Anticipating the Future for Manufacturing SME's with the Smart Industry Maturity Scan (SIMS)

Author: Stan Johan Mensen
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT

Our modern industry is on the edge of a movement towards a completely new digitized manufacturing era: the Smart Industry. In order to stay competitive in our globalized economy, the adoption of this Smart Industry is essential for businesses. Whereas large multinational corporations take the lead in these Smart Industrial developments, Small and Medium-Sized Enterprises are often lagging behind facing lots of uncertainty and different challenges than multinationals. This research has indicated what Small and Medium-Sized Enterprises are currently doing in their anticipation towards the Smart Industry and what challenges Small and Medium-Sized Enterprises face in adopting the Smart Industry, by using a Smart Industry Maturity Scan and a Focus Group Discussion. It is confirmed in this study that Small and Medium-Sized Enterprises are often overwhelmed with all the Smart Industrial developments that bring lots of uncertainty and challenges with it.

Graduation Committee Members:

1st supervisor: Dr. R.P.A. Loohuis (University of Twente)

2nd supervisor: MSc. H.G. Hanna (University of Twente)

Keywords

Smart Industry, Industry 4.0, Manufacturing SMEs, Multi-Dimensional Smart Industry Scan, Focus Group Discussion, Case Study

1. INTRODUCTION

At this moment in time, we are on the edge of the Smart Industrial Revolution (SIR) that is going to take place in the near future (Hozdić, 2015). This SIR will shift the paradigm fundamentally in nowadays' industries by the advanced digitalization of physical factories (Lasi, Fetke, Kemper, Feld, & Hoffmann, 2014) due to the implementation of innovative technologies such as: the internet of things (IoT), augmented reality (AR), virtual reality (VR), (big) data analytics, and cyber-physical systems (CPS) (Mittal, Khan, Romero, & Wuest, 2018).

Whereas multinationals take the lead in these developments, having the knowledge, capabilities, alliances, and resources necessary for implementation (Mittal et al., 2018), Small and Medium-Sized Enterprises (SMEs) often have difficulties with anticipating on the trends and recognizing all the possibilities that go along with the SIR. In addition, SMEs require more financial resources, advanced manufacturing technologies, industry standards, change in organizational culture, employee participation, collaborations, and alliances with universities and research institutes (Mittal et al., 2018). SMEs need to implement the Smart Industry (SI) practices in their own businesses, as this is essential to be able to compete and survive in nowadays globalized market (Faller, & Feldmüller, 2015). There are many reasons why it is beneficial for companies to anticipate on the SIR, reasons for this include: generating more financial resources, becoming more competitive, effective and efficient, inventing new business models, enhanced vertical and horizontal integration, time reduction in processes, higher potential of human resources, and companies become more independent (Kiel, Müller, & Arnold, 2017).

Many articles to assess companies on their adoption towards the Smart Industry have been written (e.g. Schumacher, Erol, & Sihn, 2016; De Carolis, Macchi, Negri, & Terzi, 2017; Akdil, Ustundag, & Cevikcan, 2017). Although the assessment on the adoption and maturity of companies on the SI is extensively discussed in literature, detailed real world cases specifically designed for manufacturing SMEs, in which the anticipation and challenges faced towards the SI is completely depicted are lacking. Therefore, the purpose of this study is to give a clear insight in how manufacturing SMEs anticipate towards the SI and what challenges they face, by answering the following research question: ''How do SMEs in the manufacturing industry anticipate on the SIR and deal with the challenges accompanied by it?''

This research will be positioned in the literature field of SMEs in the manufacturing industry anticipating towards the SI, by taking seven different perspectives into account, including: Strategy & Organization, Products & Customer Services, People & Organizational Culture, Customer Interfaces, Value Chain, Technology & IT Management, and Institutional Awareness.

The aim of this research is to answer the research question by conducting a case study, that provides a specific and detailed real world case of a SME in the manufacturing industry that faces challenges in the anticipation of the Smart Industry. This is done by firstly recognizing where SME stands now regarding the adoptions towards the SI, using the Smart Industry Maturity Scan (SIMS). Secondly, the anticipation of the SME on the Smart Industry is discussed, and the challenges the SME faces in anticipating towards the Smart Industry are identified, by using a focus group discussion with employees of the manufacturing SME participating in this research.

