't delved into that yet." - C2*

*"I don't have the personnel with enough education on this because you need a digital brain and mathematical skills. You have to be able to interpret statistics. That's not the type of profile we're working with today." - C9*

One respondent even mentioned that if they could make one change to their organization, they would hire someone who could constantly experiment with new technologies. They believed the company could benefit from process automation and other AI-related developments.

*"It would be very interesting to have someone and allow them to play with new technologies constantly." - C1*

Lastly, the black box principle unravels a lot of negative emotions. In the black box principle, the input that goes into an AI system is known, but there is no knowledge of how the output is produced. Due to this, respondents fear they will still need a lot of human control systems to check whether the work is correct, which SMEs generally do not have the resources for.

*"But what personally holds me back a bit is that black box principle. You don't know 100% how AI comes to certain decisions. That remains a continuous process to keep monitoring and following up. And that is often where SMEs do not have the right people, resources, knowledge, and budget to keep following that up." - C7*

Another issue linked to the black box principle is that companies often don't know where their information will end up. While the SMEs in this research often work with unique and sometimes even secret recipes, they fear AI will leak data on their ingredient composition once they enter it into AI systems.

*"Everything you put in, ask, or communicate goes to the other side. We don't know who is on the other side. So if we, for example, put in recipes or a formula, we don't know who it will end up with." - C3*

In summary, the main challenges in AI implementation in production are the high implementation costs, the motivation of the workforce, the lack of (accurate) data, the lack of in-depth AI knowledge, and the black box principle.

### 5.8.2 Sustainability of AI

Although there were no specific interview questions regarding the sustainability of AI itself, one respondent reflected on this matter when asked about the barriers to AI implementation. They doubted they would even want to implement AI in their production processes. They refer to AI as a "mega polluter" because the systems are incredibly polluting, comparing ChatGPT to the pollution caused by planes.

*"Only the sustainability aspect will have to be heavily questioned. When asking ChatGPT, they have calculated that. I don't know how many questions you must ask, but it has almost the same environmental pollution as a plane. Because of the coolers and stuff like that."*

## 5.9 Future of AI

### 5.9.1 Near Future

It is interesting how respondents mentioned testing with process innovations or having consultants inform them about future AI or automation possibilities. However, they also mentioned that they can only adjust within their means and their current machines.

*"We have also done tests with cameras that see what cookie is on the belt and then adjust based on what kind of cookie is on the belt. This is still done manually, but we are already looking into the future. Also for planning, accounting or maintenance of machines." - C1*

*"Last year or even before, you got demos from companies offering it (AI). I also had a personal demo once. Yes, they have been here, and they were very well prepared. Because some have implemented it." - C4*

However, top management in food SMEs believes that AI will not significantly impact the core of their business in the short term. When we asked respondents to elaborate on this, multiple responses came up. One is the belief that the machinery they use for production is either too expensive or not ready for AI implementation. Therefore, respondents mentioned they would not be the first to use AI-driven machinery.

> *"Innovation and machinery cost a lot of money." - C6*

> *"Last week, when I was at a food fair, I looked at the production machines. There was not one machine that had AI implemented." - C6*

> *"The technology is coming, but I find it way too expensive. I doubt that will be different in a few years." - C9*

Moreover, the fast-changing environment in which these SMEs work is one reason top managers think AI implementation in production will not be there soon. Firstly, respondents mention that their recipes change often. Human insights are necessary to test these recipes. Therefore, respondents don't see the use of AI in this process. They also fear that if one AI-driven production machine is introduced, it will get outdated soon and will not keep up with the rapidly changing industry. Moreover, there are so many new developments and trends in the food industry, such as AI and sustainability, that respondents feel they cannot implement them all.

> *"In production, so many changes happen, and they happen very quickly. Therefore, I think AI implementation is quite hard for us." - C7*

> *"Technology changes so fast that today's knowledge will be outdated tomorrow." - C4*

Once again, the black-box principle is brought about. Top management is concerned about their recipes being leaked and output being incorrect. Therefore, they show hesitance towards implementing AI in the short term.

> *"In our company, I don't think they will be able to sell much (AI) because we deal with confidentiality, which will always be a factor. So until they figure that out, I don't see us using it." - C4*

> *"If AI is not 100% correct, I don't dare to use it." - C9*

Respondents thus make clear that AI is not at the top of their minds. The quote of this respondent clearly states this.

