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Embracing Smart Industry

An investigation into the relationship between technology adoption and the perceived usefulness of new Smart Industry technologies within SME manufacturing firms in the Netherlands

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Preface

In front of you lies my thesis about the relation between technology adoption and perceived usefulness, which is investigated within SME manufacturing firms in the metal industry. This thesis was written in the context of the master Business Administration, with a specialization in Organizational Design and Development, at the Radboud University in Nijmegen. This thesis was the last step for the completion of this master.

I want to use this opportunity to thank my supervisor, dr. Raphaël Smals, for his great support and guidance during the thesis process. He has always been quick to help me with questions, kept promises throughout the period and put me in touch with valuable contacts for the execution of this research. I would also like to thank dr. Matthijs Moorkamp, my second reader, for his time and review on the research proposal and the final thesis. Furthermore, I would like to thank the Pillen Group, Heel Metaal, Van Raam, and the respondents within these organizations, for participating in this research. In addition, I would like to thank Mr. Sol of TNO and Mr. Van de Put of Metaalunie for sharing their thoughts on my research topic and the preliminary results. Last but not least, I would like to thank my family, friends, roommates, and fellow students, for the support during the difficult research process - partly due to Covid-19 - and for their encouraging advice and helpful insights.

I hope you enjoy reading this thesis.

Jelmer Veldman

Nijmegen, October 3th, 2020

Abstract

Due to the developments in the field of Smart Industry, manufacturers are facing new technologies that take over the industry. This research focuses on the issue of how technology adoption and perceived usefulness, as part of technology acceptance, affect each other. This matter is investigated within SME manufacturing firms in the metal industry in the Netherlands, which resulted in the following research question: "*How do technology adoption and the perceived usefulness of new Smart Industry technologies affect each other within SME manufacturing firms in the Netherlands?"*

For technology adoption, a model by Langley & Truax (1994) is used, in which this concept is subdivided into three sub-processes: the strategic commitment process, technology choice process, and financial justification process. Perceived usefulness is part of the technology acceptance model by Davis et al. (1989) and is further operationalized by the indicators of Segars and Grover (1993): makes the job easier, makes the job more useful, and increases productivity. This is investigated qualitatively by conducting nine interviews within three SME manufacturing firms in the metal industry and by interviewing two industry experts. The results show that the relationship between technology adoption and perceived usefulness can be seen as being bidirectional. The perception and support of employees are necessary for successful technology adoption, but how technology adoption is performed, in turn, can highly influence the perceived usefulness. Management perception and employee perception turn out not to differ substantially. By aligning management vision and employee vision, the best out of Smart Industry technologies can be achieved, since every user then perceives it as useful. The feedback loop between technology adoption and perceived usefulness can become reinforcing by paying attention to four variables: creating understanding for change, involving employees in technology adoption process, educating people to work with technologies, and employee development possibilities. This research contributes to science by demonstrating the bidirectional relationship between technology adoption and perceived usefulness, and by making old and static models around this topic more dynamic. Additionally, it contributes to practice by giving insights to SME manufacturing firms in the way they can deal with the Smart Industry revolution. By paying attention to the insights of this research, future technology adoptions become more successful and organizations can improve and develop their business.

Key words: Technology adoption, Perceived usefulness, Small and Medium-sized Enterprises, Manufacturing, Metal industry, Netherlands

Inhoud

1. Introduction

Manufacturers all over the world are facing enormous changes within their fields, such as new advanced materials, smarter machines, automated machines, and other technological improvements (Ahuett-Garza & Kurfess, 2018; Deloitte, 2015). It may be stated that we are in the middle of a fourth industrial revolution, also referred to as ‘’Industry 4.0’’ (Microsoft, 2019). Industry 4.0 represents the use of information and communication technology for a smarter and more intelligent application of machines and processes for industrial purposes (GTAI, 2020). This also applies to the Netherlands, where the government, together with the interested parties in the industry, is developing the industry towards a so-called ‘Smart Industry’. In the Smart Industry, business consists of large and diverse information flows and is based on new technologies interacting with each other and with the people working with it. Several examples of prominent technologies in this Smart Industry are the processing of big data, Internet of Things driven technology, 3D printing, nanotechnology, or new sensor technology (TNO, 2020). These contribute - according to TNO (Dutch organization for applied scientific research) - to developments such as smart products, servitization, digital factory, connected factories, sustainable factory, smart working, advanced manufacturing, and flexible manufacturing. These developments have a significant impact on the business models of existing manufacturing firms, since most of the core business of these organizations are dependent on the technologies they use (Arnold, Kiel, & Voigt, 2016). Besides, they have a significant impact on the people working in the primary process, because a change in technology directly influences their daily work.

According to Sommer (2015), SMEs are generally less capable to deal with an evolution of an industry such as the Smart Industry than large organizations, due to their restricted amount of (human) resources. The research by Sommer (2015) even showed that the smaller the SME, the higher the risk of becoming a victim of the industrial revolution. Moreover, large organizations can generally benefit more from these technologies, due to the larger scale and the bureaucratic nature of the issues which technology can solve (Meredith, 1987). Therefore, it is interesting to investigate how SMEs and their employees deal with these developments in the industry and what their attitude is towards the new technologies that emerge from Smart Industry. Research by Weil and Utterback (2005) has shown that the perceived risk of a new technology can be high in the early stages of technology adoption. There is generally a high degree of scepticism towards these emerging novel technologies, due to the fact that they are not yet proven in the market. This is crucial for technology acceptance, since this affects the two key determinators

for technology acceptance; the perceived ease of use, and the perceived usefulness of the technology (Davis, Bagozzi, & Warshaw, 1989). Technology adoption refers to new technologies that are adopted by organizations through management decisions, while technology acceptance refers to the acceptance of these technologies by individual employees. Adoption of new technologies is considered to be important, since a technology can become a must-have in the industry, while the firms who do not adopt it are considered to be laggards in this respect (Weil & Utterback, 2005).

For many organizations, the motives for adopting new technologies are related to underlying objectives, such as increased personnel productivity, better marketing, reduced costs, and enhanced profitability (Taherdoost, 2019). According to Taherdoost (2019), technology acceptance is crucial for achieving such goals, because acceptance is necessary for the development of any new technology. This illustrates that there is an important effect of technology acceptance on the adoption of technologies on a managerial level. Technology acceptance can be influenced by several social, organizational, and demographic factors (Abbasi, Tarhini, Hassouna, & Shah, 2015). However, it is not clear if technology adoption is also one of the factors that can influence technology acceptance. Would this be the case, there would be a mutual relationship between technology adoption and technology acceptance, instead of a one-sided relationship, which was earlier assumed.

A study by Langley and Truax (1994) on technology adoption in smaller manufacturing firms showed that the technology adoption process within SMEs consists out of three sub-processes: the strategic commitment process, technology choice process, and financial justification process. In this research, the relation between these processes and technology acceptance of employees within SME manufacturing firms is being studied. Two important determinators for technology acceptance are the perceived usefulness and the perceived ease of use. These two determinators influence the attitude towards using new technologies and, in the end, towards actually using the new technologies (Davis et al., 1989). The focus in this research is only on the relationship between the technology adoption processes and the perceived usefulness, derived from the technology acceptance model (TAM). Thus, the perceived ease of use is not included in the scope of this research.

1.1. Goal

In this research, the relationship between technology adoption and perceived usefulness (as part of technology acceptance) of new technologies is investigated. This investigation is supported

using the processes for adopting new technologies by Langley and Truax (1994) and the perceived usefulness out of the TAM (Davis et al., 1989). The research objective is to describe how technology adoption processes on the managerial level and the perceived usefulness of employees working with these technologies affect each other. This goal is supported by the following research question:

How do technology adoption and the perceived usefulness of new Smart Industry technologies affect each other within SME manufacturing firms in the Netherlands?

1.2. Relevance

The theoretical contribution lies in extending the TAM of Davis et al. (1989). The model suggests that the perceived usefulness and the perceived ease of the use of new technologies are critical factors for technology acceptance. Research by Taherdoost (2019) has suggested that technology acceptance is required for achieving technology adoption on the managerial level. This assumes that there is a one-sided relationship between technology acceptance and technology adoption. This research contributes to the existing literature in studying the mutual relationship between technology acceptance and technology adoption. More specifically, it aims to describe the relationship between perceived usefulness and technology adoption. Due to the short time given for this research, the focus is only on the perceived usefulness as a key indicator for technology acceptance. This implies that the perceived ease of use is excluded from this research' scope. The assumption is that the perceived usefulness of employees, as a collective, form the success of the technology adoption, but that technology adoption also affects the perceived usefulness of individual employees. This can be described as a continuous feedback loop between the individual employees and the management. This would especially be applicable for SMEs, since their organizational structures tend to be flatter than those of larger organizations. Besides this, this research forms an addition to research by Abbassi et al. (2015), which describes several factors that influence individual technology acceptance. This research is specifically aimed at SME manufacturing firms and the current developments of the Smart Industry. Since this phenomenon is quite novel, there has not been substantive research on the influence of this industrial revolution on technology acceptance and technology adoption. It is relevant to investigate the relationship between technology adoption and perceived usefulness, due to the fact that it can be used for predicting or explaining behaviour towards new technology within SME manufacturing firms.

1.3. The practical relevance

Smart Industry is a relatively new concept. Nowadays, large organizations in manufacturing are increasingly adopting and embracing the technologies that emerge from this fourth industrial revolution. At this present moment, not many SMEs are using these technologies. When looking at previous industrial (r)evolutions (Utterback, 1987), these new technologies changed the dominant technologies and therefore affected the whole industry. Therefore it is for SMEs relevant to know more about the Smart Industry, because it will probably also affect their way of working. This research is relevant for the various organizations within the industry, because it helps to understand the effect of perceived usefulness, which partly determines technology acceptance (Davis et al., 1989). When the relation between managerial technology adoption processes and the individual perceived usefulness of new technologies becomes clear, this information can be used by the organizations within the industry. In case it turns out that there is a mutual relationship between the sub-processes of technology adoption and perceived usefulness, this can be taken into account in future situations wherein (SME) manufacturing firms are planning to adopt new technologies. For organizations, this probably leads to a better implementation of a new technology and, therefore, a better usage of that technology and a better organizational performance. It can also benefit for employees working with technologies because there is a better alignment with their perceived usefulness and the technology adoption on the managerial level.

1.4. Thesis outline

In the second chapter, a theoretical framework is developed. The central concepts of the research are defined in this chapter with the evaluation of several theories about these concepts. In chapter three, the methodology is described. In this chapter is described what methods are used for the collection and analysis of the data. In chapter four the results of the research are presented, and in the fifth chapter, the conclusion and discussion are described.

2. Theoretical background

In this chapter, the main concepts of this research are identified and further elaborated. The main theories are related to technology adoption within SME manufacturing firms, technology acceptance on the individual level, and the relation between both. The contextual situation here is the fourth industrial revolution that we are in the middle of, which is also referred to as Industry 4.0. In the Netherlands this is called the Smart Industry, with specific developments and technologies that are applicable to the Dutch context. This chapter further elaborates upon what this Smart Industry is about and what it implies for SME manufacturing firms. Several theories about these topics are discussed, after which a choice is made of the theories that best fit this research topic. Moreover, the assumed relationships between the theories are outlined. Ultimately, a conceptual model is presented, which reflects the assumed relation between the core concepts of this research.

2.1. Smart industry

The context of this research is focused on the smart industry sector. This is the Dutch appellation for the fourth worldwide industrial revolution that is currently ongoing. In general, a revolution in an industry causes a change in technology, which changes the way in which work is executed. These changes form input for the description of the relationship between technology adoption and perceived usefulness. The worldwide fourth industrial revolution is driven by the internet and the Industrial Internet of Things (Haverkort & Zimmerman, 2017). The revolution has led to smarter and more intelligent use of machines and processes for industry (GTAI, 2020). This is not limited to the sole integration of ICT with products. It has also led to interconnected products which communicate with each other and with central service facilities (Haverkort & Zimmerman, 2017).

Smart industry is the Dutch version of the German ‘Industry 4.0’. Industry 4.0 is the German term and is more applicable to worldwide developments. It is based on three concepts: "Cyber-Physical Systems (a fusion of the physical and the virtual worlds) (CPS), the Internet of Things, and the Internet of Services" (Almada-Lobo, 2015, p. 16). Cyber-Physical Systems (CPS) combine physical objects with embedded power and computing power (Radanliev, et al., 2019). The implication of this for the manufacturing industry is a more integrated way of working between humans and machines and the software that drives these machines. Internet of things refers to an information-based economy that allows information interoperability internally and externally (Ahuett-Garza & Kurfess, 2018). Thereby, it implies a shift of communication, data,

services, and people from the physical world to an object for augmentation, cloud, and virtualization technologies (Atzori, 2016). The Internet of Services combines the manufacturing elements like automated machine tools, robots, human resources, and information systems to access, match and integrate these in an optimal way (Reis & Concalves, 2018).

The Dutch Smart Industry differs slightly from the German view on the fourth industrial revolution in certain respects. Smart Industry in the Netherlands makes it possible to create new business from large and diverse information flows, based on new, partly interacting technologies such as: “big data processing, the Internet of Things, new generation of adaptive robots, 3D printing, nanotechnology and miniaturization, and new sensor technology” (TNO, 2020). The FME (the association for the technology industry), TNO, the Dutch Ministry of Economic Affairs, VNO-NCW (the largest employer organization in the Netherlands), the Chamber of Commerce, and the ROMs (regional development companies) have joined forces in a Smart Industry Platform in order to successfully shape the Smart Industry. All involved parties in this platform aim to modernize the industry. In figure 1, the parties involved have visualized the trends and developments belonging to the Smart Industry. The outer ring consists of eight essential transformations in the development of the industry. The orange inner ring refers to the driving technologies, as mentioned before.

Figure 1 – Smart industry (Smart Industry, 2020)

These developments of the Smart Industry cause a situation in which the tasks of manufacturing workers are more integrated with the machines they use. To make this a success and reach the organizational goals on adoption, technology acceptance is crucial (Taherdoost, 2019). A unique characteristic of this fourth industrial revolution is that it is being predicted. This allows

organizations to take action before the actual revolution happens. SME manufacturing firms can, therefore, prepare their employees for this revolution and thereby influence technology acceptance, which in turn would lead to better technology adoption.

Evolutions in an industry, such as the Smart Industry, usually go through three phases: the fluid, transitional, and specific phase. In the fluid phase, it is mainly about product innovation by different competitors that invent different new designs. This is in a period moving towards different competitors with designs around one dominant design, and then it moves on to the second (transitional phase). Here, process innovation is the main issue with a focus on reducing cost and improving quality. In the last phase, the specific phase, it is mainly about cost reduction and utilizing the market because (probably) a new industrial revolution is coming (Utterback, 1987). It can be stated that Smart Industry is currently still in the fluid phase, since the focus is on product innovation. The large organizations in the industry are increasingly implementing technologies belonging to Smart Industry, but there is not yet a dominant or prevalent design. It should be stated that this is also something that is not likely to happen with the Smart Industry, due to the fact that there is an enormous variety of technologies. Therefore, one business model based on one technology would not exclude the other since they are there both for different purposes. This creates a great challenge for SME manufacturing firms to make the right decision for investing in a new technology, because of the varied range of available new technologies. A wrong choice can have a significant influence on SME manufacturing firms, since the business models of these firms often depend on the technologies they use (Arnold, Kiel, & Voigt, 2016). While the emerging (technologies of the) Smart Industry affect the choices within the SME manufacturing firms, their individual and jointly taken decisions also affect the Smart Industry. As described earlier, several parties interested in the industrial manufacturing industry have joined their forces on the Smart Industry Platform to make it a success. There is a clear goal set for the evolution of the industry by this platform, but the organizations within the industry decide the path for the industrial evolution. When organizations see the value of the new technologies, it will fit with their strategic goals, which can result in adopting the technologies. When more and more organizations follow, it will form the standard and thereby change the industry.