The academic relevance of this research is to use this case study to provide detailed scientific information to show how manufacturing SMEs anticipate on the SI and to define the challenges that go along with the anticipation towards the SI. The practical relevance of this research is to provide the SME included in this research with a recommended SIR strategy based on solid theory and research, with the result that these SMEs can anticipate and take advantage of the SIR in reality. This research can also help other SMEs who are in similar positions as the SMEs included in the research to anticipate on the SI.

This report consists of five sections. The next section of this report is a critical literature review on the challenges that SMEs face in the anticipation towards the Smart Industry. In the third part, the methodology will be clearly explained that is used for the research. Hereafter, in the fourth part, the results of the smart industry maturity scan and the group discussion are shown and described. Finally, in the fifth part, there will be a discussion on the research topic of how the manufacturing SME can anticipate towards the Smart Industry.

2. LITERATURE REVIEW

In this section, literature in the field of the Smart Industry is critically reviewed, in order to get an overview of what the Smart Industry is, and to get insights in what challenges SMEs face in anticipating towards the Smart Industry.

2.1 Smart Industry

Smart Industry, Industry 4.0, Smart Factory, Cyber-Physical Systems (CPS) (Ojra, 2018), Industrial Internet of Things (IIoT) (Kiel, Müller, Arnold, & Voigt, 2017) and Smart Industry are all terms that are used for the phenomenon of the advanced digitization of physical factories and products across the complete value chain (Pfohl, Yashi, & Kurnaz, 2015) (Ojra, 2018).

The emergence of the Smart Industry is based on

nine technologies that can now be interrelatedly used along the whole value chain.
These nine technologies include **(Figure 1):** autonomous robots, big data & analytics, augmented reality (AR), additive manufacturing, the cloud, cybersecurity, the industrial internet of things (IIoT), horizontal and vertical system integration, and simulation (Rüßmann et al., 2015).

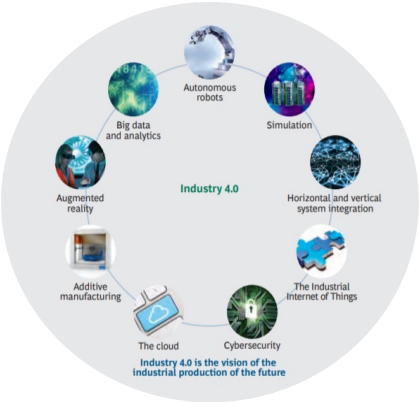

Figure 1 - Nine Technologies that are fundamental to Smart Industry (Rüßmann et al., 2015.)

The movement towards the Smart Industry is called a revolution, as it is now for the first time ever possible to create the IoT, as resources, information, objects, and people can be networked. This is the result of the growing IT infrastructure combined with the evolution of PCs into smart devices that create smart networks, the miniaturization and ubiquitous presence of the internet, and the use of embedded systems that are increasingly wirelessly networked that resulted in the convergence of the physical world and the virtual world in the form of CPS (Kagermann, Wahlster, & Helbig, 2013).

These changes will result in more flexible and more efficient production processes, to produce high-quality products against lower costs. This would eventually change the competitive landscape of companies and regions, as a result from the increased manufacturing productivity, shift in economies, fostered industrial growth, and modified profile of the workforce (Rüßmann et al., 2015)

The relationship between the implementation of the Smart Industry and the company size is significant. In general, the larger the company is, the more advanced the IT integration in the production plant will be, and vice versa (Lichtblau et al., 2015.). For this research, we will focus on Small and Medium-sized Enterprises (SMEs), as this will suggest that these enterprises will not as far as they could be with the adoption of the Smart Industry. Therefore, we want to know how SMEs in the manufacturing industry do anticipate on the Smart Industrial Revolution (SIR) and how SMEs deal with the challenges that are accompanied by it.

2.2 SMEs Towards Industry 4.0

In this section, what is meant by a SME is defined. Hereafter, the discovered challenges that SMEs face in anticipating towards the Smart Industry are outlined.