> *"AI is not something that I would invest in in 2025." - C7*

> *"I have a list of 10 things I would like to implement, and AI is not one of them." - C2*

Respondents feel that AI will not be implemented in the food industry's production processes in the following years. This can be related to factors such as the cost of AI-driven machinery, the fast-changing food industry, and the black-box principle. Moreover, due to the often limited size and financial resources of their company, they feel like even if they wanted to, they would always be constrained in their resources.

> *"You need to have the resources for that (AI), and I think that is the con of being a small company; we don't have them, whereas big companies do." - C3*

> *"We are way too small. I don't know if we will get anything out of it." - C4*

**5.9.2 Long-Term Future**

When asked about the implementation of AI in the next 10 to 15 years, respondents stated that AI will have a notable impact. There is consensus that AI has much unused potential that can be shown in the future. Some respondents are enthusiastic about this development and believe AI will transform the food industry and the world.

> *"AI will change everything, not only the industry but the entire world. It is a real game changer." - C8*

Others are more careful when expressing their future view on AI. It is clear that they think it will have a big impact on the industry, but they still express feelings of scepticism. They don't know how long it will take until AI-driven production becomes the standard and whether they will soon implement AI in their own plants.

> *"Yes, AI will rule in the future, and we will have to adapt to these systems one day. But I don't see that happening soon. I will follow the trend, but I will not be the one testing." - C4*

## 6. Discussion

Three sub-questions were drawn to answer the main research question, **“What factors influence senior management’s acceptance of artificial intelligence in the Flemish food industry?”**

### Subquestion 1: What are the key drivers and barriers to AI adoption in Flemish food SMEs?

Artificial intelligence has become an integral part of various industries, transforming traditional processes through automation and data-driven decision-making **(O’Donovan et al., 2015)**. As AI technologies evolve, they will undoubtedly influence the (Flemish) food industry. This research identifies one major driving factor facilitating and five barriers hindering the adoption of AI within the Flemish food sector.

Enablers of AI adoption

In Flemish food SMEs, AI’s current main use is in support processes, such as administration, accounting, human resources, and marketing. AI can help execute these tasks faster, freeing staff time to work on other projects. The interviewees believe AI will play an increasingly vital role in automating these processes, which they are convinced will lead to lower operational costs.

In the long term, respondents believe that AI will become essential to their core business processes, specifically in production. They see AI as an automation tool that optimizes machine performance and can reduce human error. A key application they see here is predictive maintenance, which can minimize downtime and ensure continuous production, lowering costs and increasing efficiency. Moreover, respondents view AI-controlled quality control as a valuable opportunity to produce consistent and qualitative products. Multiple studies, such as those conducted by **Yan et al. (2017)** and **Peres et al. (2020),** support these respondents' views, stating that predictive maintenance, quality control, and process automation are promising applications that increase efficiency and lower costs.

Barriers to AI adoption

Besides the enablers that foster AI integration, the interviews also reveal five significant challenges that top management currently sees in AI adoption or anticipates in the future.

The first barrier is the cost of the initial AI implementation. Respondents state that due to their small size, they don’t have the financial resources to implement AI-driven production machines or sensors for predictive maintenance. They view the implementation of AI as a time-consuming and expensive effort that is not currently worth it to them. They specifically point to AI's return on investment (ROI) and say it is currently not up to their threshold, which would have to be met for them to implement. This point can be validated by the **European Commission’s (2020)** research, which identifies implementation costs as one of the main obstacles to AI implementation in companies.

Secondly, top management mentions their workforce's motivation as a barrier to AI implementation in their SMEs. They state that workers are reluctant to work with new technologies because they fear AI will replace their jobs. This may be a realistic fear, as research from **Ghobakhloo (2020)** and **Suleiman et al. (2022)** highlights that AI can lead to a decreased need for low-skilled workers and an increased need for workers skilled in machine learning and software engineering. However, top management claims that AI will never fully replace their laborers, indicating there will be a balance between humans and machines. However, this belief may be overly optimistic, as research by **Ghobakhloo (2020)** and **Suleiman et al. (2022)** suggests that the integration of AI is likely to reduce the demand for low-skilled workers. Thus, something else must be done so that their more hesitant workers can embrace AI.