2.2. Technology adoption

In his study, Rogers (1962) described a technology adoption life cycle, which suggests how the adoption of technologies follows the normal distribution bell curve. An important part in this life cycle is the chasm between the early adopters and the early majority (Meade & Rabelo,

2004). Meade and Rabelo (2004) state that when a technology crosses this chasm, the technology is very likely to become a success. In this study, the technology adoption of individual organizations is studied and furthermore how this influences the employees' perceived usefulness of the technologies. There are several studies that take different indicators into account for technology adoption. For example, a study that takes into account individual (leader) characteristics, internal characteristics of organizational structure, and external characteristics of the organization (Rogers E. , 1995). Another study by Tornatzky and Fleischeror (1990) takes the external task environment, the organization, and technology into account. Their study zooms in on a study conducted by Langley and Truax (1994), which is aimed explicitly at the process of technology adoption in smaller manufacturing firms. Because of the scope of this research on SME manufacturing firms, this theory seems to be most suitable. According to Langley and Truax (1994), the technology adoption process consists of three sub-processes: strategic commitment, technology choice, and financial justification process. These three processes are interrelated, because a change in one process causes changes in the other processes. Besides, the processes are intertwined with other strategic decision processes within an organization and affected by contextual elements that interact with each other over time. The processes take place at least partly simultaneously. Therefore, it can be concluded that they take place rather in a parallel manner than in a sequential one (Langley & Truax, 1994).

Strategic commitment process

The strategic commitment process is an informal process of incubation in which the commitment of managers fluctuates with information changes, contextual conditions, and ongoing decisions in other areas. A study by Utterback and Weil (2005) showed that the quality and quantity of information have a positive influence on the evidential value of new technologies. This is relevant for organizations, as a manufacturing firm's business model is often dependent on the technologies that are used (Arnold, Kiel, & Voigt, 2016). From the study by Langley and Truax (1994), four elements can be identified to develop sufficient strategic commitment for the start of the technology choice process: information elements, sensitizing elements, inhibiting elements, and precipitating elements.

- Information elements: These are elements of the information that is gathered regarding new technologies from several sources.
- Sensitizing elements: This refers to internal/external events that stimulate the interest of management in new technology.

- Inhibiting elements: These are internal/external events that inhibit the interest in or the consideration of new technology
- Precipitating elements: These are internal/external events that cause the explicit study of new technology.

The strategic commitment process can be described using the abovementioned elements. This process is used to investigate the relation of this (together with the other sub-processes of technology adoption) and the perceived usefulness of new technologies within SME manufacturing firms. The perceived usefulness can be seen as an internal event that can affect the different elements stated above. Besides, the effect of these elements on the perceived usefulness is included in the study.

Technology choice process

The technology choice process is a purposeful and explicit process which defines what is needed within a new technology and what the specific priorities are. In the end, this process is aimed at the eventual selection of technology. This process only starts when there is sufficient strategic commitment towards this new technology. In the technology choice process, three types of activities can be distinguished, namely:

- Diagnostic activities: This refers to defining or confirming the priorities of the technology that need to be accomplished.
- Feasibility studies: This refers to studying if the technology is feasible to adopt for the organization and what the impact will be on the organization.
- Supplier evaluation and selection: This refers to the informal contacts with suppliers of new technologies throughout the adoption process.

There are also contextual elements that influence interference once the process of technology selection has commenced. These elements can be distinguished into facilitating, interrupting/slowing, and reorienting elements. Facilitating elements are internal/external events that help facilitate or accelerate the technology choice. With interrupting or slowing elements, internal/external events are meant that influence the ongoing process of technology choice by interrupting or slowing down. The latter, reorienting elements, are internal/external elements that cause a rethinking of the technology process. This mainly reflects to elements aimed at the perceived usefulness that can interfere in the technology selection process.

Financial justification process

In the financial justification process, financial support for the technology is obtained. It is a formal and political process in which there is a focus on the justification of financial results and market potential that can be achieved. There are two types of arguments that can be used for the financial justification process.

- Financial/strategic arguments: These are arguments for justification that refer to elements such as overall financial results, market growth potential, payback/ROI on technology, job creation/preservation, guarantees, or modernization.
- Intrapersonal/political arguments: This refers to the justification of new technology with elements such as track record, credibility provided by funding from other sources, networking/PR/support from 'outsiders'.

The contextual factors that can interfere in this process are the same as the ones in the technology choice process, namely facilitating, interrupting/slowing, and reorienting elements. There is a particular focus on elements of perceived usefulness and the relation of these elements with this financial justification process.

As previously described, these three processes are highly interrelated. A change in one process can affect the other processes, and thereby the processes are continually changing over time. In this research, the way these processes affect each other over time cannot be taken into account. The conduction of a longitudinal study would be necessary to investigate this process over time and the relation of this with the perceived usefulness of individual employees. Because of the limited time given for this research, it is not feasible to carry out such a longitudinal study. Therefore, the effect between these sub-processes are only taken into account at a given moment in time.

2.3. Perceived usefulness

The influence of the previously described technology adoption is investigated on the perceived usefulness of the technologies by the employees working in the SME manufacturing firms. This is a term derived from the TAM by Davis et al. (1989), where perceived usefulness and perceived ease of use are key determinators of technology acceptance. The TAM is a form of Theory of Reasoned Action (TRA), which is a traditional theory by Fishbein and Azjen (1975) that was made for sociological and psychological research. Nowadays, it has become a foundation to investigate IT usage behaviour. It states that three factors can predict and explain any human behaviour, namely: attitudes, social norms, and intentions. Other theories that are

part of TRA are Theory of Interpersonal Behaviour (TIB), Theory of Planned Behaviour (TPB), and Perceived Characteristics of Innovating Theory (Taherdoost, 2018). The reason that this research applies the TAM as described by Davis et al. (1989) is that it is specifically aimed at the acceptance of technology and, therefore, the most applicable in this research. Besides, the TAM has proven itself to be a useful model for helping understanding behaviour in qualitative and quantitative research (Chen, Shing-Han, & Chien-Yi, 2011). In figure 2, the model of Davis et al. (1989) is presented. The model illustrates the relations between the factors that ultimately lead to technology acceptance.

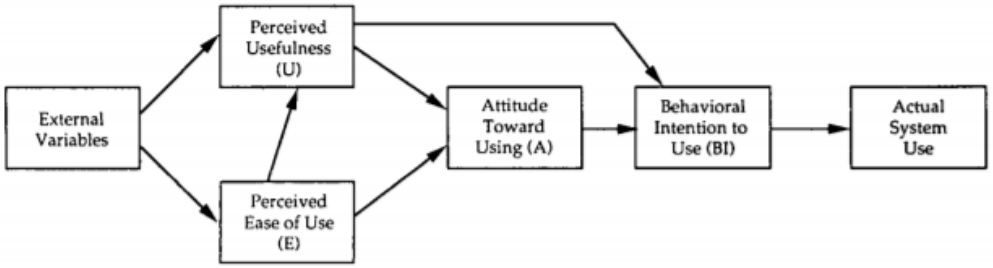

Figure 2 – Technology acceptance model (Davis et al., 1989, p. 985)

The perceived usefulness and the perceived ease of use are critical factors in this model for technology acceptance, since they affect the attitude towards using, and in the end towards actual usage of the technology. In this research, the effect of the previously described technology adoption on technology acceptance is investigated. Because of the limited time and resources given for this research, not the whole TAM can be taken into account. The decision has been made to focus solely on the influence of organizational technology adoption (as an external variable) on the perceived usefulness of individual employees. The choice for the relation with perceived usefulness instead of perceived ease of use is made because it is assumed that someone can only get a good perception of the ease of use when someone has actually worked with the particular technology. Because the developments of the Smart Industry are quite new, it is not likely that everyone is familiar with the actual usage of these technologies. The perceived usefulness, on the other hand, can be estimated well, even when the respondent has not worked with the technology.

For external variables, Davis et al. (1989) refer to several factors mentioned by Fishbein and Ajzen (1975) in their theory about TRA. Examples that are used are variables such as characteristics about the user or the task, the nature of the development or implementation process, political influences, and organizational structure (Fishbein & Ajzen, 1975). Several other studies have focused on exploring other variables that can influence the perceived

usefulness. Abbasi et al. (2015) showed that several social, organizational, and demographic factors have an influence on technology acceptance. In their research, the technology adoption processes in smaller manufacturing firms by Langley and Truax (1994) are used as external variables. Due to the fact that external factors highly influence perceived usefulness, the assumption in this research is that it also is influenced by the strategic commitment process, technology choice process, and financial justification process (Langley & Truax, 1994).

Perceived usefulness is defined as: "the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context" (Davis et al., 1989, p. 985). This definition indicates that an individual considers whether or not using new technology will improve their total expected value to an organization (Motowidlo & Kell, 2012). A study by Segars and Grover (1993) showed in a re-examining of the perceived usefulness and ease of use that the indicators for perceived usefulness could be reduced to three factors: (1) makes the job easier, (2) useful, and (3) increase productivity. These indicators are stated to have a significant relationship with the perceived usefulness (Segars & Grover, 1993). Although this is suggested in a quantitative research, these indicators can also be applied to qualitative research for understanding the relationship between managerial technology adoption and the individual perceived usefulness.

2.4. Conceptual model

The evaluation of the aforementioned theories has resulted in the conceptual model presented in figure 3. This model visualizes the relation between the technology adoption process within an organization and the perceived usefulness. For the technology adoption process, the three sub-processes studied by Langley and Truax (1994) are studied. This concerns the strategic commitment process, technology choice process, and financial justification. The concept of perceived usefulness is taken out of the technology acceptance model (Davis, et al., 1989). The decision has been made to present the technology adoption process as one variable instead of a distinction between the three subprocesses, because these are highly interrelated and can, therefore, not be seen as completely separate variables.

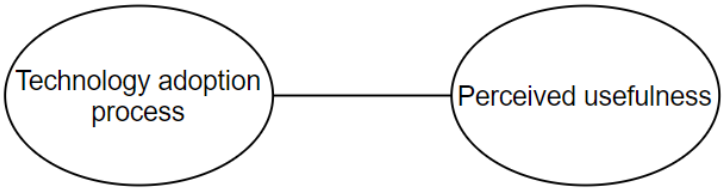

Figure 3 – *Conceptual model for the relation between technology adoption and perceived usefulness*

3. Methodology

In this chapter, the methodology for collecting the necessary data for answering the research question is described. At first, the research strategy is described. A clarification of the research methodology is provided, which explains why the decision for a qualitative or quantitative approach has been made. Thereafter, the sample and data sources used are described. Afterwards, the core concepts are operationalized and the data analysis procedure is outlined. Furthermore, several quality criteria and ethical considerations underlying this research are discussed. Finally, a planning for conducting the research is presented.

3.1. Research strategy

The goal of this research was to gain a better understanding of the relation between technology adoption processes on managerial level and the perceived usefulness of technologies on individual employee level. For understanding such situations, a qualitative study was the most applicable, since it is focused on understanding human thinking, decision making and acts in natural context (Myers, 2013).

The research was performed in a deductive way. For the variable 'technology adoption process', some sub-processes were defined from the theory by Langley and Truax (1994). These include the strategic commitment process, technology choice process, and financial justification process. The variable 'perceived usefulness' was further defined by the definition of Davis et al. (1989) and the indicators of Segars and Grover (1993). This led to the following sub-constructs: makes the job easier, useful, and increases productivity. These constructs and the relation between both were investigated with the use of semi-structured interviews. These were conducted with nine people and spread over three SME manufacturing firms. Within these organizations, interviews were conducted with managers, production leaders, and employees working with the technologies. Moreover, two interviews were conducted with people who have a more overarching view of the industry. One with Egbert-Jan Sol, who is a researcher specialized in Smart industry topics at TNO, and Jo van de Put, who is an Advisor Teqnow at Metaalunie. Because of the developments around the COVID-19 virus, physical interviews could not be conducted during this research. Therefore, the interviews were executed in an alternative way, via Skype or by telephone. This form of field research is combined with desk research. Desk research refers to combining the obtained empirical data with existing data regarding this topic.

3.2. Data sources and selection criteria

The objects of analysis were SME manufacturing firms in the Netherlands. The characteristics of these organizations are that they have fewer than 250 employees and an annual turnover of less than €40 million or a total value of assets that is less or equal to €20 million (KVK, 2020). To further specify this group, this research is specifically aimed at base metal industry and metal products industry[1]. In total, this sector consists - according to CBS (2020) - of 12.625 organizations. This research only takes into account SME manufacturing firms with more than 25 employees. This number was chosen because it was assumed that the technology adoption processes can be better identified within these firms, and thereby the relation of this with the perceived usefulness of individual employees. In total, there are 385 organizations in the Netherlands that meet these criteria (CBS, 2020).

Eleven interviews were conducted in order to appropriately gather sufficient data to answer this research' main question. The interviews were conducted with managers, production leaders, and the employees who actually have to work with the new technologies. Besides, also two people with industry-wide knowledge have been interviewed. Interviewing these people gives a good reflection of the actual technology adoption process in SME manufacturing firms and the relation of this process with the perceived usefulness of employees working with the technologies. Nine interviews were conducted within three SME manufacturing firms. By conducting multiple interviews within one firm, the bias of an individual interviewee is excluded and a more complete view of the situation can be obtained within that organization. The choice for three organizations instead of one has been made because of practical arguments. Conducting nine interviews within one SME manufacturing firm is assumed to be difficult because it would imply that a significant part of the organization is interviewed. This is a problem because an SME should have invested much time in the research, and more than five interviews within one SME does not lead to breakthrough insights into this topic. Also the difficulty of finding willing organizations to participate in times of Covid-19 has made that for practical reasons three organizations were included in this research.

Selective sampling has been used for the selection of the organizations. The network of the author and supervisor was used in the search for organizations that met the stated requirements. This was the most pragmatic manner of selecting organizations, as it was the most likely to find organizations that are willing to participate within times of Covid-19 and the limited time and

[1] Based on industries of CBS Statline – C24 Basismetaalindustrie and C25 Metaalproductenindustrie (CBS, 2020)

resources given for this research. The first participating organization is Heel Metaal from Doetinchem, which was contacted through the network of the supervisor, Mr. Smals. This is a manufacturer in semi-finished products, complete products, and prototypes in sheet metal. They supply their products to various branches from the automotive industry to the interior industry. The second organization is Pillen Group from Lichtenvoorde and has been found by cold approximation. The Pillen Group is a family business since 1956. The organization consists of various private companies, each with its own specialism; from supply in the precision engineering industry to end product in interior construction. The third organization is Van Raam from Varsseveld and is approached by the role the organization plays within BOOST, the navigator for a smart and clean industry in the east of the Netherlands. The distribution of the eleven interviews conducted in this research is shown in figure 4. Each organization was randomly appointed to one of the three case organizations in the table. This was done to remain anonymity so that statements could not be traced back to an organization. This distribution was also used in the used quotes in the result section of this report, someone there is identified as, for example, participant 1.1, participant 1.2 etcetera.

Interviewed	**Manager**	**Employee**	***Other***
Organization 1	2x cooperating foreman, 1x production leader, 1x ICT manager, 1 operational manager		**5**
Organization 2	2x owner		**2**
Organization 3	1x owner, 1x operational manager		**2**
Industry experts	Mr. Van de Put, advisor Teqnow at Metaalunie Mr. Sol, researcher at TNO		**2**
			11

Figure 4 – Distribution of the interviews

3.3. Operationalization

The variables of the conceptual model are here further operationalized for conducting the research. This operationalization was used for the development of questions for the semi-structured interviews that were executed in this research. First, the variables and the dimensions were described from the theory coming from the theoretical framework. Afterward, these were translated to this specific research with items that were important for describing the dimensions. These were adjusted during the research process to the essential constructs that emerged out of the conducted interviews.