2.2.1 SME Definition

To define a SME, the European Commission has set some criteria in order to distinguish them. Small enterprises employ less than 50 employees, while having a turnover that does not exceed €10,000,000, and/or has a balance sheet total of less than €10,000,000. Medium-sized enterprises do not have more than 249 employees, their turnover does not exceed the amount of €50,000,000 and/or their balance sheet total is less than €43,000,000 (European Commission, 2014). An overview of the criteria of SMEs can be found in **Table 1.**

Enterprise	Employees	Turnover	Balance Sheet Total
Small	<50	<€10,000,000	<€10,000,000
Medium-Sized	<250	€50,000,000	<€43,000,000

Table 1 - SME Criteria (European Commission, 2014)

2.2.2 Smart Industry Challenges for SMEs

SMEs face various difficulties in different divisions of their companies. Eight clusters in which SMEs are different from Multinational Enterprises (MNEs) have been constructed (Mittal, Khan, Romero, & Wuest, 2018) . These clusters include: Finance, technical resource availability, product specialization, standards, organizational culture, employee participation, alliances, and collaboration (Mittal et al., 2018). These clusters are explained in more depth in the following parts.

SMEs are limited in financial resources due to market failures caused by asymmetric information and agency problems, lack of expertise to create sophisticated financial statements, limited credit history, and are often under-collateralized. Besides this, the interest rates that are charged to SMEs are higher than the interest rates charged to larger firms, and the last years this gap has been increasing (Mittal et al., 2018)(OECD, 2017).

These financial constraints have as a consequence that SMEs cannot invest in the Advanced Manufacturing Technologies (AMTs), that require often huge capital investments. Another problem is, that SMEs do not have the technological resources readily available to build on their current technological resources onwards to the Smart Industry's advanced manufacturing technologies. This results in the fact that SMEs do not perform well in terms of research and development in general (R&D) (Mittal et al., 2018).

Experiments and the implementation of the newest technologies in SMEs is often limited by an inflexible organizational culture (Van De Vrande, De Jong, Vanhaverbeke, De, & Zoetermeer, 2008). The company strategy of a SME is usually based on the instinct of the manager, leader, or owner, instead of market research and market analyses. Decisions are also often made on gut-feelings of the manager, leader, or owner, instead of harsh facts, and without many other internal or external knowledge providers (Mittal et al., 2018).

Active employee participation in SMEs in terms of human resource development and human resource engagement with the enterprise, is often absent. The employees of SMEs also have jobs that are often broader oriented instead of being experts in their specific field (Mittal et al., 2018).

Collaboration activities with universities and other research institutes are lacking in SMEs, preventing them from obtaining cutting-edge research results in our rapidly changing and developing world, resulting in that SMEs are lagging behind in terms of knowledge (Mittal et al., 2018).

Industry standards are less used by SMEs than multinationals, preventing them from competing in large projects in which these standards are required (Mittal et al., 2018).

The majority of SMEs learn from their own experience and internal knowledge, often in their own specific field. This has as a consequence that SMEs outsource many important and essential activities outside of their own specific domain, and become highly dependent on one or a few suppliers and/or vendors (Mittal et al., 2018).

Based on this literature review, it is obvious that SMEs face huge challenges in the coming years to anticipate towards the Smart Industry and how they deal with the challenges that go along with it. Therefore, this case study is used to get a specific real life case, to show the anticipation and challenges for SMEs in the Smart Industry.

3. METHODOLOGY

The SME participating in this research is first briefly described to get an idea about their size and the industry they compete in. Then, the two data collection methods for this research are explained. Finally, the data analysis methods are described.

3.1 Company Description

The company included in this research is a machine manufacturing SME with an amount of 50-100 employees and a revenue between €25,000,000-€50,000,000.

The employees of this company included in the research fulfilled the following functions within their company:

- Engineering & Production Manager
- Global Operations Manager
- Managing Director
- Service & Engineering Manager

3.2 Data Collection

The data collection of this research took place in two ways: a smart industry maturity scan (SIMS), and a group discussion with the employees of the company included in the research who filled out this SIMS. The purpose of the smart industry maturity scan is to get an overview of the extent to which the SME is developed in terms of the Smart Industry. This will be the starting point of the focus group discussion, of which the purpose is to discuss how the company can anticipate better on the Smart Industry and what challenges they face per separate dimension of the scan.

3.2.1 Smart Industry Maturity Scan

The Smart Industry Maturity Scan used in this research is the one designed by Ungerer (2018). First, this scan requires some general information about the company, including the amount of revenue, number of employees and information about the industry they compete in.