Thirdly, respondents mentioned their lack of in-house data as another barrier to implementation. Some respondents mention a lack of data as the key issue. **The European Commission's (2020)** research confirms this point, highlighting the lack of internal data to train AI as a barrier to AI adaptation. Other respondents point to high data management costs as the main barrier.

Fourthly, the lack of knowledge of AI in SMEs is a big hurdle for AI adoption. Top management indicates that all current AI initiatives must come from them, which is problematic since they often have little to no expertise in AI. Some respondents show interest in hiring AI specialists but find it challenging to find the right profiles with enough expertise, or deviate from this idea because hiring an additional employee is too expensive. **The European Commission (2020)** identifies the shortage of AI experts as the most significant barrier to AI implementation, supporting the respondents' opinions.

The last barrier that top management noted hindering AI implementation in their SMEs is the "black box" principle. The black box principle raises significant concerns for top management, as some respondents fear that confidential information, such as recipes, could be misused or unintentionally leaked through AI systems since there is a lack of transparency. **The European Commission (2020)** report includes this issue under "possible damage caused by AI."

To conclude, the key driver for AI implementation is the perceived benefit it may have on the performance of SMEs. Significant identified barriers include high implementation costs, workforce resistance, lack of data, limited AI expertise, the black box issue, and security issues.

**Subquestion 2: How does the mindset of senior executives affect AI integration in Flemish food SMEs?**

The attitudes of top management teams significantly influence if AI is adopted into food SMEs or not. While senior managers recognize AI's potential in their companies, the choice to move forward with AI or not can be tainted by past experiences, age, personal beliefs, risk aversion, and other personal characteristics.

Most respondents indicated they feel very comfortable with change, recognizing that the food industry is subject to many fluctuations, making adaptability an inherent trait of players active within the sector. However, a more in-depth analysis of the interviews shows that each top manager interprets "comfortable with change" differently. While some managers see frequent change as "a positive force," others describe it as "a necessary crisis." When linked to AI, managers who view frequent change as a necessary crisis perceive AI adoption as a risk, while those who see change as a positive force may be more open to embracing it. These interpretations can be linked to the Upper Echelons Theory by **Hambrick & Mason (1984)**, which states that top management's characteristics and cognitive frames partially predict organizational outcomes (such as strategic decisions). In this context, top managers acknowledge that their attitudes and behaviours toward change are coloured by past experiences, age, and other personal characteristics, influencing how they view, respond to, and manage transformation within their organizations.

A similar pattern emerges when discussing their attitudes towards AI. Most respondents indicated a positive outlook on AI, mentioning that it will bring about many positive changes, such as increased efficiency and lower costs. However, feelings of hesitation and caution could be observed when delving deeper. These thoughts are linked to the barriers mentioned earlier in this study. Therefore, respondents don't believe AI will significantly affect their production processes in the short term. This outlook shows that managers' personal views play a significant role in making decisions, just as the Upper Echelons Theory suggests **(Hambrick & Mason, 1984)**.

Another illustrative insight is that top management in food SMEs refer to themselves as "followers" rather than "pioneers" regarding technology adoption. If competitors or colleagues in the food sector master AI in their production, they could also consider adopting it, but they mostly don't see themselves as "trendsetters" for AI-driven production. Some respondents linked their hesitancy to being a first mover in earlier technologies, but it did not work out, which led them to step away from being early adopters. Other respondents linked their older age to another indicator that they may not have a "finger on the pulse," thus being less aware and, therefore, being slower to implement new technologies. Another indicator that could explain the hesitation to be the first mover is that SMEs have smaller budgets they can work with and see it as a risky investment; therefore, waiting until the ROI of implementing the new technology is "worth it." These concerns reflect how top managers' personal experiences and risk perceptions shape the strategic direction of their SMEs **(Hambrick & Mason, 1984)**.

In conclusion, the attitudes of top management teams influence AI adoption in food SMEs, with their personal experiences, age, risk aversion, and other personal characteristics shaping their attitudes toward the implementation of new technologies and other strategic decision-making. As the Upper Echelons Theory suggests, their cognitive frames play a crucial role in how top management implements AI innovation in their company and how they will continue to do so.