Figure 5 includes the variable ‘perceived usefulness’. This is a term coming from the technology acceptance model by Davis et al. (1989). For the operationalizing of this term, the

indicators out of the research by Segars and Grover (1993) are used for the description of the perceived usefulness.

Variable	**Dimension theory**	**Dimension research**	**Items**
Perceived usefulness	Makes job easier	Technology makes the job easier	(1) Physical effort (2) Mental effort
	Useful	Technology makes the job more useful	(1) Job performance (2) Valuable job
	Increase productivity	Technology increase productivity	(1) Effectiveness (2) Efficiency

Figure 5 – Operationalization of variable perceived usefulness

The second variable in the conceptual model is 'technology adoption process'. This process was further elaborated by using the sub-processes that together form technology adoption within SME manufacturing firms (Langley & Truax, 1994). These three sub-processes are the strategic commitment process, the technology choice process, and the financial justification process. In figure 6, these are further operationalized with important dimensions and items that has described this concept from theory and applied to this research.

Variable	**Core concept**	**Dimension theory**	**Dimension research**	**Item**
Technology adoption process	Strategic commitment process	Information elements	Information about technology	(1) Information search (2) Information provided by others
		Sensitizing elements	Interest in technology	(1) Internal attention grabbers (2) External attention grabbers
		Inhibiting elements	Consideration of technology	(1) Internal factors for consideration (2) External consideration factors

		Precipitating elements	Explicit study of technology	(1) Internal decisive factors (2) External decisive factors
	Technology choice process	Diagnostic activities	Defining priorities of technology	(Cyber) security (Energy) consumption Quality and features Service User-friendliness
		Feasibility studies	Impact of technology on organization	(1) Feasible to adopt technology (2) Effect on organization
		Supplier evaluation and selection	Selection and evaluation of technology supplier	(1) Selection of supplier (2) Evaluating suppliers
	Financial justification	Financial/strategic arguments	Financial/ strategic arguments	(1) Financial arguments (2) Strategic arguments
		Intrapersonal/political arguments	Intrapersonal/ political arguments	(1) Intrapersonal arguments (2) Political arguments

Figure 6 – Operationalization of variable technology adoption process

The separate topics were investigated in the way this applied to the SME manufacturing firms involved. Besides, the relation between these two main concepts was investigated. Thus, it has been investigated how perceived usefulness causes changes in the technology adoption process. To give an example, this research aimed to investigate if the perceived usefulness could cause facilitating the technology to become a success, slowing it down, or cause reorienting on the

technology. However, this process has also been studied the other way around. This implied the investigation in the way the technology adoption processes were executed and if this has an effect on the way the individuals within the firm perceived the new technology as being useful. These topics were included in the interviews that were conducted in this research. This resulted in a new category with variables that influenced the relationship between technology adoption and perceived usefulness. These can be seen in figure 7.

Variable	**Dimension research**
Relationship between technology adoption and perceived usefulness	Creating understanding for change
	Involving employees in technology adoption process
	Educate people to work with technologies
	Employee development possibilities

Figure 7 – Relationship between technology adoption and perceived usefulness

The initial code scheme as presented in the research proposal of this research is included in Appendix B. The new code schema - which was adjusted to the data - is included in Appendix C. Because different actors were interviewed, the interview questions were slightly adjusted to the interviewee. To give an example, a specific manager had more insight into the way the technology adoption process was designed, and less in the way technologies were perceived as useful. The opposite applies to the employees working with the technologies. This was taken into account in the preparation of the interviews.

3.4. Data collection procedure

As described before, the empirical data was collected by conducting nine interviews in three SME manufacturing firms and by interviewing two industry experts. Because of the developments around the COVID-19 virus, these interviews could not be conducted physically. Physical contact was limited within the period this research was conducted, which implied that the interviews were conducted via Skype or by phone. Managers, production leaders, and employees who actually have to work with the technologies were interviewed within the three SME manufacturing firms involved. Together with the contact person in the organization, it has been discussed which people could be approached for participation in this research. Only when the people were positive about the research, they were selected as potential participants. The interview processes between the three firms were performed parallel instead of sequential. By doing this, insights gained in one organization could be used for new insights in the other

organization. By conducting the interviews in a parallel manner, the predetermined constructs were further optimized during the research process. Because there were interviews conducted with respondents that had different roles within the organization, they differed in terms of their knowledge about the technology adoption process and the perceived usefulness of technologies. Therefore, the semi-structured interviews were adjusted to the role of the employee within the organization: manager, production leader, or employee working with the technology. This enabled the researcher to gather the most valuable information out of each interview. The general interview guidelines are represented in Appendix A of this report.

The information gathered from desk research is derived mainly from online databanks and literature belonging to the master Organizational Design & Development.

3.5. Data analysis procedure

After transcribing the interviews, template analysis was performed to identify important constructs. Template analysis has a high degree in the structure for analyzing textual data but is also flexible to adapt to the specific research and their needs (King, 2012). The data gathered could, therefore, be analysed optimally. The operationalization of the data was used as an initial template. This initial template was slightly adjusted by the relationship that attended and the variables that are influencing this relationship. This could be seen as an iterative process to eventually arrive at the template that turns out to fit the best with the data. Important constructs that arose out of the interviews could be included in the research, and constructs that turned out not to be of importance could be excluded. This was done by first identifying the most essential information out of the transcripts. During the course 'Advanced Research Methods, part A' a context mapping was organized for identifying the essential constructs out of transcripts. The essential quotes out of the interviews were noted and paraphrased into the context it was said. This implied approximately about five to ten quotes derived from each transcript. By combining these quotes into clusters, important constructs arose that could be used for the further coding of the transcripts. These constructs provided input for adjusting the initial template by the inclusion of these important constructs. This was done throughout the research process as an iterative process of applying, modifying, and re-applying the initial template. First, fragments of text were labelled by giving a short summary of that fragment. After this, these labels were clustered and linked to the dimensions from the operationalization. As can be seen in Appendix B, first there were about 130 codes that gave specific information about one of the dimensions. A lot of those codes could be grouped under the items of the operationalization, in which the number of codes could be reduced to 32. This provided more overview in the coding. Some

constructs that could not fit into the initial template these were grouped and formed a new category: the variables that influenced the relationship between perceived usefulness and technology adoption.

Throughout this procedure, a better understanding of the relation between technology adoption and perceived usefulness was gained. The information obtained in the first interviews could be used in the remainder of the interviews with the end goal to understand the situation as well as possible. When all interviews were conducted, the final template could be made with all the essential constructs belonging to this topic. Using this data analysis procedure, it was expected that a good picture of the situation could be created. The template was adjusted to the most important information that emerged during the research process instead of sticking to the predetermined constructs and fitting the data within these constructs.

3.6. Quality criteria

The strong and weak points underlying this research methodology can be assessed with the use of quality criteria. The traditional quality criteria are internal validity, generalizability, reliability, and objectivity. According to Symon and Cassell (2012), these criteria fit the best with quantitative research but not so well with qualitative research. Alternatives for the traditional criteria and more applicable to qualitative research are credibility, transferability, dependability, and confirmability (Symon & Cassell, 2012). Since this research is conducted qualitatively, these quality criteria were used for assessing this research.

Credibility

Credibility refers to the believability of the information gathered by the researcher. The researcher wants to pursue a good fit between the construed realities of the respondents and the reconstructions attributed to them (Symon & Cassell, 2012). The credibility was high in this research, due to several measures taken by the researcher. The interviews were conducted with multiple actors that are active in different roles within the three organizations. A downside of this approach is that the ratio employee vs. manager was slightly skewed. More managers were interviewed which could make the results a bit biased by management perspective. Because management had a quite good view on the perceived usefulness of employees due to the relation with them in their job and this view did not differ much from the employee perspective, the expectation is that this has not much influenced the results. The interviews were recorded and transcribed to ensure that the findings were as much independent of the interpretation of the researcher as possible. Sufficient time was taken in the interviews by the researcher to obtain a

good picture of the situation as described by the interviewee. The average duration of one interview was about one hour but differs slightly per interview. Important findings of the interviews were included in subsequent interviews, in order to find out whether these findings also applied to the vision of another respondent. Besides, two industry experts were interviewed to compare the results of this research with the vision they had on this. All these measures ensure the high credibility of the results.

Transferability

Tranferability is a qualitative translation of generalizability and is about the question if the findings can be translated, or are of value, to other contexts. There were only three firms involved which are all located in the eastern part of the Netherlands, which made it difficult to decide if the findings are representative for the whole SME manufacturing firms in the metal industry in the Netherlands. Because the results of this research were compared with the view of two industry experts, the transferability of the results to the SME manufacturing firms in the metal industry is considered as being high. The mutual relation was confirmed by all participants and the variables that can influence this relation by almost all participants. Because the mutual relationship was confirmed by all participants, it could be assumed that this would as well apply to other manufacturing firms in the Netherlands. The variables that influence this relationship could differ per context of a certain industry and could therefore probably not be translated to all manufacturing firms in the Netherlands. These manufacturing firms can assess which characteristics of their specific industry correspond with the findings in the research and can assess if certain findings could also hold for them. In other words, it can be concluded that there is a quite high transferability concerning the relationship between technology adoption and perceived usefulness. It is not clear how widely the conclusions about the variables that affect this relationship can be drawn within the manufacturing industry. The transferability of this is assumed to be quite low because it will probably differ per context.

Dependability

Dependability is about the way the reliability of the findings and the way methodological changes and shifts in constructs are captured throughout the process. This is important because this can, in the end, be used for the evaluation of the research to analyse how the choices of the researcher have affected the outcomes of the research. To capture this, the research process and choices made were discussed with the supervisor, Mr. Smals, and with a fellow student. They took a look to the way the research process was performed and how the translation was made

from the interviews to the results of the research. For example, they have shed light on the way the code structure was designed and the argumentation for it. With insights and feedback of them, this was adjusted to the way this was assumed to fit the best with the results. By sharing the thoughts of the researcher with external researchers, decisions made had to be substantiated to them to ensure the reliability of the research. Because of this, the dependability is assumed to be quite high in this research.

Confirmability

This refers to the data that is gathered and the way in which it is translated into the results. Research findings should be objectively derived out of the data and should not be affected by the interpretation and imagination of the researcher. To ensure this, the interview questions were openly formulated without a suggested direction for the answer. Besides, all interviews were recorded and fully transcribed to ensure that only the factual information could be used. Of course, interpretation could not entirely be excluded, but the aim was to reduce this as much as possible. In addition, the results are compared with two industry experts to find out if they had the same view on the findings. Findings in the report are supported with quotes to show what statements are based on. Furthermore, essential constructs were merely included in several interviews to ensure that these were not just based on a single respondent. Through all these measures the confirmability of the data and findings is considered to be high.

3.7. Research ethics

Multiple measures were taken to ensure that the research was performed ethically. The researcher has sustained transparency towards the organizations and the respondents involved in the research. The goals of the research and the interviews were explained a priori to make sure all potential participants know what was expected of them. The respondents could participate voluntarily. The relevant contact person within the three approached organizations has helped in deciding which people to approach for the research. No such thing as an obligation or the pressure to participate was involved in selecting the participants, only the ones who were positive about the research were asked to participate. The interviews were transcribed afterwards, while the respondents remain anonymous in these transcripts and in the further analysis of the report. Only the name of the two industry experts, Egbert-Jan Sol and Jo van de Put, are used in the report. The quotes of them were only used after approval of these quotes to prevent they would not support the quotes or do not prefer to have such a quote with their names included.

The gathered data has been handled with care. The audio recordings and transcript files were encrypted and stored externally by the researcher, to ensure no one except the researcher could have access to these files. These files are only included in the report with the submission of the report to the supervisor and co-reader. By using FileSender, these files could be submitted encrypted to ensure the data could not reach people from outside the field of study. For other purposes, the transcripts and audio files were excluded from the appendices of the report.

Because this research was performed within three organizations in the same industry, sensitive company information from one organization was not shared with the other organization. There was nothing shared about, for example, the technologies these organizations use or how they deal with technology adoption, technology acceptance, and the developments of the Smart Industry. This information was also not included in the report because findings were shared with the involved organizations. If there were individual respondents who would like to be informed about the results of the research, the report was also sent to them.

Researchers generally always have a biased attitude towards the topic because of the earlier gathered data out of desk and field research. There has been attempted to minimize this and to approach each respondent in a neutral manner. This was done to prevent the potential steering or influencing the respondents' opinions. The interview questions were formulated openly as much as possible, to gather only the opinion of the respondent on this topic.

4. Results

In this chapter, the results of the study are presented. Firstly, the two main concepts in this research - technology adoption and perceived usefulness - are described. These results are based on the empirical data collected by interviews with SME manufacturing firms in the Dutch metal industry. After describing how the two main concepts manifest themselves within the industry, i.e. technology adoption (section 4.1) and perceived usefulness (4.2), the relation between both is discussed (4.3).

4.1. Technology adoption

The technology adoption process is described based on the three sub-processes by Langley and Truax (1994): the strategic commitment process, technology choice process, and financial justification process.

4.1.1. Strategic commitment process

This process relates to the period between not knowing about a technology and the situation that there is sufficient support to move on to the technology choice process. This process is described by the subdivision of this process into four phases, which is visualized in figure 8.

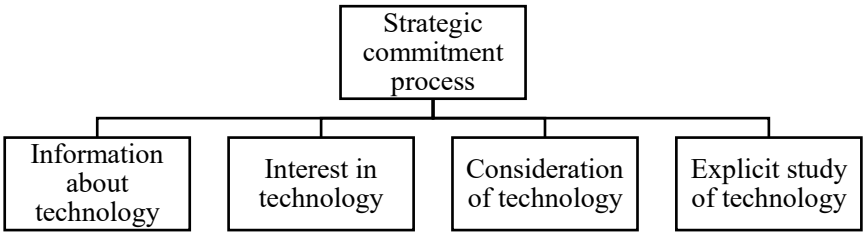

Figure 8 – Strategic commitment process

- Information about technology

Information about new technologies is mostly provided by others. This refers to parties within the network of the organization, such as suppliers, customers, and fellow entrepreneurs. The following quote shows the importance of the supplier and fellow entrepreneurs in information provision: *"We have a lot of contact with the suppliers of our machines. (...) That is the most important source of innovations I think. And in the field of new machines, we do of course network meetings with our fellow entrepreneurs."* (Participant 2.1, owner, 19:01-19:41). Besides external sources, organization themselves also look for information. The own organization is compared to other organizations within the industry, as is evident from the following quote: *"Of course we look at competitors in the region, but also to industry peers"*

(Participant 1.3, ICT manager, 26:49-26:55). Furthermore, organizations visit events and retrieve information at other sources, such as the internet, for information regarding new technologies. This is reflected in the following quote: *"Yes well that is usually, of course, a, yes, searching on the internet for solutions and going to some events when it comes to automating."* (Participant 1.1, production leader, 07:13-07:27).

- Interest in technology

Main points of interest concerning the information gathered about technology are mainly concentrated in improvements of the current organization that can be achieved. The focus is on continuous improvements of the process, which make it interesting: "*Every day you look at what you are doing and whether that can be done better or differently and, thus, you try to adjust to that."* (Participant 2.1, owner, 34:27-34:38). It can be concluded that triggers are often based on daily problems an organization faces, which is also reflected in the quote from Mr Van de Put from Metaalunie. He highlights that SME manufacturing firms are generally short-term oriented and make decisions based on the problems they face today and not by the problems an organization could face in the future (Mr Van de Put, Metaalunie, 36:08-37:37). This short-term focus could be dangerous, since an organization could become outdated when they are not ready for future developments. Ambidexterity is crucial for organizations to be future proof. Practically, this means the alignment of the current short-term activities and also focus on the adaptability of future developments is of crucial importance (Birkinshaw & Gibson, 2004). An example of future developments that are taken into account and arouse interest is the shortage of skilled personnel in the labour market. The labour market in skilled personnel will decrease by ageing population and dejuvenation (Mr Sol, TNO, 34:58-35:26). Smart Industry technologies are interesting since they can create a higher output with fewer people. Furthermore, it turns out that there are many family businesses in the industry and most are founded by good technicians that started for themselves (Mr Van de Put, Metaalunie, 32:35-32:48). They are intrinsically interested in new technologies, as is reflected in the following quote: "*And technology, we both have technical degrees and we love it."* (Participant 2.1, owner, 40:42-40:54).