Secondly, this scan measures the maturity of a company with regards to the Smart Industry on seven different dimensions:

- Strategy & Organization
- Products & Customer Services
- People & Organizational Culture
- Customer Interfaces
- Value Chain
- Technology & IT Management
- Institutional Awareness

Every single dimension has 5 measurement questions, thus the scan totally consist of 35 questions. Every question can be answered on a scale from (1) not at all to (5) fully. ''Not at all'' means that this measurement question is not present in the company, and is the least preferable situation with regards to Smart Industry. ''Fully'' means that the specific measurement question is completely implemented in the company, and is the most preferable situation with regards to the Smart Industry (Ungerer, 2018).

The five measurement questions will give the score on the maturity of the company on the particular dimension they belong to. All seven dimensions taken together, will give the overall maturity level of the organization with regards to the Smart Industry. An overview of this SIMS can be found in **Figure 2 (Appendix)**.

3.2.2 Focus Group Discussion

The results of the SIMS are the starting point of the Focus Group Discussion. Focus Group Discussions are known for their following advantages (Freitas, Jenkins, & Popjoy, 1998):

- Allows to explore topics and to generate hypotheses
- Allows to generate data on the topic of interest from the group interaction
- High face validity in data
- Results are rapidly available

These advantages align well with the search for unstandardized answers that are needed in this research. The focus group discussion has the following purposes:

- Discover what the manufacturing SME does right now in Smart Industry anticipation
- Discover what challenges the company faces in anticipating to the Smart Industry

To retrieve this information, I will be the moderator of the focus group discussion and therefore I will lead the focus group discussion. The focus group discussion will start with a brief introduction about the purpose of this discussion. Hereafter, I will start discussing every dimension on how the SME anticipates on the Smart Industry, and what challenges the SME faces in anticipating towards the Smart Industry.

3.3 Data Analysis

The data from the SIMS will be analyzed by generating mean scores per separate dimension, and an overall score of the company on the Smart Industry maturity level. These mean scores will lie within a range between 1 and 5. The scores will give the maturity level in terms of the Smart Industry and an indication on the Smart Industry implementation of the company, this is shown in **Table 2**.

Maturity Level	Smart Industry Implementation	Score
Level 1 *''Newcomers''*	Poor	1 – 1.49
Level 2 *''Learners''*	Moderate	1.5 – 2.49
Level 3 *''Leaders''*	Semi-Advanced	2.5 – 3.49
Level 4 *''Leaders''*	Advanced	3.5 – 4.49
Level 5 *''Leaders''*	Expert	4.5 – 5

Table 2 - Smart Industry Maturity Levels (Ungerer, 2018)

The data from the group discussion will be analyzed by filtering out of the discussion:

- What the manufacturing SME is doing right now in anticipating towards the Smart Industry per dimension
- What challenges the manufacturing SME faces in anticipating on the Smart Industry per dimension

The data of the SIMS and the group discussion are used to answer the research question. This is depicted in **Figure 2.**

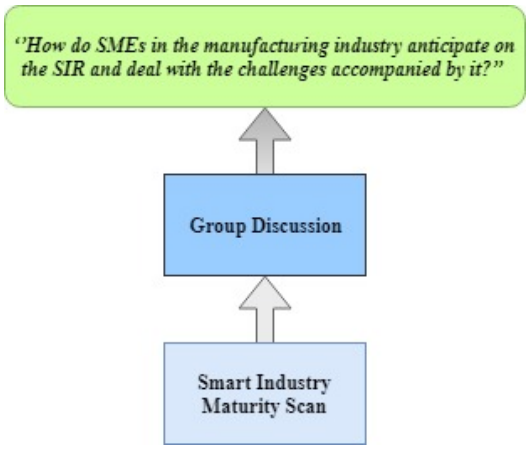

Figure 2 - Schematic Representation of the Methodology

4. RESULTS

In the first part of this section, the results from the SIMS are shown. The SIMS was filled out by four managers of the manufacturing SME participating in this research. The results from the focus group discussion, that was held with two out of the four managers who filled out the SIMS, can be found in the second part of this section.

4.1 Smart Industry Maturity Scan (SIMS)

The results of the SIMS are outlined per separate dimension. Every dimension has its own score, based on the SIMS that was filled out by the managers of the participating SME. Per separate dimension, the SME has five ''Leaners'' maturity levels, and two ''Leaders'' maturity levels **(Figure 3; Table 2)**. The SME has an overall Smart Industry Maturity Level of a ''Learner''. The scores, maturity levels, the Smart Industry implementation, and the explanation, are described in this section.