**Subquestion 3: How can AI adoption in Flemish food SMEs contribute to sustainability in alignment with SDG 12?**

The SDG 12 states, "*Ensure sustainable consumption and production patterns.”* This SDG also includes a key target (SDG 12.6): *“Encourage companies to adopt sustainable practices and sustainability reports.”*

The interviewees in this study indicated that they were highly conscious of the rising importance of sustainability, and some stated that they had already implemented small changes in their businesses to make them more sustainable overall. For example, applying for different sustainability certifications, installing solar panels, or switching to recyclable packaging. While some respondents indicate that they implement these initiatives for the “greater good” and to lessen the environmental impact of their companies, other respondents mentioned that they are also strategic moves. Most members of the top management of food SMEs pointed out that the market demanded it, and if they didn’t meet the sustainability expectations of their customers, their competitors would. For example, one respondent stated that they adopted a Fair Trade certification to meet client demands.

If they didn’t move towards more sustainable practices, their competitors would, and they would lose market share. Thus, a motive for the top management of food SMEs to implement changes is to remain competitive in the changing market landscape. This can be supported by the **2023** study by **BDO and Mercuri Urval**, which stated that 78% of European companies in their study had received specific sustainability-related questions from mainly their clients, indicating that clients may choose their partners based on how sustainable they operate.

Another motive of some respondents was that they needed to implement changes to comply with governmental regulations. For example, a manufacturer of lollies mentioned that since the European Union’s restrictions on single-use plastics, which included plastic lollipop sticks, they also had to comply and change to paper sticks.

In addition to implementing modifications in response to regulatory shifts, firms felt the ripple effects of regulatory pressure through their clients, who were driven by new compliance obligations.

Respondents mentioned being critical of the impact that ESG reporting had on their business. They explained that their larger clients had an ESG reporting obligation, specifically regarding the CSRD (Corporate Sustainability Reporting Directive). Despite lacking a formal reporting obligation, the “trickle-down effect” still impacted SMEs, as larger clients approached them to gather data needed for their CSRD reports. Top management of these SMEs mentioned being frustrated with this since it added a lot of administrative complexity to their plate. Each client had their method of requesting information, using various documents in different formats that suppliers were required to complete. Top management pointed out that they did not have the resources, including time and manpower, to lend to this.

Some respondents mentioned that they anticipated having to comply with CSRD reporting requirements themselves in the future. Some even indicated they planned to hire an external consultant to help set up their ESG reporting.

When asked about the potential of AI when filling in documents for their client's CSRD reporting, respondents saw the possibility of AI doing some of the initial heavy lifting. Still, they had doubts about its accuracy, meaning it would still have to be checked manually. Overall, the feeling was positive, and they saw real potential in using AI in ESG reporting since it would cut out the bulk of the man-hours that were currently being spent on it.

Members of the top management team of Flemish food SMEs indicated that they were implementing some sustainability initiatives, referring, on the one hand, to their clients as the main denominator in the decision to become more sustainable to maintain competitiveness. On the other hand, regulatory bodies also played a significant role in the decision to implement sustainability changes. Although the reasoning may differ, the focus on sustainability has the potential to be an essential differentiator, distinguishing them from the competition and gaining market share. Interestingly, respondents made no linkages between AI and how it could aid in their sustainability.

# 7. Conclusion

Artificial intelligence is everywhere today. It has become a buzzword in many industries. That said, its (future) impact on the Flemish food industry may not be underestimated. The findings from this research are interesting in understanding how leaders' attitudes influence the adoption of AI into their companies.

This study looked at the potential of AI in the Flemish food industry and how the attitudes of the members of top management teams influence the adoption of AI in these SMEs. Relatedly, it looked at the different barriers and enablers that members of the top management teams see in the implementation of AI that additionally influence their attitude toward AI.

## 7.1 Conclusion to the Main Research Question

The main research question, **"How do the attitudes of senior management affect the acceptance of AI in the Flemish food industry?"** can be answered as follows.

The attitudes of senior management play an important role in the acceptance of AI in Flemish food SMEs. While many top managers recognize the potential of AI, their implementation decisions are often shaped by factors such as past experiences, age, personal beliefs, risk aversion, and other personal characteristics. Most senior managers adopt a cautious, follower-oriented approach in their SMEs. There is often hesitation to adopt until the technology's usefulness is established. Key barriers, such as cost concerns, lack of expertise, and the "black-box" principle, further reinforce this hesitancy.