- Consideration of technology

In the consideration phase, interest has already been aroused by technology and the question is now whether that technology is suitable for the specific organization. In this phase, it turns out that there is a high degree of cooperation between manufacturers. They help each other by

visiting each other in order to look at technologies. A relationship is built within the network where people help each other*: "That means that a lot of people can come and have a look here. The advantage that you create in this is that you can also go to many others."* (Participant 3.2, operational manager, 13:58-14:06). The reason for visiting others is to gain practical information about the technology and the supplier: *"And there, I eventually went to see the practical situation with the machine. Does the supplier really promise what he says and does he live up to it."* (Participant 2.2, owner, 11:35-11:50). Furthermore, the level of employee involvement differs in the consideration phase. Sometimes, employees are involved in the consideration if a technology will suit the organization, but sometimes they can be excluded.

- Explicit study of technology

It can be stated that the customer is perceived to be a key actor for creating strategic commitment, which is also illustrated by the following quote: "*But a machine that is mainly purchased to serve demands of the customer."* (Participant 1.5, operational manager, 26:58-27:04). Technologies are often bought because of a customer and their long-term commitment to the organization. This is highly applicable to organization 1 and 2, but less to organization 3. This can be explained by the fact that organization 3 produces a specific product and serves the market with this product. The customer is an intermediary between the market and the producer, which means it has little power over the producer. Besides, this organization has one production process on which to focus. Within the other organizations, different production processes are established for the different products and customers. Therefore, organization 3 is relatively less customer dependent and more focused on efficiency and effectivity improvements of the overall production process. In the decision for a technology, the technology itself is of less importance. The main focus lies on the overall process improvements that can be achieved: *"We actually subordinate the machines to the process."* (Participant 3.1, owner, 22:39-22:43).

Based on the aforementioned results, it should be stated that there is some overlap between the phases and not all phases are followed formally, but each step is more or less reflected in the adoption process. However, the steps are not strictly sequential, but rather it can be considered as an iterative process. For example, in the consideration phase (practical) information is gathered at fellow manufacturers. This information can arouse interest and therefore incentivize the process to re-start again. Furthermore, it turns out that there are also interfaces with the other processes. The information provided by a supplier regarding a new technology can affect the technology choice process. The supplier promotes their (new) technologies to the manufacturers and tries to convince them of the usefulness of it for their organization. Therefore, the

technology choice process can be limited due to a preference for a specific supplier. It turns out that the factors of the last process, the financial justification process, emerge throughout the strategic commitment process. Interest, consideration, and decisions on technology are made and justified by financial, strategic, political, and intrapersonal arguments. Strategic and financial arguments are reflected in process improvements that can be achieved, which arouses interest and can even be decisive factors. Political arguments emerge in information by suppliers, cooperation with fellow manufacturers, and the dependence on the customer as a decisive factor. If an organization is dependent on its customers, political arguments prevail and when this is not the case, more strategic arguments prevail. Furthermore, intrapersonal arguments are reflected in the intrinsic interest in new technologies and developments by the management board of the organizations.

4.1.2. Technology choice process

In case sufficient strategic commitment is achieved, organizations move on to the choice for a specific technology that would be suitable to their organization. The sub-processes in figure 9 form the basis for the description of this process.

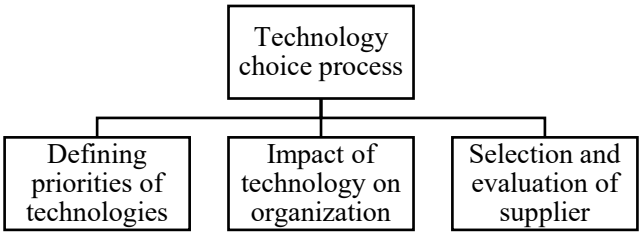

Figure 9 – Technology choice process

- Defining priorities of technologies

The priorities in the choice for a technology are overlapping with the points of interest and the decisive factors in the strategic commitment process. This pertains to achieving organizational improvements now and in the future. The quality and features of a technology are the most important aspects in this respect. In addition, the ease of use, ease of implementation, consumption and service of the technology are frequently mentioned priorities. This is all reflected in the following quote: "*(...) and that has to do with the accuracy of the machine, of course with the price of a machine, the maintenance that a machine needs, what all is involved. The consumption of the machine."* (Participant 1.5, operational manager, 27:17-27:34). The ease of use and ease of implementation relate to the short-term benefits that can be achieved. When there is a smooth connection with the current systems of the organization or when

employees are already familiar with operating such a technology, implementation time and costs can be reduced. This is somewhat overlapping with 'technology makes the job easier', which is one of the indicators of perceived usefulness. Service and consumption of the machine are focused on the long-term, since this can be beneficial over the lifespan of the technology.

- Impact of technology on organization

Regarding the impact of a technology on the organization, mostly only practical issues from a managerial perspective are taken into account. This refers to hard issues, such as return on investment or feasibility to adopt. The following quote demonstrates this: *"So before such a machine arrives, we first assess whether the machine will go to yield the return we are looking for. After that, we are going to look if it is easy to operate for such a man. Is it in the house or should we look for it?"* (Participant 2.1, owner, 24:35-24:51). Soft issues, such as the impact on employees, are taken into account to a lesser extent. The perceived usefulness is part of the soft issues and is not highly taken into account within SME manufacturing firms. However, this turns out to be important with Smart Industry technologies, since it appears to be that workers do not understand how such technologies will affect their work. A respondent gave an example of this with the introduction of a welding robot: "*The entire welding department looks at that somewhat sceptically. People still think, wait a moment, a device is coming to replace my workplace."* (Participant 2.2, owner, 26:35-26:46). Mr Van de Put of Metaalunie attributes the lack of inclusion of the soft issues to the fact that many organizations were started by technicians. This is reflected in the following quote: "*These entrepreneurs are well versed in technical items (...) but when they achieve success they are not the ones with the best feeling about managing employees or motivating people. Usually, they are quite bad at that."* (Mr Van de Put, Metaalunie, 32:50-33:16). The main conclusion that can be derived from this is, is that the entrepreneur's background also influences the way in which technology adoption is dealt with.

- Supplier selection and evaluation

The selection of a supplier can sometimes be related to the decision to choose for a certain technology, which is described as 'explicit study of technology' in the strategic commitment process. A technology is often bought because of the demands of the customer to find a technology that fits their needs best. This is reflected in the following quote: *"Usually, the preference for a brand is determined by the workpiece you have to make. This determines what the best options are in the machine you should purchase. It just depends on the workpiece you*

have to make." (Participant 1.1, production leader, 29:00-29:15). Furthermore, a supplier is selected based on previous experiences, partnerships, or because of obtained information from fellow entrepreneurs. The preference is to choose for a familiar supplier: *"For example, we have a press brake and we need a new press break, then we look at the same supplier."* (Participant 2.1, owner, 44:28-44:33). However, the preferred supplier is always compared with other providers, in order to check if the right decision has been taken. The evaluation of technologies is not formally done in practice. The degree of satisfaction with a supplier determines whether the supplier is considered in a subsequent purchase or not.

To conclude, it turns out that there is some overlap with the other two processes. In the strategic commitment process, commitment can be gained for a specific technology of a supplier. When this is the case, it implies that the technology choice can be almost fully placed within the strategic commitment process. This also applies to the purchase of a similar technology. When an organization is satisfied with the current technology, it is likely to choose for the same supplier and, therefore, the choice process can be limited. However, with new technologies, SME manufacturing firms are also likely to choose for familiar technologies and/or suppliers. The arguments of the financial justification process affect - just as in the strategic commitment process - all the phases. All choices are justified throughout the technology choice process. This means that there is also a huge overlap with the financial justification process. Besides, it turns out that there are also connections with the perceived usefulness of employees. This is included in defining priorities, in which, for example, the ease of use is reflected. Furthermore, there are connections with the impact of the technology on the organization. The perceived usefulness is included in this to a limited extent. However, it turns out that this is quite important with Smart Industry technologies.

4.1.3. Financial justification process

This stage in the process is about the justification of a technology. This can be subdivided into four types of arguments, which are illustrated in figure 10.

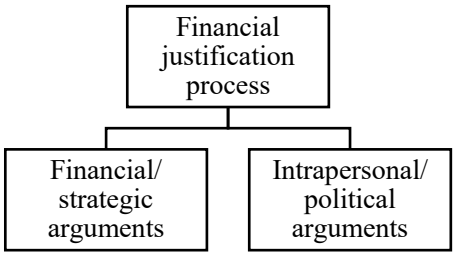

Figure 10 – Financial justification process

As became clear in the description of the first two processes, there is a lot of overlap of this process with the other two processes. It turns out to be that this process does not consist of separate activities, but emerges within the other processes. This situation is described below.

- Financial/strategic arguments

Throughout the strategic commitment and technology choice process, financial arguments are always of great importance. It plays a crucial role in deciding whether it is attractive and feasible to adopt a technology. Return on investment is often mentioned, however this does not necessarily have to be financial: "*If it is just the quality, the numbers produced, or that it is beneficial for the physical load for an employee. As long as it pays for itself in some way."* (Participant 2.1, owner, 28:27-28:35). There are a lot of family businesses in the industry which are less short-term focused, because they are not solely focused at generating quick money, but instead focus on the long-term financial vitality of the organization. This is reflected in the following quote, which shows that strategic advantage is more important than a correct return on investment within a few years: "*We really do not earn back a 3D printer in two years, but we do put it there so that we have an advantage in six years"* (Participant 3.2, operational manager, 14:50-15:01). Strategic arguments are also used throughout the processes to substantiate choices. Change towards Smart Industry technologies is becoming a necessity, because otherwise you cannot compete with competitors in the future. This is reflected in the following quote: "*And if you stay with people, let's say you keep that employee, there is a certain hourly wage for it and those costs are getting higher. So you have to go there if you want to survive as a company, it will have to be automated in some way"* (Participant 1.4, cooperating foreman, 50:53-51:11). The reason for adopting a technology is therefore not just a choice, but it can also be necessary for the long-term survival of the organization.

- Intrapersonal/political arguments

Intrapersonal arguments – in the strategic commitment process - mainly refer to the intrinsic interest of entrepreneurs in the new technologies. This can be related to the technical background of many entrepreneurs, which is represented in the following quote: "*Sometimes if you visit an event or you visit an entrepreneur, a fellow entrepreneur, then you sometimes wee something that you have never really thought about. Or something that actually does not fit in your company at all. Sometimes you just like that as an entrepreneur."* (Participant 2.1, owner, 40:26-40:42). Intrapersonal arguments are reflected in the technology choice process by having personal preferences for a certain technology and/or supplier. For example, the intrapersonal

preference to choose for suppliers that are familiar within the organization, or at least within the direct network of the organization. When looking at political arguments, this can refer to power relations with external parties in which the dependence on customers is important as decisive factor. The power of the customer is reflected in the following quote: *"I now have two machines running at work of two to three clients. Then we can say, one customer is responsible for 70%. So if he drops out or says take it easy with production, then we do have a serious problem."* (Participant 1.2, cooperating foreman, 10:51-10:08).

In addition, the relations with suppliers can influence the information about technologies and the choice for a technology. Suppliers can play a huge role in the provision of information and, therefore, in the choice for that technology. Besides external political arguments, also internal political arguments are of importance. This refers to the power relations within an organization, in particular the involvement of employees within the strategic commitment process and/or the technology choice process. Employees can be involved in the first phase for creating strategic commitment, or can be involved in the final decision making. However, ultimate power always remain with management.

4.1.4. Recapitulatory

It turns out, just as described in the theory by Langley and Truax (1994), that the processes in the technology adoption process are highly interrelated and take place rather parallelly than sequentially. Although the strategic commitment process and technology choice process are somewhat sequential, the financial justification process takes place almost fully within these two processes. It is dependent on the context and the novelty of the purchase to what extent the strategic commitment process and technology choice process are overlapping. The technology choice process can be limited in the case of a re-purchase or when an organization is focused on a specific technology of a supplier. Because of these findings, the process model of the technology adoption process can be visualized as is presented in figure 11. The strategic commitment process and technology choice are separate processes, although there is some overlap between them. The arguments of the financial justification are placed in the overlapping area, since these arguments are of value in both processes. The phases within the processes are visualized as separate consecutive phase, while, as described, some phases may not be formally followed or there might be (a lot of) overlap between the phases.

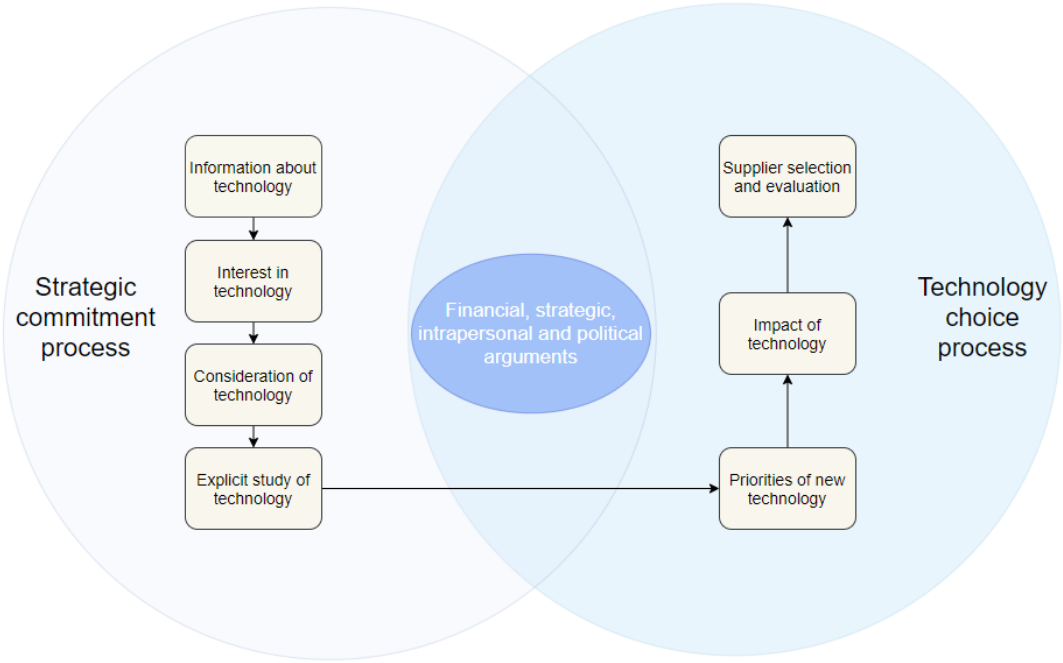

Figure 11 – Technology adoption process

4.2. Perceived usefulness

This paragraph outlines the results that refer to the perceived usefulness of employees working with the technologies adopted by the organization. The perceived usefulness is described using the three aforementioned indicators: technology makes the job easier, technology makes the job more useful, and technology increase productivity.

4.2.1. Technology makes the job easier

Whether or not a technology can make someone's job easier is further subdivided in the effort someone has to deliver physically and mentally.