4.1.1 ''Learners'' (Level 2)

The manufacturing SME participating in this research has scored between 1.5 – 2.49 on 5 out of the 7 dimensions, and therefore they are on these dimensions ''Learners''. A company with a learner maturity level on the SIMS indicates a moderate implementation of the Smart Industry, which means in more detail that the company did initialize some first projects related to the Smart Industry, but that they are not ahead of others in the industry.

The dimension on which the manufacturing SME has scored a ''Learners'' maturity level are:

- People & Organizational Culture (2.05)
- Products & Customer Services (1.95)
- Value Chain (2.20)
- Technology & IT Management (2.40)
- Institutional Awareness (2.05)

4.1.2 ''Leaders'' (Level 3)

For 2 out of the 7 dimensions, the manufacturing SME has a score between 2.5 – 3.49, which means that they are ''Leaders'' on these dimensions with regards to the Smart Industry. ''Leaders'' of a level 3 maturity have a semi-advanced Smart Industry implementation, that means more specifically that they are ahead of other companies in their industry with the Smart Industry implementation. The dimensions in which the manufacturing SME has scored a ''Leaders'' maturity level are:

- Strategy & Organization (2.80)
- Customer Interfaces (2.80)

4.1.3 ''Learners'' (Level 2) Manufacturing SME

The overall company score of the SME is 2.32 out of 5. This means that the SME is a ''Learner'' with regards to the Smart Industry and has moderate Smart Industry implementation. The SME has initialized the first Smart Industry projects, but is not ahead of other companies in the industry. This indicates that the SME can still improve three levels with regards to the Smart Industry implementation.

Figure 3 - SIMS Results

4.2 Focus Group Discussion

During this focus group discussion, the scores of the SIMS served as the starting point of the discussion of every separate dimension. The discussion was held with two out of the four people who filled out the SIMS. The purpose of the focus group discussion was to give answer to the following questions on all seven dimensions:

- How does the manufacturing SME anticipate on the Smart Industry?
- What challenges does the manufacturing SME face in anticipating to the Smart Industry?

The answers on these questions following from the focus group discussion are described in the next seven parts, and are outlined in **Table 3 (Appendix)**.

4.2.1 Strategy & Organization

The machine manufacturing SME has recognized that there is a growing demand for digitized machinery, and acknowledges that this trend will grow even further in the near future. To keep on being competitive in the market, they started to implement Smart Industry practices in their strategy. In more concrete terms, they begun digitization projects of their products and services. These are, however, still in the developing stage, but in the coming years the machine manufacturing SME will serve the market with digitized products and services to achieve their short- and long-term goals. The challenges that they face right now in anticipating on the Smart Industry with their Strategy & Organization, are the lack of expert knowledge on how to implement the Smart Industry exactly in their strategy, products and services; the ongoing privacy issues in our modern world, that brings a lot of uncertainty for businesses; and the fact that there is not one dominant standard system for horizontal and vertical system integration. These challenges avoid the manufacturing SME from further aligning their Strategy & Organization towards the Smart Industry.

Dimension	Score	Maturity Level	Smart Industry Implementation
1. Strategy & Organization	2.80	Leaders	Semi-Advanced
2. People & Organizational Culture	2.05	Learners	Moderate
3. Products & Customer Services	1.95	Learners	Moderate
4. Customer Interfaces	2.80	Leaders	Semi-Advanced
5. Value Chain	2.20	Learners	Moderate
6. Technology & IT Management	2.40	Learners	Moderate
7. Institutional Awareness	2.05	Learners	Moderate
Smart Industry Maturity (Average)	***2.32***	***Learners***	***Moderate***

Table 2 - SIMS Results

4.2.2 People & Organizational Culture

Currently, only a small part of the management team of the machine manufacturing SME is coping with the Smart Industry, the other employees of the organization are not involved with the Smart Industry. This holds that the organizational culture with their norms, values, beliefs and rituals, is not anticipated towards the Smart Industry. The challenge they face in anticipating the people and organizational culture towards the Smart Industry, is that right now there is a negative ROI in their recognized Smart Industry investments. For this reason, the company is not moving in a Smart Industrial direction, and so do not the employees and organizational culture.