It can be concluded that the attitudes of top management play a crucial role in either facilitating or obstructing the adoption of new technologies. Therefore, gaining the support of senior leadership is a vital step toward achieving broader AI integration in the sector. In the following sections, we offer recommendations for industry leaders, policymakers, and other stakeholders to help shift the mindset of both current and future managers, thereby encouraging wider adoption of AI into the Flemish food industry.

## 7.2 Summary of Findings

### Barriers to AI adoption

The most important barriers to implementing AI according to top management of Flemish food SMEs include the perceived high costs associated with AI implementation, the perception that their workforce shows resistance toward AI implementation in their jobs, lack of in-house knowledge of AI, a lack of data and a lack of transparency in how AI comes to its decisions.

**Enablers of AI adoption**

One key enabler that members of the top management teams see in AI implementation is the perceived benefits it may have, including the potential for long-term cost savings combined with an increase in efficiency.

**Attitudes of top management on AI adoption**

Attitudes of top management significantly influence AI adoption in Flemish food SMEs. While most acknowledge AI's potential, personal characteristics such as age, experience, and risk tolerance influence their attitudes towards AI.

Many describe themselves as "followers" rather than "pioneers", indicating that they feel that the ROI of AI has not been proven, and prefer to wait until it has before investing. These findings align with the Upper Echelons Theory, which states that leaders' characteristics shape their strategic decision-making.

**Impact of Trump's Tariffs on the Flemish Food Industry**

The interviews highlight that while the tariffs themselves pose financial challenges, the primary concern for Flemish senior management is the unpredictability of exporting to the U.S.

This uncertainty makes long-term strategic planning difficult and puts pressure on price negotiations with clients. In the VUCA framework, the Trump tariffs can be classified as volatile, because European companies that export to the US had to suddenly deal with higher import tariffs to the US. This affects their relationship with their American clients.

The tariffs and Trump being in office in general can be described as uncertain under the VUCA framework, because it is difficult for European firms to have long-term strategies when it is uncertain if the tariffs will increase/lower, or if there will be additional tariffs introduced.

**Sustainability in SMEs**

Sustainability is an increasingly important topic to which SMEs are dedicating more attention, effort, and resources.

On the one hand, this increase can be attributed to introducing more sustainability-related legislation by governmental institutions, which directly impacts how some SMEs operate. For example, the ban on some single-use plastics impacts the production processes of certain SMEs. In the future, more SMEs expect similar regulations to affect how they operate today, and are actively testing out what other sustainable practices would look like. For example, a respondent tested what recyclable packaging would look like in their production process.

On the other hand, respondents mentioned that competitive advantage is a big factor in their sustainability efforts. SMEs are expected to live up to certain sustainability norms to stay competitive, retain current customers, and gain new ones.

Interestingly, while sustainability was identified as a strategic differentiator, the potential for AI to assist in broader sustainability efforts was not yet on the radar for most respondents.

In general, top management teams of Flemish food firms had to implement changes that made them more sustainable because of market demand or regulatory changes.

However, when asked about the benefits that AI implementation could bring, respondents did not mention the potential benefits that AI could have on their sustainability or the environment. It was clear from the interviews that sustainability was not top-of-mind for top management; instead, they referred to advantages like cost decreases and efficiency.

**Impacts of CSRD reporting on SMEs**

Top management in the Flemish food industry highlighted the significant administrative burden of ESG reporting on their business, specifically concerning CSRD. Although they don't have to report, the trickle-down effect from larger clients requiring ESG reporting has resulted in inconsistent documentation practices and has put a drain on already limited resources.

Respondents expressed cautious optimism about the potential of AI to support ESG reporting, reducing its value in automating repetitive tasks, and reducing manual workload. However, concerns about accuracy were raised. Therefore, respondents believed AI in ESG reporting would be more of a support tool than a strategic differentiator.

### 7.3 Recommendations

Based on the results of this research, potential solutions are put forward to ease the barriers to adopting AI into Flemish SMEs.