- Physical effort

A lower degree of physical effort is highly related to the technologies that emerge from the developments of the Smart Industry. Technologies can take over some tasks of humans, which results in less physical effort being necessary for performing the job. An illustrative example of this with respect to a technology that took away the heavy lifting of steel plates which reduced the physical effort was provided by participant 2.1: "*So there is still manpower needed for operation, but less manpower is needed to physically do the job.*" (Participant 2.1, owner, 15:02-15:07). This is considered to be a positive point to the employees, because the heavy work does release them of burden: *"Yes I do think so and in special the repetitive acts what I said. That you make the same movement with your muscles every time is not good either."*

(Participant 1.4, cooperating foreman, 47:14-47:23) Another point is the number of actions that are reduced by the technology which make it easier to perform the job: "*So deviations become less and it also becomes easier for them to make a good product. These are all arguments that people are enthusiastic about."* (Participant 2.2, owner, 31:59-32:11). However, there are always people who love to do their skilled job and do prefer using their craftmanship over working with a robot. For those, some skilled work remain: *"The boring, repetitive work that was done by the robot or that was being automated. And yes, then you have still something that requires a little more craftmanship and that remained."* (Participant 3.1, owner, 33:38-33:51).

- Mental effort

One aspect that influences the mental effort is the change in the job structure. While much simpler, mind-numbing work disappears, more complex tasks arise. For many employees, this implies a change from production worker to the operator/controller of the production process. However, there remain some simpler tasks and, thus, tasks will shift: *"The moment you really do not like it anymore because work becomes much simpler, yes then the work will shift. Then you will get someone of a different level who likes the simpler work."* (Participant 3.2, operational manager, 47:09-47:23). The mental effort will also increase because people have to keep up with the latest developments, which can be hard for some employees: "*But yes, you also have people who at a certain moment may just not be able to keep up psychologically because there will be a new programming language of a robot or something else and what is new for them. And yes, learning itself becomes as people get older, it becomes increasingly difficult."* (Participant 1.1, production leader, 49:11-49:28).

So, the physical effort decreases, which is beneficial for employees since it becomes easier to perform their job. However, the mental effort increases, which causes a shift in work because tasks are becoming more complex and not everyone can keep up with that. The ease to perform the job also emerges in the phases 'interest about technology' and 'priorities of new technologies', as described in the technology adoption process. This implies that apart from people performing the job enjoying the ability to perform their job with less effort, management also considers it as being beneficial for the organization.

4.2.2 Technology makes the job more useful

Another aspect of perceived usefulness is the way in which a technology can make soneone's job more useful. This can be subdivided into two sub-indicators: job performance and valuable job.

- Job performance

As described previously, quality improvements in products and processes are crucial points for organizations in adopting a new technology. For employees, quality improvements are points of interest as well, which can contribute to perceiving a technology as being useful. New technologies arising from the Smart Industry are much more accurate and more consistent than humans. Therefore, human errors can be prevented as much as possible from the production process. It becomes easier for someone to deliver a high-quality product, which is considered as useful to the employee: *"So there it becomes easier for the employee to produce all high-quality products or products that are dimensionally stable. When you see all that, then acceptance also becomes easier."* (Participant 2.2, owner, 30:07-30:26). It turns out that not all employees share this perception. Employees can foresee problems with technologies, because problems can arise that are not noticed: "*He feels that and has a faster eye with, oh there is something there and not the dimensions are no longer good. And a robot is dumb, blind."* (Participant 1.3, ICT manager, 29:56-30:05). This can be an issue that is more common in the difference between the perceived usefulness of management and employees. Therefore, this can be an important point for explaining how a technology deals with such thing to align the perception between management and employees. When looking at the job performance of someone, this can be related to 'Technology makes the job easier'. Someone has to put less physical effort because of the technology that takes over some of the work. However, someone has to think more and is responsible for a larger part of the production process which increases someone's performance and contribution to the organization. This will only hold for the employees that are capable to perform these tasks,. Employees who cannot keep up with this, can still execute the somewhat simpler tasks. Overall, a technology will somehow help someone to perform better, but it is important for employees to understand the technology and use it right: *"Yes it has to, it has to improve the work, improve the quality, or it has to make the work easier. They have to understand the job. They need to know what to do to use that machine in the right way."* (Participant 3.2, operational manager, 39:20-39:43).

- Valuable job

As described previously, the mental effort increases, because of the more complex and different tasks arising from Smart Industry. Although not all people can keep up with the development, the general the perception is that their job will become more fun by the different challenge the

developments bring: *"I think it will only get more fun. If you continuously have to do the same thing all day long, which is of course very mind-numbing and monotonous work, then there is just 0.0 challenge."* (Participant 1.1, production leader, 42:45-42:57). As described at 'mental effort', the work tasks will shift. The ones that are able to keep up with more complex tasks can perform these and for the ones who cannot, still, some simpler tasks remain. Many skilled workers have a high interest in their job and have great affinity with the tasks they perform and the technologies they use. This makes that they are often quite interested in new technologies and it keeps them occupied, also outside of their regular job schedule: "*So that does not imply only working eight hours a day, but that also means reading up at home and preparing for what is to come. And yes, there are a lot of colleagues with me who do that."* (Participant 1.2, cooperating foreman, 33:39-33:50). This implies that the work is of high value for the employees, which makes it important for someone to be recognized in the work they do: "*I think that every person who works wants to feel like he matters. If you can achieve that, then I think it is interesting for everyone in his own field."* (Participant 3.1, owner, 51:17-51:33).

The job is getting more useful for someone, because it increases the job performance as well as the value of the job. Someone can perform more complex tasks by the technologies and, besides, the technologies ensure a higher quality, accuracy and quantity of someone's output. The job is valued to a greater extent by the employees, because the new challenges bring them more pleasure in doing their job. The employees are intrinsically interested in their job, the tasks and technologies, which makes that they do want to be recognized in their job. This can be realized by involving them in the organizational choices about their job, such as technology adoption.

4.2.3. Technology increases productivity

A technology can be interpreted as being useful because it increases someone's productivity. This is possible because the work is carried out more efficiently or effectively.

- Efficiency

Efficiency benefits are highly related to the adoption of Smart Industry technologies. As described before, technologies cause a shift in the performance of work. Technologies increase scalability because it is less human dependent. This is interesting for management in the sence that it reduces the costs per product, but also due to the fact that employees value a more efficient process: *"But that is really the challenge and you see that other people in the workplace see that as a challenge as well. To keep that machine running continuously, that is great fun."* (Participant 1.2, cooperating foreman, 06:15-06:22). These benefits are not always

clear for employees, since it is more about working smarter, instead of harder. This is evident from the following quote: *"Look indeed, you are much calmer in between activities. But in the end, you express three times as much as you did before."* (Participant 3.1, owner, 57:37-57:44). Although efficiency benefits can be at the expense of jobs, this turned out to be not the case with technology adoptions at SME manufacturing firms. In all cases, technologies helped the organization to grow and did not reduce the number of jobs*: "(...)and that is of course only just, we are in a growing company. So the fear that a technology will be at the expense of a job is actually not here."* (Participant 3.2, operational manager, 34:48-34:59). This is also confirmed by Mr Sol of TNO: *"Well actually it is mainly the first, that you can realize a higher production with the same crew."* (Mr Sol, TNO, 42:16-42:25).

- Effectiveness

Someone can interpret a technology as being useful if it increases the effectiveness of the tasks someone has to execute. Technologies make it possible to distribute work better over time. People cannot work constantly, but need several breaks and are sensitive to distraction. Therefore, while production involving people is interrupted and standing still, a robot works constantly at the same pace: *"And a robot is never ill, or never ill, it can require service. But it works on a constant pace that you have set for it."* (Participant 1.5, operational manager, 20:08-20:19). Besides, flexibility can be increased by a technology which itself is able to calculate how it will produce a certain amount of different products: *"Then everything has to come together in a random order, which you can of course prioritize. That you want certain workpieces, I want so many of them at the end of the week and then the software package itself calculates how often it has to put the workpiece in."* (Participant 1.1, production leader, 10:44-11:01). A good example was provided by one of the respondents, who told about a milling machine with a track in front of it: *"That is a kind of track of 14 meters long and there is a robot on it. The robot takes the products from the clamping station, puts them in a rack in the wall that we built ourselves. And then the machine and the robot can decide for themselves when a product is produced"* (Participant 1.5, operational manager, 16:46-17:13).

In short, it can be stated that, Smart Industry technologies increase productivity by enhancing efficiency and effectivity. This notion is confirmed by employees, who perceived those technologies as being useful for performing their job. Since this is also beneficial for organizations, it can be considered as being beneficial for both employees and management.

4.2.4. Recapitulatory

It has been found that there are some connections between organizational technology adoption and perceived usefulness. In technology adoption, the perceived usefulness of management is more or less included. It should improve their business and be beneficial for organizational outcomes. It may be concluded that this does not have to differ much from the perspective of the employees, since they usually also want what is the best for the organization. Smart Industry technologies fit with the perceived usefulness of employees, since it decreases physical effort and increases mental effort. Job performance increases by implementing these novel technologies and the more complex tasks associated with them. Furthermore, productivity increases in terms of efficiency and effectiveness, which is perceived to be beneficial for both the employees and the organization. Since both concepts are highly interrelated and Smart Industry technologies can be interpreted as being beneficial for employees as well as to management, the way in which organizations deal with these developments plays a key role. A deeper understanding of the relationship between technology adoption and perceived usefulness is discussed in the next section.

4.3. Relation between technology adoption and perceived usefulness

In the previous two sections, the two main concepts in this research are described in more detail. This section provides a deeper analysis of how both concepts are related to each other. The relation between technology adoption and perceived usefulness is central in this research, which makes it the most important aspect of the result section.

4.3.1 Relation between technology adoption and perceived usefulness

As described in the previous two sections, there are plenty of touchpoints between technology adoption and perceived usefulness. Based on other studies, it was already expected that the perceived usefulness (as part of technology acceptance) influences technology adoption (Davis, Bagozzi, & Warshaw, 1989; Taherdoost, 2019). The importance of this relation is underlined in this research by all participants. When employees do not agree with the choice for a technology, the attitude towards that technology is already negative. This results in unsuccessful technology adoption, which is reflected in the following quote: "*People were too eager to bring in something, by which we in the workplace already said that it should not be done because it is not going to work. That is pushed through anyway and in the end, it resulted in nothing"* (Participant 1.2, cooperating foreman, 43:25-43:38). So, the support of the people who have to

work with the technologies on a daily basis should support it: *"They must support that choice, otherwise it is of no use."* (Participant 1.1, production leader, 52:36-52:39).

Additionally, employees can have another, sometimes better, view on what is useful for their job. They can have a different view on the situation than management, which caused a huge improvement in the following situation: *"And in the end, another option was suggested by the department itself. Because of that, we could say goodbye to I believe about three lathes and we now all make that on that one newer lathe."* (Participant 1.1, production leader, 52:03-52:15). The knowledge of employees is also underlined from a managerial perspective, where the contrary relationship is mentioned: *"After all, they are also technically better informed than a board that is ultimately not technical. So, if you involve them and they know the options, you simply have a lot more support"* (Participant 1.5, operational manager, 01:09:43-01:10:04). Put short, the way technology adoption is executed, for example by involving employees, is considered to have an effect on the perceived usefulness. A negative attitude of employees towards a new technology is often blamed on the communication: *"Then it lacks communication. That the unknown is not good, then the point is missed."* (Participant 3.1, owner, 56:29-56:39).

The reasons for which an employee perceives a technology to be useful as compared to the way management perceives it, does not really differ. The aspects through which an employee perceives a technology as useful generally correspond to what management perceives as useful. Employees usually want what is best for the organization and want to help the organization improve. Moreover, employees are generally able to understand the thought of management when they are involved: "*Whether you are a management board or an MT, those guys on the floor are really not crazy. So if you just explain, yes one if of course a bit more jerky in the communication than the other and that could be why they do what they do. But they really are, they really get the gist."* (Participant 3.2, operational manager, 44:00-44:22).

So, the relationship between technology adoption and perceived usefulness can be interpreted as bidirectional. Moreover, there appear to be some factors that influence the way the relation manifests itself and whether this can be considered as a positive or negative influence. These characteristics are described in the next section.

4.3.2. Characteristics of the relationship

In the description of the previous section, it became clear that there is a bidirectional relationship between technology adoption and perceived usefulness. In that description, some

factors already emerged that have an influence on the relationship. In this section, the factors mentioned in the interviews are categorized into four variables, which are considered as key factors that influence the relationship. For technology adoption, 'creating understanding for change' and 'involving employees in technology adoption process' are the two variables that affect this concept. Perceived usefulness is affected by 'employee development possibilities' and 'educate people to work with technologies'. These variables are also underlined by Mr. Sol of TNO, who shared the opinion of the mutual relationship which is affected by several variables such as communication, creating understanding and the development of employees (Mr. Sol, TNO, 01:03:12-01:03:44). Paying close attention to all these four variables can create a reinforcing relationship between the two main concepts. This is visualized in figure 12 below.

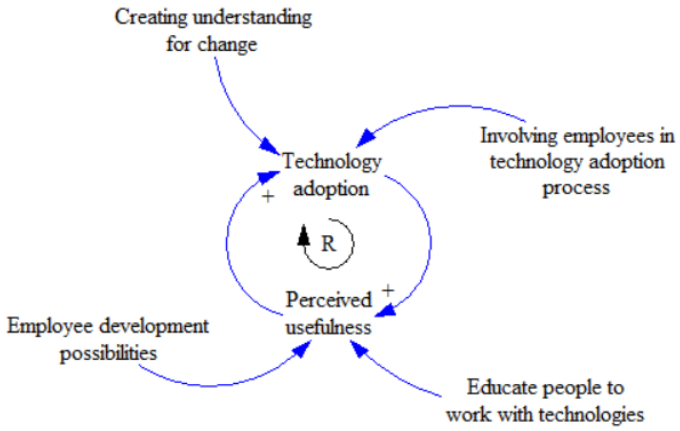

Figure 12 – Causal loop diagram with influencing variables

To support this causal loop diagram, the effect of each variable on the mutual relationship between technology adoption and perceived usefulness is described.

- Creating understanding for change

Although most organizations already pay attention to this, it is an important factor to include in technology adoption. Decisions should be substantiated and people within the organization have to understand what is changing and why. It turns out that new technologies of Smart Industry have a different impact on employees than previous adoptions. When a similar machine was purchased, people did not feel that this would change much for them. This is different with Smart Industry technologies, since it turns out that the first assumption of employees is that these technologies would take over their job. Therefore, people would think they could lose their job, which can cause panic in the organization. A good example was given during one of the interviews, where a welding robot was purchased and the communication

was, just as with previous technologies, to put a note on the notice board. It turned out that this kind of technology causes a different reaction: "*So we had not done the information properly. They all thought, that welding robot is coming so someone has to leave."* (Participant 2.1, owner, 13:05-13:11). When, in technology adoption, attention is paid to creating understanding for this adoption, this will influence the perceived usefulness of employees. As described earlier, a bad explanation can lead to resistance of employees. Therefore, it is important to give a good explanation to the employees and to inform them about the arguments why certain choices are made and how these will contribute to their job. Usually, automation techniques take away the least enjoyable part of someone's job. If this is communicated well, employees are more likely to embrace the technology: "*Yes, someone really does not like to spray the ashes clean, go over it with a cloth and put it in a container. If he gets a device for that, he will eventually only embrace it."* (Participant 3.2, operational manager, 35:09-35:24). A good explanation of a choice will, therefore, contribute to the usefulness and value of the technology for their job. Besides, it turns out that investments in new technologies, in general, are interpreted as being positive to employees: *"In general, people see it as positive when you invest because then your company grows. We now see that it can give a positive turn to happiness at work, motivation, involvement. (...) So generally, it gives a very positive vibe when something new comes along."* (Participant 2.1, owner, 35:31-36:15). For these reasons, it does not have to be very difficult to create understanding for a change. Employees want what is the best for the organization, they perceive investments as positive, and can perceive their job as more fun because of the technologies. With making these things clear, technologies will usually be perceived as useful and technology adoption will get more successful.