4.2.3 Products & Customer Services

The products are not provided with Smart Industrial technologies yet. The reasons for this are that there is not an industry standard or dominant technology in the horizontal and vertical system integration. Besides this, the challenge with these horizontal and vertical system integration is that the integrated networks have to be 100% secure and fulfil all privacy requirements, something the manufacturing SME cannot guarantee for sure right now. These challenges cause uncertainty and unclarity in their product roadmap, therefore they only broadly develop their products and services in terms of the Smart Industry.

4.2.4 Customer Interfaces

Right now, the customer interaction is mostly done in terms of personal contact. With their dealers, they sometimes have teleconferences, and they can call-in the machines they have delivered if they see something is not going according to plans. In general, however, the customer interfaces with regards to the Smart Industry are not far developed. The manufacturing SME would like to digitize their customer interfaces for service information, stock availability and the learning techniques that are required to use their machine. The challenges they have is in the development of these technologies, and the fact that the customers, when provided with this information, are likely to make inefficiently use of it.

4.2.5 Value Chain

In the value chain, the manufacturing SME wants to implement Smart Industry practices within their products and services to add more value to their customers. Development projects for new products, digitized products, digitization kits for old products, and digitized services should enhance the value chain, however, the biggest challenge is that there is a grey area where exactly in their products value can be added for their customers with regards to the Smart Industry.

4.2.6 Technology & IT Management

Internally, the machine manufacturer makes use of digitized products and integrated systems within their production plants. These data are stored electronically in the cloud. They want to further digitize their production plants with more sensors and CPS, to move further towards the Smart Industry. The challenge they face to realize this, is that they have now different systems internally, that cannot work all together simultaneously. The SME has not a clear idea what systems they should purchase for their organization that can also be integrated with the systems of the customers. Herewith, not the full potential of the systems is achieved.

4.2.7 Institutional Awareness

Not much awareness is created within the organization, as only a small part of the management is involved in the Smart Industrial developments. This small part of the management team anticipates only on the Smart Industry in terms of analysing what the leaders in the industry are doing with regards to the Smart Industry and what the developments in rules and regulations are. Their biggest challenges in adopting the Smart Industry in this part are cybersecurity and the privacy rules and regulations, for which the SME has not the expert internal knowledge on how to act on it.

5. DISCUSSION

In this section, the limitations of the study are highlighted. Besides this, recommendations following from this study are given. Hereafter, the conclusion is drawn. Finally, the people who helped me during this research are acknowledged.

5.1 Limitations

A limitation of this research is that it is based on one single manufacturing SME. The results can be different for other manufacturing SMEs, and/or SMEs competing in other industries. Besides this, the SIMS measures every dimension of the company using five ''general'' questions, whereas more, and more specific questions could lead to other outcomes. The focus group discussion took place with two out of the four employees of the participating SME, if all four employees would have participated, the outcomes of the group discussion might have been differently.

5.2 Recommendations

I would recommend others who research the anticipation and challenges of manufacturing SMEs in terms of the Smart Industry to include multiple SMEs from the manufacturing industry, with also four or more respondents per SME. This will ensure that the results from the research are more reliable and can better be generalized for other manufacturing SMEs, instead of being applicable to just the SME included in the research.

For SMEs in the manufacturing industry, I would recommend to form networks/clusters with each other, in order to analyse Smart Industrial developments, as uncertainty and the knowledge lack turned out to be a major issue for the SME in this case study. If more SMEs cooperate together, trends, industry standards, and dominant technologies are more likely to be discovered in early stages, and therefore the SMEs can take advantage of the Smart Industry earlier on.

5.3 Conclusion

In this research I had the purpose to find out how manufacturing SMEs anticipated on the Smart Industry and how they deal with the challenges that go along with Smart Industry anticipation. To find this out, a Smart Industry Maturity Scan was used to see where the manufacturing SME stands right now in terms of Smart Industry anticipation. Hereafter, a focus group discussion with employees of the manufacturing SME was held, to find out what they were really doing on Smart Industry anticipation right now, and what challenges they face.

The result from the Smart Industry Maturity was that the manufacturing SME was a ‘’Learner’’ in terms of the Smart Industry, which means that they have initialized some first projects, but that the Smart Industry is not fully implemented within their company. This was confirmed in the focus group discussion, in which it became clear that the manufacturing SME was anticipating on the Smart Industry, however, they did not implement these Smart Industry principles yet.