**Stimulating AI in education and lifelong learning**

AI should be integrated into curricula in primary schools, high schools, and higher education. This can pique the interest of more students to pursue an education path in AI-related fields, but it also gives everyone a basic understanding of how AI works and its importance. This can reduce the shortage of skilled workers with knowledge about AI, which is a massive barrier to implementing AI in the food industry.

Furthermore, employees should be incentivised to learn by receiving training about AI. This can reduce the skills gap and provide workers with more information about how AI can help them in their roles, make them more accepting of AI, and reduce workforce resistance toward AI implementation. This training could also be valuable for top management team members, increasing their knowledge of AI.

**Lack of transparency of AI applications**

To gain the trust of the members of top management, AI systems need more transparency into their decision-making process. Senior management needs confirmation that their data will be handled confidentially. This can also be done either with contracts between the SMEs and the company providing the AI, or by laws implemented by the government.

**Improving data collection in-house**

To address the issue of the lack of in-house data in SMEs, it is vital to tackle the root cause, namely, improving data collection. Whereas there is little digitisation in food SMEs, a first step SMEs can implement is by digitalising key processes, for example, by installing IoT sensors that track temperature, humidity, and machine uptime. This way, relevant data can be gathered. Then, systems like ERP can be integrated to streamline and centralise the data. This data will need to be stored in a secure database. By installing these systems, a lot of data can be collected and stored for future AI use.

**Administrative burden of ESG reporting**

A recommendation based on this research is to lessen the trickle-down effect that ESG reporting has on Flemish food SMEs. Clients requesting data from these SMEs create a significant administrative burden, consuming time and other resources that the SMEs simply don't have. A recommendation here is for policymakers to reduce the administrative burden for SMEs by reducing or streamlining sustainability reporting.

However, the EU has proposed its Omnibus I and II packages, aiming to reduce the burden on SMEs by reducing the scope of reporting companies, reducing complexity, and postponing the mandatory reporting deadline by approximately two years for the largest companies. However, these changes have not been implemented into law, and the texts might still undergo some changes.

### 7.4 Limitations of This Research

Some limitations were found in conducting this study.

**Changing Landscape**

AI is a fast-developing technology, with many changes and new applications. During this study, new AI technologies such as DeepSeek were released. Whereas DeepSeek has the main capabilities of other large language models, it released an LLM model at a fraction of the cost other vendors had for their development. This shows how quickly the AI world is developing, with lower costs and faster results.

Hereby, regulations change constantly. In February 2025, during the writing process of this thesis, the European Commission proposed its so-called “Omnibus” packages, aiming to simplify EU sustainability regulations. These simplifications include exempting companies with fewer than 1,000 employees and an annual turnover below 50 million euros from the CSRD. This adjustment could significantly ease the reporting burden on SMEs. This package was proposed after the interviews were conducted and analyzed in this research. However, the package may still undergo some changes before it is adopted, if it is adopted at all.

**Specific Geographical Focus**

The SME landscape can vary significantly from country to country. This research was conducted in Flanders, Belgium, and, unfortunately, doesn’t contain insights from Belgium as a whole or even other countries.

**Limited Number of Interviews**

Another critical restriction of this research is the small sample size. Due to time constraints, twelve interviews were conducted, eleven out of twelve respondents were members of the top management team of Flemish food companies, and one was the CEO of an ESG reporting tool. This narrow sample size limits the generalizability of the results of this study.

**Lack of female respondents**

After having reached out to many possible interviewees, it became apparent that most of the respondents were men. In total, eleven out of the twelve respondents were male, while one respondent was a woman. This imbalance can be attributed to the fact that more men than women take on senior roles in companies. In a **2024** study of both listed and unlisted medium-sized companies by **Grant Thornton**, 10,000 companies in 28 countries were interviewed to provide insights into the composition of their senior management. This study found that worldwide, 33.5% of all top positions are held by women, while in the European Union, this is 35%, which is an increase of 5% compared to 2020 **(Grant Thornton, 2024)**.

While this study used judgment sampling as a sampling method, the respondents were chosen based on their competencies and specific roles, not gender. However, due to the higher representation of men in senior management positions, there is a possibility that the current gender imbalance influenced the composition of our sample.