Although most people can have an understanding for a certain change, the fact is that there always remain people who are not ready for, or do not like, change. These should be taken into account in technology adoption. In general, people tend to dislike change. Therefore, it is essential to pay sufficient attention for creating understanding for change. This is something that needs time from employees, before they are able to understand and accept the change. A good example is provided by Mr. Van de Put of Metaalunie, who has seen several mistakes within manufacturing firms: *"People do not like changes. (...) That is the problem I often encounter in the workplace. For example, an entrepreneur who has been thinking about a new technology for six months. He shares his ideas in five minutes with the employees in the workplace. He is surprised that they are not very enthusiastic within a week, while it took him half a year to get excited about it. So you have to involve them in that process in time because*

you have to let the change processes take effect. (…) Then the next step and the next step so it can take effect in time, which can go quite quickly. But if you want to force it to drop quickly, you create uncertainty and resistance because people cannot think about it. That is logical." (Mr Van de Put, Metaalunie, 45:35-47:06).

An essential aspect for creating understanding for change are co-workers who already accept the change. When people see that others do accept a new technology and embrace the possibilities associated with it, this will also persuade others within the organization who are not yet convinced by the technology. Although creating understanding for change for one specific situation is already important, the real challenge is to create an overarching mindset for continuous change from bottom-up: *"The most important change I think is to change continuous and be open to and be open in continuous learning. (…) And then you can achieve the situation that when you do not change, people are saying: hey, why we do not change anything"* (Mr Van de Put, Metaalunie, 49:26-50:08). When employees understand the need for change, they get used to change in the organization, which is useful for future technology adoptions. Changing such a mindset is difficult. A splendid example of how this can be achieved is reflected in the following quote: (…) *we invited a visionary, a trend watcher. And he has sketched the world for ten years from now and everyone was on the edge of their seat. (…) And then they were all like, okay, say what needs to be done because we understand that the world is going to change. And that is nice. They were turned on by that, you know. Hanging back in the chair was over by then."* (Participant 3.1, owner, 35:41-36:11).

- Involving employees in the technology adoption process

As a second characteristic, the extent to which people are involved in the adoption process is discussed. This is an issue that is related to 'creating understanding for change', since involving people in the adoption process could probably lead to a better understanding for change. Involving employees in the technology adoption process brings multiple positive outcomes for an organization. The first potential outcome is related to employee satisfaction, in which the involvement of an employee contributes to the perceived usefulness and thereby to the happiness of that employee. This is reflected in the following quote, which also illustrates the relation between creating understanding and involving employees: *"If you inform people and include people in the processes because it is sometimes so difficult for people, the better you prepare or include them, the faster the acceptance. (…) What are the consequences, what are the positive effects, but also the disadvantages. And if you include them in the argumentation why you made that choice, acceptance is much faster. (…) Look that man who wanted a certain*

type is so committed. It really became his child. He wanted that and he is completely in love with that, which is beautiful. He is so committed, he goes all out for it." (Participant 2.1, owner, 01:15:39-01:17:00).

Besides the direct effect of involving someone in the adoption process, indirect effects can also be achieved. As mentioned in the section 'creating understanding for change', people are likely to look at others in the organization for their perception of a change within the organization. When they see that a colleague, whom they trust and respect, embrace a certain technology, they tend to be more likely to embrace the technology themselves as well. Thus, it can be concluded that involving employees in the technology adoption process has a direct and indirect influence on the perceived usefulness. This is of importance for understanding the relationship between technology adoption and perceived usefulness.

Another objective that can be achieved by involving people in the technology adoption process is related to achieving the best outcome in decision-making for that organization. Someone in a management position can be a great engineer and can have a good feeling about the situation in the workplace, but might not know everything that is required or what is the best for that specific situation. By including people from the workplace, a holistic understanding of the wishes and needs can be obtained, which can be used to make the best decision in technology adoption. Therefore, including people in the adoption process would lead to better outcomes for the organization: *"Yes I always say, I also do not have all the knowledge. If I make a choice by myself then I do this of course on good faith, but I do not have all the knowledge, we have that together. So by talking to employees and putting proposals on the table, we set something in motion which makes other people think too."* (Participant 1.1, production leader, 55:42-56:06).

A third crucial aspect is the importance of employees for an organization. Although technologies further evolve and are increasingly able to take over tasks from people, the success of a technology is still defined by the employees who work with the technology. In principle, any organization can purchase a technology, but the way employees work with it and the attitude of them can make a difference with competitors. Thus, employees can be a source for a sustainable competitive advantage, which makes it important to involve those people into the adoption process of a technology. This is evident from the following quote: *"The moment you facilitate and give energy and give the other space to also put that energy in it. Yes, then you get ahead. Ultimately, it is the people who help your company move forward and not that cobot."* (Participant 3.2, operational manager, 27:23-27:38). The importance of people within

manufacturing firms is further emphasized by Mr Sol of TNO: *"So that indicates that the human factor is much more important in such an environment than you think. (…) they are the only ones who can ensure that learning effect and increase productivity." (Mr Sol, TNO, 01:04:53-01:05:08).*

In conclusion, it has been found that involvement in technology adoption is important for as well the organization as the employee. Hence, if the knowledge level of an employee allows it, an organization should always take him seriously in the organization and organizational decisions such as technology adoption. The employees usually want what is the best for the organization and, if they are involved, this will even contribute to the organizational commitment.

- Educate people to work with technologies

As previously stated in the 'involving employees in the technology adoption process' section, the way in which employees deal with new technologies is decisive for the success of that particular technology. This is related to this variable, since it is related to teaching the people how to work with a new technology. This can influence the perceived usefulness of a technology, as it ensures that an employee understands how to work with such a technology. Once someone is educated about the use, possibilities, and improvements that can be realized due to that technology, the technology is likely to be better absorbed. This is further substantited by the following quote: *"It is actually not about to print 3D, yes that is also a profession, but the real challenge is to show all other engineers the possibilities and the potential and conditions. By this, they can learn to deal with it so that the technology can be actually absorbed later on."* (Participant 3.2, operational manager, 10:42-11:01). Mr. Van de Put of Metaalunie has also experienced that mistaked have been made by simply deploying a new technology within the organization: "*Involve the welder in the choice for the welding robot and give him an appropriate training to work with it. Then, when the robot comes, the welder will be curious and prepared to work with the robot and the robot will be successfully deployed very quick."* (Mr Van de Put, Metaalunie, 55:35-55:54).

These training and courses are often offered by suppliers of the technologies to obtain the best information for that specific technology. What often happens is that, at first, leading employees within a task group get educated on the specificities of the technology to be implemented: *"And you just know that the skilled professional will be the first to operate that robot. (…) Then you can tell to him to train some other people because then you can put him in another place."* (Mr

Sol, TNO, 30:04-30:21). In this way, the ones with the best knowledge capacity and experience are triggered to work with the new technologies. Once they master it, they can train other employees to work with it, so that they can then be deployed for other tasks.

A main difficulty that organizations face regarding the education of new technologies is the difference between generations. Young people have grown up with technologies and can therefore easily switch to new technologies, as well as understand them much quicker than older people. The latter have a lot of work-related knowledge, but can struggle with the new interfaces and the operating mode of the technology: "*Young people, for example, can think very quickly, switch very quickly. (...) People say over 50, I think these are exceptions who can. So if you are going to automate a company, also in the field of ICT, that is difficult. Not everyone can participate in this."* (Participant 2.1, owner, 01:08:53-01:09:25).

- Employee development possibilities

The fourth variable that affects the relation between technology adoption and perceived usefulness is related to options for the development of employees. As described at 'valuable job', employees are often intrinsically motivated to do their job. This can be ascribed to the fact that employees are not only occupied with their job during working hours, but also in their spare time. It differs per person, but it turns out that most of the employees aim to develop their skills and knowledge. The following quote underlines that everyone needs to be triggered in order to develop: *"Folks, you will surely die mentally when you are not stimulated. (...) I notice that everyone is actually happy with progress. And of course, we also have few people who are really cautious about first seeing before believing."* (Participant 3.1, owner, 46:24-47:03). It will differ per person how much one wants to be and can be triggered, but in the end, everyone wants to have some sort of trigger: "*I have to be challenged every day. But not everyone has that. Not everyone is the same and that does not have to be"* (Participant 1.2, cooperating foreman, 34:51-34:58).

The organization benefits from this situation, since a well-developed employee has more skills and knowledge which could be used in the work one does. Besides the increased performance by development, someone's job satisfaction could also increase by this. As described above, people need and want to be challenged by the organization for better performance. When this is possible, for example through training and courses, they will value their work more and cause an increase in job satisfaction. Because there is a shortage of skilled personnel, and employees within the organization are still the ones who decide the success of technologies for the

organization, it is important to keep these people on board. This can be achieved by fulfilling the needs of the employee, including the employee development possibilities. Besides this, further developed people will understand new technologies and the necessity of it even more. Therefore, this can contribute to the perceived usefulness of new technologies. Mr. Sol of TNO also expects that developing employees will be of more importance for the organizations to remain future proof: *"So my guess is that bosses will invest more and more in their own employees so that they can keep going. And if in 2-3 years' time increasingly complex equipment will be installed, those employees will be prepared for it and have the opportunity to receive additional training. That the welder will soon be able to handle a welding robot. Because if you do not do that, he will not get a new welder on the job market."* (Mr Sol, TNO, 36:00-36:29).

4.3.3. Recapitulatory

The relation between technology adoption and perceived usefulness turns out to be bidirectional. The perception and support of employees are necessary for successful technology adoption, but the way technology adoption is performed can highly influence the perceived usefulness. In technology adoption, the perceived usefulness from a managerial perspective is usually related to the aspects they think are relevant for the organization. These aspects do not necessarily have to differ much from the perceived usefulness of employees, since they also want what is the best for the organization and want to improve their work and, by that, the organization. Communication is key in this relationship. The characteristics that affect this relationship can be categorized into four variables. Creating understanding for change and involving employees in the technology adoption process creates a better understanding and alignment of the preferences of management and employees. Furthermore, it is important for employees to be able to understand the technology and what is going on in the industry. Therefore, education to work with technologies contributes to the perceived usefulness, just as employee development possibilities.

5. Conclusion and discussion

This chapter starts by providing an answer to the research question as described in the first chapter. Thereafter, the theoretical and practical contributions of this research are described. Finally, the limitations of this research are described and options for further research are provided.

5.1. Conclusion

Central in this research are the concepts technology adoption, perceived usefulness, and the relation between these two concepts. The following research question has been formulated for the description of how this relationship takes place in practice:

"*How do technology adoption and the perceived usefulness of Smart Industry technologies affect each other within SME manufacturing firms in the Netherlands?*"

To answer the research question, technology adoption and perceived usefulness are studied separately and the relationship between both is investigated. Regarding technology adoption, it can be concluded that the three processes, and phases within these processes, are not always formally followed within SME manufacturing firms. The strategic commitment process and technology choice process are somewhat sequential, although there can be a certain overlap. When strategic commitment is created for a specific technology of a supplier or if a similar technology is purchased, the technology choice process can be limited. In new purchases, or in situations in which there are many providers of such technologies, the processes can be regarded as being more consecutive. However, there is still overlap, since the areas that arouse interest or count as decisive factor in the strategic commitment process correspond to the priorities in a new technology and to the selection of a supplier in the technology choice process. The arguments in the financial justification process are strongly reflected in the other two processes and are, therefore, not considered as being part of a separate process in technology adoption. As a result, the technology adoption process can be reduced to two processes instead of three.

It has been found that the perceived usefulness from the perspective of employees does not differ much from the managerial perspective. People appreciate the fact that their job requires less physical effort, while the required mental effort increases, due to more complex tasks that follow from implementing Smart Industry technologies. The job performance of the involved employee increases through the more complex tasks and the process improvements that these technologies bring. People generally value their job more, because they enjoy the challenges that technological developments bring. Furthermore, efficiency and effectiveness of tasks

increase, which is beneficial for both the employee and the organization. Organizations value the fact that the costs per product can be decreased and employees enjoy the fact that their work is getting more efficient and effective, resulting in them being able to easily produce a higher number of products.

The relation between technology adoption and perceived usefulness turns out to be bidirectional. The perception and support of employees are necessary for successful technology adoption, but the manner in which technology adoption is performed can also affect the perceived usefulness. Both concepts affect each other over time, which can be seen as a feedback loop between the two concepts. There appear to be four variables that affect the feedback loop, which can cause it to become a reinforcing or balancing feedback loop. Whether the feedback loop becomes reinforcing or balancing depends on the degree of attention that is paid to the interpretation of the variables. Two variables can influence the relation of technology adoption on the perceived usefulness, which are 'creating understanding for change' and 'involving employees in technology adoption process'. The other two are 'educate people to work with technologies' and 'employee development possibilities' and influence the perceived usefulness and, thereby, the relation to technology adoption.

When people within the organization are informed about the arguments, or about the necessity for change in technology adoption, this will positively influence the perceived usefulness. People generally tend to dislike change, and when there is no understanding, people will turn against the change, which causes a less effective technology adoption. This is especially the case with Smart Industry technologies, which create the assumption to employees that the technology would take over their job. Therefore, creating understanding is a crucial part of this process. Understanding for change can even cause a situation in which people in the organizations are used to change and, therefore, constantly are looking for improvements in the organization. Involving people in the technology adoption process also has a positive effect on the perceived usefulness of new technologies. It can be related to 'creating understanding for change', because when people are involved, they will have a better understanding of the arguments and considerations that are made in the choice for a technology. It has been found that when employees are heard, involved, and taken seriously in their opinion, this will generate a certain sense of free choice for a certain technology for the employees. This increases the perception of the usefulness of a technology. Besides, employees working with the technologies can have the best view on work-specific priorities that have to be taken into account and on problems they currently face in their job. Knowledge is spread throughout the organization and

involving different actors with knowledge in different knowledge areas would lead to a more successful technology adoption. A technology can, in principle, be bought by every organization. However, the way people work with these technologies and the attitude towards them can vary, as opposed to their competitors. Therefore, using this knowledge and paying attention to the perceptions of employees will positively influence the relation between technology adoption and the perceived usefulness.

The way employees deal with technologies influences the success of a technology, which makes it important to educate people on how to work with technologies. When people are getting in touch with technologies in the early stages of technology adoption, they become curious about the technology and how it can be used in practice. At the moment the technology is actually implemented in the organization, they are already educated on the technology and know-how to work with the technology and the possibilities of it. This, in turn, results in an increase in perceived usefulness towards the technology. In particular, attention should be paid to older workers, as they may be reluctant to have a favourable attitude towards new technologies, because they may have less affinity with the working of technologies. When several skilled employees are educated, they can educate other employees and this, in turn, increases the perceived usefulness, which affects the potential success of the technology positively. Employee development possibilities, in general, also play an important role. People like to be challenged in their job, to get the best out of themselves. For some this is more visible than for others, while interest in personal development will differ per person. However, everyone needs some sort of trigger in their job. Most employees are intrinsically interested in their job and want to improve their knowledge and skills in their job. Because work is continuously changing, especially through the developments of Smart Industry that revolutionize the industry, employee development possibilities help to increase the perceived usefulness and in turn the technology adoption. Employees generally do like their job more when there are development possibilities offered by the employer, which is also beneficial for the employer, since they then have higher-skilled employees in their organization. There are indications that higher-skilled employees, in general, have a higher tendency to leave the organization. However, satisfied employees are generally more inclined to stay at the organization, which is mostly the case for those higher-skilled employees with development possibilities.

The feedback loop between technology adoption and perceived usefulness can also become balancing when too little attention is paid to (one of) the variables or when (one of) these variables are missing. People tend to follow each other in their actions in which such a situation

got worse and worse until there was severe resistance at the workplace. Employees are no longer willing to commit to a technology and the gap between management and employees is widening. This leads to a situation where there is no trust between management and employees, which will cause future technology adoptions to fail. The organization runs into problems, because it cannot keep up with competitors who are able to implement Smart Industry technologies. The production process of competitors is getting more efficient and effective and there is a better alignment between management and employees. This can be seen as a vicious circle where the situation gets worse until the organization is no longer able to survive. So, when organizations do not pay sufficient attention to the four variables, the relation between technology adoption and perceived usefulness can become balancing instead of reinforcing. Because of this, the relationship between both concepts can be regarded as highly important, as it determines the success of an organization. Although the direct result of it is not always immediately visible, the chain of reactions that accompany it has a large effect over time.