The reasons why the manufacturing SME did not already implement these Smart Industrial developments, can be related to the challenges explained during the group discussion. The major challenge for the manufacturing SME is uncertainty. The uncertainty comes from the fact that there is not a standard and dominant technology or platform in their industry, that can fully integrate all nine technologies that form the fundament of the Smart Industry. As there is not a standard and dominant technology, the manufacturing SME faces uncertainty on what technology or platform will be the leading one in the future. To act right now by choosing one of the multiple available technologies, the risk is too big that the manufacturing SME will make a wrong decision on what technology to implement within their organization and products, with the possible consequence that they could exclude themselves out of the market by using a technology that is widely rejected by the market in the near future. For that reason they watch the leaders in their industry on the developments they make with regards to the Smart Industry, and they will act when a standard and dominant technology or platform has established.

5.4 Acknowledgements

I would thank both my supervisors Dr. R.P.A. Loohuis and MSc H.G. Hanna for their help and guidance during this bachelor thesis. Especially Dr. R.P.A. Loohuis’ clear explanation, critical feedback and discussions were helpful and very instructive. Furthermore, I would like to thank the managers of the SME participating in this research for filling out the SIMS and their participation in the focus group discussion, something that gave insight to me how the Smart Industry influences a SME in reality. At last, I would thank my fellow students who researched the Smart Industry on SMEs as well for their discussions and knowledge sharing.

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APPENDIX

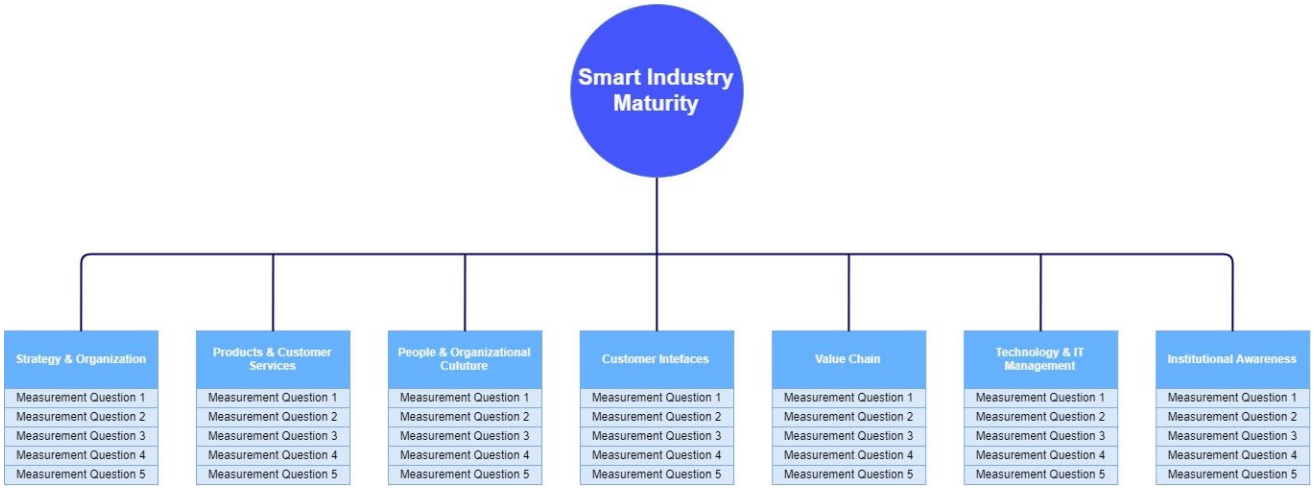

Figure 4 - Smart Industry Maturity Scan

Dimension	**Question**	
	''How does the manufacturing SME anticipate on the Smart Industry?''	*What challenges does the manufacturing SME face in anticipating to the Smart Industry?*
Strategy & Organization	Digitization of products Digitization of services	Expert knowledge capacity Privacy issues Horizontal/Vertical system integration
People & Organizational Culture	Smart Industry trend analysis	Negative ROI
Products & Customer Services	Digital product development Digital service development	Privacy Horizontal/Vertical system integration Cybersecurity Software Unclear product roadmap
Customer Interfaces	Call-in systems	Software updates Service information
Value Chain	New products Digitization of products Digitization kits Digitization of services	Grey area
Technology & IT Management	Digitization of products Integrated systems (Internal) Cloud data storage system	Multiple different systems Horizontal/Vertical system integration
Institutional Awareness	Smart Industry leaders analysis	Privacy rules & regulations Cybersecurity

Table 3 - Focus Group Discussion Results