## 7.5 Recommendations for Future Research

### Research After “Omnibus”

The interviews analyzed in this research were conducted before the proposal to ease the CSRD reporting standards. An interesting avenue for future research could be further investigating the impact of implementing the "Omnibus" packages on food SMEs. Moreover, a comparison based on these possible changes is recommended. But, it must be noted that this package has not been accepted, and it may still undergo some changes before it is implemented, if it is implemented at all.

**Broadening the Geographical Area**

Future research should strive to expand the research to gain insights from different countries and regions and gain a more comprehensive understanding of AI in food SMEs. This extension will give a more representative analysis of AI-related challenges and their potential in the food industry. A comparative study could be performed to see if there are differences or similarities in how members of top management teams in different countries perceive AI, and how their attitudes impact the implementation of AI in their firms.

**Changing environment**

As mentioned before in this study, the Flemish food industry is subjected to many different "VUCA" events, a good example of an volatile, uncertain, complex and ambiguous event that happened during this study was the introduction of the "reciprocal" 20% tariff package by the president of the United States, Donald Trump, on goods exported from Europe to the USA. Later, this was changed to a 10% tariff, and during the writing of this thesis, it is planned that in June 2025, this will again increase to 20%. This package will significantly impact the Flemish food industry and the European food industry as a whole. This is very problematic for the Flemish food industry because it already has problems competing with companies in countries with cheaper labour. This is a developing and unpredictable event, and future research can look at the (long-term) impact that these tariffs will have on the Flemish food industry.

**Larger Pool of Respondents**

Future research could use a larger pool of respondents to explore further the insights of members of top management teams of food SMEs and increase the study's generalizability. Furthermore, expanding the sample size could also include expanding the type of stakeholders interviewed. Engaging stakeholders could consist of employees who are not a part of the top management team or other industry voices, such as Fevia, the Belgian Federation of food companies.

In this research, the primary focus was on the members of the top management teams of food companies. They mentioned that some workers are hesitant toward new technologies because they fear AI will make them obsolete. However, further research could focus on these workers and ask them how they perceive AI integration into their work. This research could reveal whether the perceptions of the TMT align with those of its workers. Furthermore, a closer examination may provide a more precise understanding of why employees are less receptive to implementing AI into their work and identify potential strategies to improve their perception of AI.

**More female respondents**

A last recommendation for future research is that future researchers should aim to include more women in their study to have a more complete understanding of how top management makes its strategic decisions. Additionally, a comparison can be made between male members of senior management and female members and how each group makes their decisions.

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**Addendum 1: Chapter Separation**

| | |
|---|---|
| PROBLEM STATEMENT | JADE DAEMS & ELIEN VAVEDIN |
| LITERATURE STUDY | JADE DAEMS & ELIEN VAVEDIN |
| RESEARCH METHODOLOGY | JADE DAEMS & ELIEN VAVEDIN |
| RESULT | JADE DAEMS & ELIEN VAVEDIN |
| DISCUSSIONS | JADE DAEMS & ELIEN VAVEDIN |
| CONCLUSION | JADE DAEMS & ELIEN VAVEDIN |

**Addendum 2: Interview Questionnaire for senior management of food SMEs**

Cluster 1: Personal Information

- What is your name?
- What is your age?
- What is your gender?
- In which city/town do you live?

Cluster 2: Job Description

1. **Can you give me a brief description of your job?**
    - At what level of the organization are you active?
    - Which departments fall under your supervision?
    - How long have you been in this job?
    - What motivates you most in your work?
2. **Can you describe a typical workday?**
3. **What kind of decisions are you responsible for or influence?**
    - Are you responsible for financial decisions?
    - Are you responsible for decisions related to sustainability?
    - Are you responsible for decisions regarding the adoption of (new) technologies?
4. **What do you consider the biggest challenges in your job?**
5. **Which trends and developments in the sector have the greatest impact on your job?**
    - Can you give an example of when a sector development significantly impacted your job/company?
    - How do you anticipate and respond to these changes?
    - How do you stay informed about new trends and developments in your industry?

Cluster 3: Company Description

1. **Can you briefly describe your company's activities?**

2. **How would you describe your company's mission and vision?**
    - How are these values translated into daily operations?
    - How would you describe the company culture?
3. **How does your company position itself in the market?**
    - What makes your company unique compared to competitors?
    - How does technology play a role in business strategy?
    - How does sustainability play a role in the business strategy?
    - In what ways does your company invest in research and development?
4. **Does your company have specific goals? Which ones?**
    - How are your goals aligned with market developments?
    - How do you communicate these goals to employees?
    - How do you track progress on these goals?