5.2. Theoretical contribution

Earlier studies of Taherdoost (2019) and Davis et al. (1989) underlined that perceived usefulness, as part of technology acceptance, leads to more successful technology adoption. The contrariwise direction was not yet described in research, although the expectation was that the way technology adoption is performed would also affect someone's perceived usefulness of a technology. It turns out that the relationship between these two main concepts is indeed bidirectional, which means that both concepts affect each other over time. This research confirmed the existing theory concerning this topic and, besides, it enriched the theory by unravelling the bidirectional relationship between the two concepts.

In addition to the contribution of this static relationship, a significant contribution is made by making the used theories more dynamic. The studies of Taherdoost (2019) and Davis et al. (1989) presented mainly static and timeless models, which have been made dynamic in this study. The relation of perceived usefulness, stated in these models, is related to technology adoption and gives insights on how this can be affected and change over time. Each concept affects the other over time and by this change, it will change itself as well. Figure 13 in chapter 4.3.2. presented a causal loop diagram, which visualizes this relationship with four variables that have an influence on this relationship. These affect the two main concepts in this research and can cause a reinforcing, or balancing, feedback loop over time. Although the positive effect on this relationship is mainly included in this research, it can also become negative. A worse

technology adoption causes less perceived usefulness which, in turn, only makes technology adoption worse.

Moreover, the theory by Langley and Truax (1994) is further elaborated and tested in an SME manufacturing firm context. Although the theory emphasized the dynamic relationship between the three sub-processes of the technology adoption process (strategic commitment, technology choice, and financial justification), this is further conceptualized in this research. It appeared that there is a high degree of overlap between the sub-processes and the phases within these sub-processes. Figure 10 in chapter 4.1.4. showed that the strategic commitment process and technology choice process are somewhat sequential, but the financial justification process takes place within these processes and is considered not to be a separate process. With regards to the phases within these processes, stemming from the theory by Segars and Grover (1993), it appears that some of these phases are not formally followed, but rather have a more informal character within the SME manufacturing firms. It differs a lot depending on the context of the technology adoption how much overlap there is and how extensively the processes, and phases within these processes, are followed. By this, a deeper understanding is created in the way these theories take place in practice within SME manufacturing firms.

5.3. Practical recommendations

Most SME manufacturing firms in the metal industry are founded by engineers who started for themselves and not by business experts. In addition, there are many family businesses in the industry. This implies that many organizations are quite practical and do have more knowledge regarding the products and techniques than regarding the ability to run an organization and to deal with personnel. This study pays attention to two aspects that are of crucial importance for business operations, namely the technologies and the personnel that work with these technologies. It provides insights and tools for entrepreneurs within SME manufacturing firms, especially in the metal industry, that can help them improve their business. Additionally, it helps them to deal with the adoption of Smart Industry technologies that revolutionize the industry. In this section, recommendations are provided on how an organization can use the four described variables to establish a good relationship between perceived usefulness and technology adoption.

A recommendation that is related to ‘Creating understanding for change’ is to keep employees informed about the developments in the industry. Organizations can use internal or external events that explain what is happening within their field and how this will change the industry.

Employees will sooner understand why the organization is considering a certain technology in case an organization is considering purchasing it. Afterwards, understanding should be created for the specific technology in the organization. Employees have to understand why work is changing and why this could potentially be beneficial for performing their job. Most technologies are adopted because it somehow improves the organization, which implies that usually there are good arguments for adopting a technology. These arguments should be shared with employees, in order to ensure that they fully understand the purpose of the technology. Although it may seem inefficient at first, because creating understanding can take a lot of time, this is really important in the long run. Technologies are better adopted in the organization and employees are more satisfied when they understand the purpose of the technology and feel involved.

A recommendation for 'Involving employees in technology adoption process' is to include employees into the early stages of technology adoption. With regard to the processes of technology adoption, they should be included from the consideration phase in the strategic commitment process. The information regarding technologies and the interest in technologies can remain for management, since they have more contacts with suppliers and understand, from a helicopter view, what could be interesting for the organization. However, there should be room for input of the employees. In the consideration phase, employees should be involved to find out their vision on the technology, so they can use their practical knowledge. Thereafter, they should be included in decision-making and into the technology choice process. They know which features would be most relevant for performing their job, which can provide valuable insights in defining priorities for a technology. Employees should also be included in the impact of the technology on the organization, since they can estimate what the effect of the technology will be in the workplace. For supplier selection, less employee involvement is required. The management has greater knowledge regarding the considerations for choosing a specific supplier and the preferences of employees would follow from the input of employees in the previous phases. In practice, not always all phases are formally reflected, but it is important to always include employees slightly, to prevent them from feeling left out in technology adoption. When a technology is re-purchased, employees will understand that not all phases need to be completed in detail. So when this is communicated, they still feel involved.

With regard to 'Educate people to work with technologies', it is important for employees to get in touch with the working of a technology before it actually arrives. This can be realized by planning courses and training for operating the technology. Suppliers can often offer such

courses to teach people to work with these technologies and teach them what the related possibilities are. When the technology is actually implemented, they are curious to bring their knowledge in practice and can immediately make good use of it. Some money and time of employees should be invested in advance, but this will result in a better use and perception of the technologies in the future. This will eventually outweigh the investments made in advance.

'Employee development possibilities' are increasingly important with the advent of Smart Industry technologies. Various simple tasks disappear, since they are taken over by technologies and more complex tasks arise. Executive employees become operators of the production process, which dramatically changes their job. It is beneficial for both the organizations as well as for their employees to develop employees to be ready for such changes in their tasks. Organizations can put them in other places and are able to deal with the shortage in the labour market, while employees enjoy progress and do generally like more complex tasks. This only holds for the employees who are capable to perform these tasks. However, the assumption is that many of the employees are able to pick up other tasks when they are properly guided in this respect. Such courses and training can be provided by the organization itself or, when knowledge or human resources for this are missing to guide them, external parties can be engaged.

If these variables are properly interpreted, this should lead to a good relationship between technology adoption and perceived usefulness. It turned out that the perception of management and employees did not necessarily have to differ much. When both perceptions are aligned by paying attention to the four variables, several beneficial outcomes can be achieved. This is related to short-term benefits as well as to long-term beneficial outcomes. In the short-term, people are more satisfied, engaged in their work and are performing a better job, since they make better use of the technologies. In the long-term, competitive advantages can be achieved by investing in the skills and knowledge of employees. Skilled personnel can be retained, which is of high value as there is a shortage of skilled personnel. Therefore, organizations should pay close attention to their most valuable resources: human resources. Technologies can, in principle, be acquired by all organizations, but the people working in the organization contribute to decide the success of it. In addition, work plays an important part in the lives of employees and they care much about the work they do. This makes it important to make them feel appreciated, make them part of organizational decisions, and value them for their organizational contribution. Since the phases in technology adoption are not all formally followed, it is difficult for organizations to place the four variables in this process in order to

align employee and management perspective. However, the variables are fairly flexible and not specifically tied to any of the phases. This will therefore not pose a problem in practice.

In conclusion, organizations must take into account the relationship between technology adoption and perceived usefulness and the variables that influence this relationship. By keeping this in mind, future technology adoption will become more successful and organizations and its employees improve.

5.4. Limitations

A first limitation refers to the data set. The intention was to compare different people within a few organizations that are involved in the production process. This would differ from employees working in the workplace to the director of the organization. Only in one case, it was possible to speak with people working in the workplace, in the other two cases only people with a management position were interviewed. Therefore, the vision on the relationship may be biased by a management perspective. Because the perception from management generally also emerged among the employees, this is expected to have a low impact on the outcomes. Management looked critically at the relationship and was able to substantiate their expectations from contact with employees, but it remains an expectation.

Another limitation is the transferability of this research. The research is aimed at SME manufacturing firms in the metal industry, but it cannot be ensured that the results hold for all organizations within this industry or within other industries. Organization 1 and 2 of the focus organizations could be compared quite well, but organization 3 operates in a slightly different context. This has to do with the size of the firm, the progress in Smart Industry developments and the type of customers served. Organization 1 and organization 2 both have approximately 50 employees working within the organization, while organization 3 has about 200 employees. Organization 3 belongs to the group of the forerunners in the field of Smart Industry in the east of the Netherlands and is also involved in a platform that aims to create a smart and clean industry in the east of the Netherlands. Organization 1 and 2 both processed different types of metal and adapted them to the wishes of the customer. Organization 3 has a specific product and only adapts these slightly to customer demands. This makes a difference in technology adoption, since the motive for adopting a technology is different. Organization 1 and 2 were more customer dependent, where organization 3 could focus more on improving their own process. Although the technology adoption process was somewhat different, the relation between this process and the perceived usefulness did not differ much. The same variables that

have an impact on the relationship emerged, although the perceived usefulness could be achieved more rapidly within the context of organization three. This has to do with the fact that there is a specific product that is produced with technologies that support them in the production process. Employees have a broader overview over the process, whereby understanding can be created more easily, because employees understand the purpose of the technology quicker. By interviewing two industry experts, who were able to provide an industry-wide picture, a deeper understanding was gained concerning the differences between the organizations and how this relates to the whole industry. It is therefore expected that a reasonably good picture has been obtained of the industry, while taking into account the differences between organizations.

A third limitation is that less information may have been gathered by conducting interviews via Skype or by telephone instead of conducting them face -to-face. In personal interviews, non-verbal signs could be better interpreted and a better picture of the context could be gathered by seeing the organization and the people in real life. Due to Covid-19, personal interviews were not possible, which make it a limitation beyond the control of the researcher.

A fourth limitation has to do with the fact that this research is conducted cross-sectionally and not longitudinally. Comparisons are made at a single point in time instead of making comparisons over time, which was also not possible to perform in the limited time frame in which this research was ought to be conducted. There are some suggestions that perceived usefulness and technology adoption influence each other over time. This is based on the information gathered in this research, which is referred to the way it has affected previous technology adoption. However, it cannot be stated with certainty that this causal relationship becomes reinforcing or balancing, as no longitudinal study has been conducted.

Translating the information out of the interview from Dutch into English constitutes the fifth limitation. Original information had to be translated, so there is a danger that information has been lost in translation. To avoid this, the interview quotes used in the results section were also translated by a fellow student. These were compared to ensure that the meaning of the information was not lost in the translation. As a result, it is not expected to have much influence on the internal validity of the report.

A final limitation tied to this research has to do with the theories used in the research and the demarcation of the research. In the research, the main theories date from a long time ago. The theory about perceived usefulness dates back to the year 1989 (Davis, et al., 1989) and the theory about technology adoption dates back to the year 1994 (Langley & Truax, 1994). As

much is changed since then, it should be stated that other factors could be of importance for technology adoption or the perceived usefulness. However, the factors in these models proved to be still applicable for the concepts in this research. Additionally, other important concepts that arose out of the data were included in this research. This refer to the four variables that affect the relationship between technology adoption and perceived usefulness. This shows that the models were reasonably representative of the current situation and that important variables which fell outside these models were also included in the research.

5.5. Future research

Based on the limitations, there are some suggestions for future research. The first suggestion has to do with the data set. In future research, more attention could be paid to the perception and view of the employees concerning the usefulness of technologies. Although it turned out to be difficult to get in touch with employees working in the workplace, these people could provide valuable insights. Another suggestion is to investigate if the findings of this research also hold for other organizations in the manufacturing industry. While the focus of this research lies on SME manufacturing firms, the outcomes of this research are specifically aimed at these organizations in the metal industry. As described previously, there were some differences between organizations within this scope. Despite the fact that these differences emerged within the way technologies were adopted and in the perceived usefulness, the relationship between both and the variables that affect this relation were similar. It is likely that, by investigating the relationship at other manufacturing firms in different industries, more differences will emerge. Therefore, it is interesting to investigate how this is situated within other industries and if the relationship is similar within other industries. When similar results emerge, the results can be broadened beyond the metal industry.

This research is conducted qualitatively, in order to obtain deeper insights in the relation between technology adoption and perceived usefulness. By testing these results quantitatively within the industry, it becomes possible to find out how representative the results are for the industry. Therefore, a suggestion for future research is to conduct such a research quantitatively, in order to find out with more statistical certainty that the causal relation takes place within the industry. This could be done by performing regression analysis between the main concepts, technology adoption and perceived usefulness, and with use of the four variables as moderating variables. This makes it possible to check how these variables influence the relationship. Another suggestion regarding methodology is to perform a longitudinal study instead of a cross-sectional. one This study is conducted cross-sectionally, which implies that it is done at a single

moment in time. By conducting a longitudinal study, more insight can be obtained about the suggested reinforcing relationship between technology adoption and perceived usefulness. The current results are based on examples from the past, but it is not sure how the dynamic in the relationship actually takes place over time. This can be achieved by having several cases where the complete technology adoption process is followed, which makes it possible to interpret how the six constructs take place over time within the cases.

A final suggestion for future research is a study on more variables that can affect the relationship between technology adoption and perceived usefulness. In this research, four variables were identified that influenced this relationship. However, more variables can be of importance in this relationship that are not clearly recognized in the interviews. Somewhat more contextual factors can be included in future research. Suggestions are to investigate how organizational culture influences the relationship. To give an example, comparing organizations whose management has a technical background with organizations whose entrepreneurs have a business administration background could provide valuable insights. Arguments in the result section were related to the technical background of the founders, which can be further elaborated in studies comparing organizations with a different background. Other factors that can be included in future research are, for example, how the organizational structure affects the relationship or how the knowledge capacity of the employees affect the relationship. A future study could aim at exploring how these, or other factors, influence the relationship between technology adoption and perceived usefulness. This can provide insights into the differences between manufacturers and how this affects the relationship. Such a study could be performed by comparing several cases with an assumed positive and negative feedback loop in the relationship. In such a way, light can be shed on how the dynamics with regard to the four variables really take place. This makes it possible to investigate whether there are more variables that have an influence on the relationship, or whether the variables stated in this research are actually present and if these are still mutually related. The theory resulting from this thesis can thus be tested by performing such a study and this theory can possibly be enriched by such a future study.

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Appendix A: Interview guidelines

Naam

Functie

Organisatie

Introductie onderwerp thesis, interview en vertellen wat er gebeurd met de uitkomsten uit het interview.

1. Hoe lang bent u al werkzaam bij ….?
2. Kunt u wat meer vertellen over uw organisatie en de rol die u hierin vervult?
    a. Core business
    b. Manier van werken
    c. Producten
    d. Klanten
    e. Medewerkers, aantal en verdeling kantoor, uitvoerend personeel etc.

Smart Industry

Bent u bekend met de term ‘Smart Industry’?

➔ Zo niet, toelichten:

3. Wat is uw houding ten opzichte van deze nieuwe technologieën die voortkomen uit deze industriële revolutie?
4. Beschikt u al over deze technologieën?
    a. Zo niet, bent u hier geïnteresseerd in? Waarom of waarom niet?

Verdere introductie centrale concepten. Verwijzen naar specifieke voorbeelden van eerdere technologie adopties.

<u>Strategic commitment process</u>

5. Hoe komt u tot informatie over nieuwe technologieën?
    a. Wordt dit bijvoorbeeld aangeboden of gaat u hier zelf naar opzoek
    b. Kunt u hier een voorbeeld bij geven?
6. Welke punten in nieuwe technologieën wekken de interesse of waar wordt op gezocht?

    a. Welke punten zorgen er juist voor dat er niet meer door wordt gezocht en wekken dus geen interesse?
7. Wat maakt dat u gaat overwegen of een nieuwe technologie geschikt is voor de organisatie?
    a. Hoe verloopt dit proces en wie zijn hierbij betrokken?
    b. Voorbeeld?
8. Waar hangt het van af of jullie meer tijd en energie gaan steken in het nader uitpluizen van de mogelijkheden en inzetbaarheid van een bepaalde technologie? Hoe komt dat besluit tot stand?
9. Wat geeft de doorslag om te onderzoeken welke technologie/aanbieder het meest geschikt is? De factoren die ervoor zorgen dat het niet de vraag is of er een technologie wordt aangeschaft, maar welke.
    a. Welke personen zijn betrokken/hebben invloed op dit proces?
    b. Voorbeeld?