Cluster 4: Openness to Innovation

1. **How important are innovation and renewal in your company?**
    - Can you share some recent examples of initiatives or projects set up to encourage innovation?
    - How do you measure the success and long-term impact of your innovation efforts?
    - How do you deal with the uncertainty that comes with innovation?
2. **How do you feel about change?**
    - How do you feel about change in your work environment?
    - Would you describe your work as dynamic or static?
    - How do you feel when you have to use new technologies yourself?
    - What would you change about the way innovation is currently handled in the company?

Cluster 5: Knowledge of Artificial Intelligence

1. **What is your view on the use of AI in the food industry?**
    - How do you think AI can contribute to innovation and growth in your company?
    - How realistic is AI integration within your organization?
2. **Has your company considered integrating AI solutions?**
    - Are there specific AI applications that you find interesting for your company?
    - If AI is already being used, what are the initial results?
3. **What benefits do you see in applying AI to your company?**
    - How can AI improve efficiency?
    - Can AI contribute to better product quality?
    - How can AI help reduce costs?
4. **What challenges do you see in implementing AI in the food industry?**
    - Is there sufficient knowledge and expertise in your company?
    - How do you ensure AI is used ethically?

5. **How do you see the future of AI in your company and the broader food industry?**
    - Has your company taken steps to prepare for AI implementation?
    - How do you stay informed about new AI developments in the food sector?
    - What long-term impact do you expect?

**Addendum 3: Interview Questionnaire for CEO of ESG-tool**

**Cluster 1: personalia**

- What is your name?
- What is your age?
- What is your gender?
- In which city/town do you live?

**Cluster 2: company description**

- Can you describe your business activities?
- How would you describe your company's mission and vision?
- How does your company position itself within the market?
- What makes you unique from competitors?
- Can you walk me through the process of how the implementation of your platform goes with a customer? What is involved?
- What sectors/what kind of companies do you mainly serve (if he happens to say food or SMEs, ask him)?

**Cluster 3: their job**

- What is your role within the company?
- What are your responsibilities?

**Cluster 4: ESG reporting**

- Do you also serve SMEs? These, e.g. are not yet CSRD-compliant for now, but do you feel they may already be preparing for this?
- What do you think are the biggest challenges your clients face in terms of ESG reporting?
- How does your service stay up to date with the changing EU/Belgium ESG reporting requirements?
- How do you think the reporting requirements for Flemish SMEs will evolve in the future?
- How do you think the importance of your tool will evolve in the future?
- How does AI play a role within your tool? Is it already fully autonomous/do you see it working fully autonomously using AI in the future?
- Would your tool include other reporting in the future? Such as other sector-specific reports: quality, food safety,...

**Addendum 4: Interview Questionnaire for sales managers of food SMEs**

Cluster 1: personalia

**Cluster 1: personalia**

- What is your name?
- What is your age?
- What is your gender?
- In which city/town do you live?

**Cluster 2: company description**

- Can you describe your business activities?
- How would you describe your company's mission and vision?
- How does your company position itself within the market?
- What makes your company unique from competitors?

**Cluster 3: their job**

- Can you give me a brief description of your job?
- Can you describe a typical workday?
- What kind of decisions are you responsible for or influence?
- What do you consider the biggest challenges in your job?
- Which trends and developments in the sector have the greatest impact on your job?

**Cluster 4: Trump tariffs**

- What impacts have you felt after the announcement that President Trump made surrounding the tariffs he would impose on European imports to the USA?
- How are you mitigating this impact?
- What are the expected consequences of this tariff?
- How are your American clients reacting to the tariff?

**Addendum 5: Code of conduct**

As part of our commitment to transparency, integrity, and ethical communication, we acknowledge the use of AI-powered tools in the development of our written materials.

We ethically used ChatGPT (by OpenAI) and Grammarly to assist in rephrasing sentences and reframe parts of our own content, knowledge, and ideas. The tools were used to improve clarity, structure, and language quality while preserving the original meaning and intent of our work.

Jade Daems & Elien Vavedin