<u>Technology choice → kijken naar specifiek voorbeeld in de vergelijking etc.</u>

10. In de keuze tussen verschillende technologieën, wat zijn de belangrijkste punten die in overweging worden genomen?
    a. Waar worden deze punten op gebaseerd?
11. Zou u van deze punten een hiërarchie kunnen maken in prioriteiten voor de technologie?
    a. Vanwaar deze hiërarchie?
12. Waar wordt naar gekeken bij haalbaarheid van de technologie?
    a. Hoe wordt dit beoordeeld? Welke factoren/welke personen?
13. Hoe wordt er bekeken wat de impact van een nieuwe technologie op de organisatie kan zijn?
    a. Wie zijn hierbij betrokken?
    b. Wordt er enkel naar harde gegevens (cijfers) gekeken of ook naar het menselijke aspect?
14. Waar wordt naar gekeken bij de keuze tussen verschillende aanbieders? (dus niet de technologie)
    a. Hoe worden aanbieders met elkaar vergeleken?

15. Hoe worden de punten geëvalueerd en hoe wordt een technologie/aanbieder geselecteerd?
    a. Welke punten zijn cruciaal in het kiezen van een technologie/aanbieder? Welke hebben een ondergeschikt belang?

Financial justification

16. Hoe belangrijk is de huidige strategie voor de nieuwe verantwoording van de technologie?
    a. Welke strategische argumenten zijn belangrijk om een technologie goed te keuren?
17. Welke financiële argumenten zijn belangrijk?
    a. Terugverdientijd, winst op product, waar wordt naar gekeken?
18. Welke van deze argumenten zijn het meest doorslaggevend bij het rechtvaardigen van de technologie?
    a. Hoe verhouden de strategische argumenten zich tot de financiële argumenten en hangen deze met elkaar samen?
19. Hoe gaat deze weg tot het goedkeuring van een technologie?
    a. Welke personen zijn hierin betrokken?
    b. Wat zijn de verschillende rollen hierin?
    c. Hoe is de wisselwerking tussen persoonlijke argumenten? Welke wegen zwaarder en welke minder zwaar?

Perceived usefulness

➔ Introductie betekenis perceived usefulness in dit onderzoek.

20. In het kader van de nieuwe technologieën, hoe denkt u dat dit de werkwijze voor de productiemedewerkers verandert?
    a. Hoe schat u de impact hiervan op de medewerkers?
    b. Wat denkt u dat zij hiervan vinden?
21. Wanneer ziet u persoonlijk, los van de organisatie, een technologie als zijnde bruikbaar?
22. Wat zijn denkt u de punten waardoor een productiemedewerker een technologie als bruikbaar ervaart?

23. In hoeverre wordt de bruikbaarheid van de technologie voor de medewerkers meegenomen in de besluitvorming?
24. Waar wordt dan op gelet?
    a. Wordt het werk er voor hen makkelijker op?
        i. Fysieke en mentale inspanningen → aantal acties die vereist zijn.
    b. Denkt u dat de medewerkers het als bruikbaar ervaren?
        i. Verbetert het de werkcondities?
        ii. Verbetert het de werkprestatie?
        iii. Verbetert het de waarde van de baan voor de medewerker?
    c. Verbetert de technologie de productiviteit van de medewerkers?
        i. Op welke manier? In termen van effectiviteit of efficiency?
25. Hoe verhoudt de bruikbaarheid voor de medewerkers zich ten opzichte van de eerder genoemde processen?
    a. Wat wordt er bijvoorbeeld gedaan als medewerkers de technologie niet als bruikbaar ervaren, maar deze voor bedrijfsresultaat wel het best is bijvoorbeeld?
    b. Hoe wordt het adoptieproces (zoals hiervoor besproken) beïnvloed door de houding van de medewerkers ten opzichte van die technologie?
26. In hoeverre denkt u dat het adoptieproces zelf de houding t.o.v. de bruikbaarheid van een technologie beïnvloedt?
    a. Op welke manier?
    b. Hoe denkt u dat dit elkaar kan beïnvloeden en door welke factoren wordt het juist versterkt of zwakt het af?

Appendix B: Old code scheme

Variable	Dimension theory	Dimension research	Items
Perceived usefulness	Makes job easier	Technology makes the job easier	(1) Physical effort (2) Mental effort (3) Actions required
	Useful	Technology makes the job more useful	(1) Working conditions (2) Job performance (3) Valuable job
	Increase productivity	Technology increase productivity	(1) Effectiveness (2) Efficiency

Table 1 – Operationalization of variable perceived usefulness

Variable	Core concept	Dimension theory	Dimension research	Item
Technology adoption process	Strategic commitment process	Information elements	Information about technology	(1) Information search (2) Information provided by others
		Sensitizing elements	Interest in technology	(1) Internal attention grabbers (2) External attention grabbers
		Inhibiting elements	Consideration of technology	(1) Internal factors for consideration (2) External consideration factors
		Precipitating elements	Explicit study of technology	(1) Internal decisive factors (2) External decisive factors

	Technology choice process	Diagnostic activities	Defining priorities of technology	(1) First priority for technology (2) Second priority for technology (3) Less important points
		Feasibility studies	Impact of technology on organization	(1) Feasible to adopt technology (2) Effect on organization
		Supplier evaluation and selection	Selection and evaluation of technology supplier	(1) Selection criteria for supplier (2) Evaluating suppliers
	Financial justification	Financial/strategic arguments	Financial/ strategic arguments	(1) Financial arguments (2) Strategic arguments
		Intrapersonal/political arguments	Intrapersonal/ political arguments	(1) Intrapersonal arguments (2) Political arguments

Appendix C: New code scheme

Perceived usefulness

Variable	Dimension theory	Dimension research	Items
Perceived usefulness	Makes job easier	Technology makes the job easier	(1) Physical effort (2) Mental effort
	Useful	Technology makes the job more useful	(1) Job performance (2) Valuable job
	Increase productivity	Technology increase productivity	(1) Effectiveness (2) Efficiency

Technology adoption

Variable	Core concept	Dimension theory	Dimension research	Item
Technology adoption process	Strategic commitment process	Information elements	Information about technology	(1) Information search (2) Information provided by others
		Sensitizing elements	Interest in technology	(1) Internal attention grabbers (2) External attention grabbers
		Inhibiting elements	Consideration of technology	(1) Internal factors for consideration (2) External consideration factors
		Precipitating elements	Explicit study of technology	(1) Internal decisive factors (2) External decisive factors

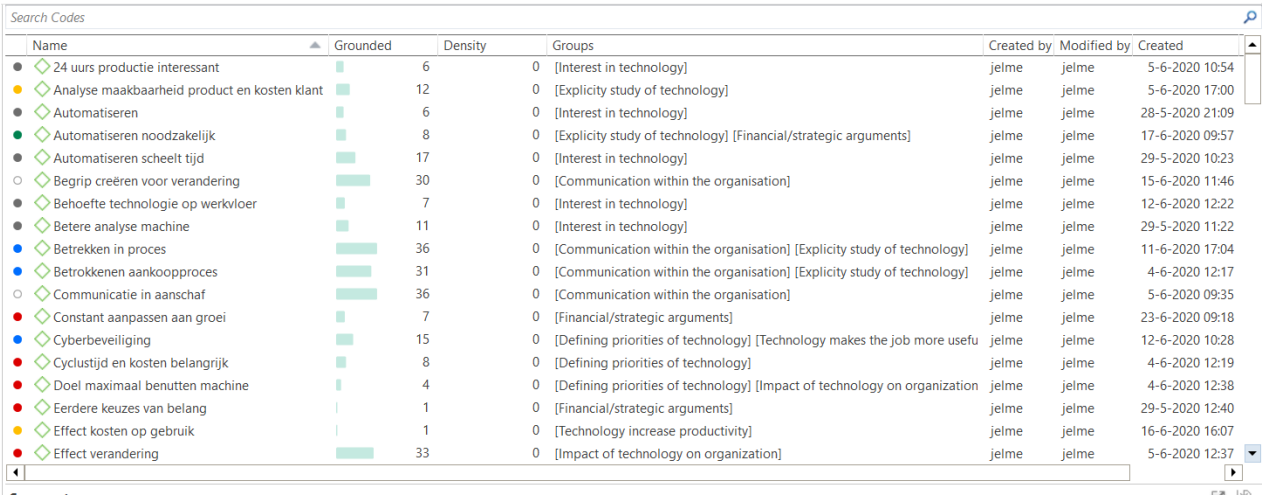
	Technology choice process	Diagnostic activities	Defining priorities of technology	(1) First priority for technology (2) Second priority for technology (3) Less important points
		Feasibility studies	Impact of technology on organization	(1) Feasible to adopt technology (2) Effect on organization
		Supplier evaluation and selection	Selection and evaluation of technology supplier	(1) Selection criteria for supplier (2) Evaluating suppliers
	Financial justification	Financial/strategic arguments	Financial/ strategic arguments	(1) Financial arguments (2) Strategic arguments
		Intrapersonal/political arguments	Intrapersonal/ political arguments	(1) Intrapersonal arguments (2) Political arguments

Relationship between technology adoption and perceived usefulness

Variable	**Dimension research**
Relationship between technology adoption and perceived usefulness	Creating understanding for change
	Involving employees in technology adoption process
	Educate people to work with technologies
	Employee development possibilities

Appendix D: Code process

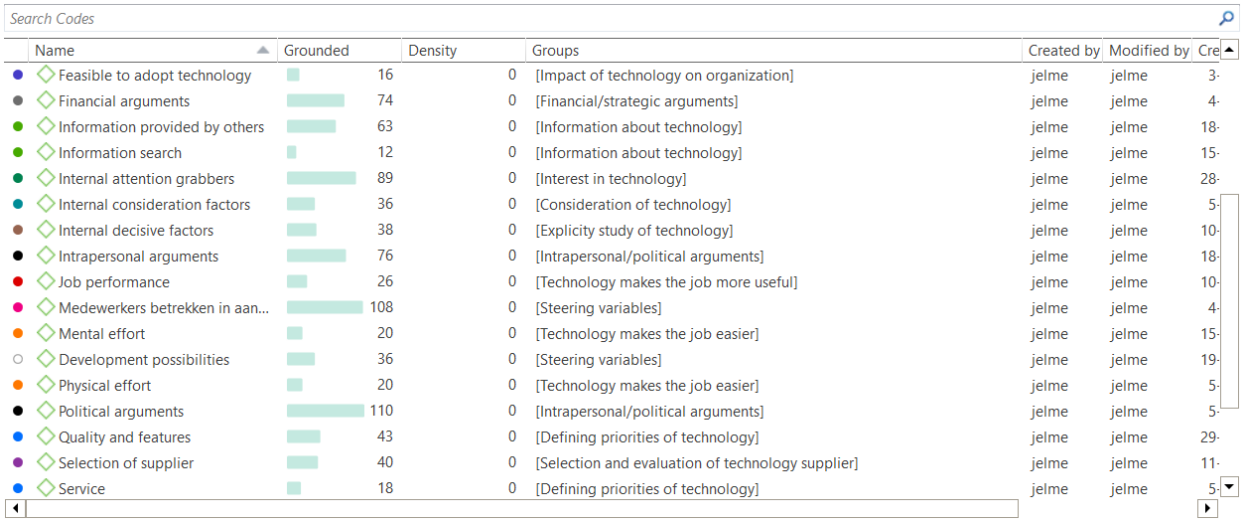
Initial way of coding



Search Codes

Name	Grounded	Density	Groups	Created by	Modified by	Created
24 uurs productie interessant	6	0	[Interest in technology]	jelme	jelme	5-6-2020 10:54
Analyse maakbaarheid product en kosten klant	12	0	[Explicity study of technology]	jelme	jelme	5-6-2020 17:00
Automatiseren	6	0	[Interest in technology]	jelme	jelme	28-5-2020 21:09
Automatiseren noodzakelijk	8	0	[Explicity study of technology] [Financial/strategic arguments]	jelme	jelme	17-6-2020 09:57
Automatiseren scheelt tijd	17	0	[Interest in technology]	jelme	jelme	29-5-2020 10:23
Begrip creëren voor verandering	30	0	[Communication within the organisation]	jelme	jelme	15-6-2020 11:46
Behoefte technologie op werkvloer	7	0	[Interest in technology]	jelme	jelme	12-6-2020 12:22
Betere analyse machine	11	0	[Interest in technology]	jelme	jelme	29-5-2020 11:22
Betrekken in proces	36	0	[Communication within the organisation] [Explicity study of technology]	jelme	jelme	11-6-2020 17:04
Betrokkenen aankoopproces	31	0	[Communication within the organisation] [Explicity study of technology]	jelme	jelme	4-6-2020 12:17
Communicatie in aanschaf	36	0	[Communication within the organisation]	jelme	jelme	5-6-2020 09:35
Constant aanpassen aan groei	7	0	[Financial/strategic arguments]	jelme	jelme	23-6-2020 09:18
Cyberbeveiliging	15	0	[Defining priorities of technology] [Technology makes the job more usefu	jelme	jelme	12-6-2020 10:28
Cyclustijd en kosten belangrijk	8	0	[Defining priorities of technology]	jelme	jelme	4-6-2020 12:19
Doel maximaal benutten machine	4	0	[Defining priorities of technology] [Impact of technology on organization	jelme	jelme	4-6-2020 12:38
Eerdere keuzes van belang	1	0	[Financial/strategic arguments]	jelme	jelme	29-5-2020 12:40
Effect kosten op gebruik	1	0	[Technology increase productivity]	jelme	jelme	16-6-2020 16:07
Effect verandering	33	0	[Impact of technology on organization]	jelme	jelme	5-6-2020 12:37

Adjusted towards coding scheme



Search Codes

Name	Grounded	Density	Groups	Created by	Modified by	Cre
Feasible to adopt technology	16	0	[Impact of technology on organization]	jelme	jelme	3·
Financial arguments	74	0	[Financial/strategic arguments]	jelme	jelme	4·
Information provided by others	63	0	[Information about technology]	jelme	jelme	18·
Information search	12	0	[Information about technology]	jelme	jelme	15·
Internal attention grabbers	89	0	[Interest in technology]	jelme	jelme	28·
Internal consideration factors	36	0	[Consideration of technology]	jelme	jelme	5·
Internal decisive factors	38	0	[Explicity study of technology]	jelme	jelme	10·
Intrapersonal arguments	76	0	[Intrapersonal/political arguments]	jelme	jelme	18·
Job performance	26	0	[Technology makes the job more useful]	jelme	jelme	10·
Medewerkers betrekken in aan...	108	0	[Steering variables]	jelme	jelme	4·
Mental effort	20	0	[Technology makes the job easier]	jelme	jelme	15·
Development possibilities	36	0	[Steering variables]	jelme	jelme	19·
Physical effort	20	0	[Technology makes the job easier]	jelme	jelme	5·
Political arguments	110	0	[Intrapersonal/political arguments]	jelme	jelme	5·
Quality and features	43	0	[Defining priorities of technology]	jelme	jelme	29·
Selection of supplier	40	0	[Selection and evaluation of technology supplier]	jelme	jelme	11·
Service	18	0	[Defining priorities of technology]	jelme	jelme	5·

Coding fragments in Atlas.ti

Het ging over hoe dan die medewerker op de werkvloer, hoe er voor wordt gezorgd dat hij zelf met het idee uiteindelijk gaat komen zeg maar.

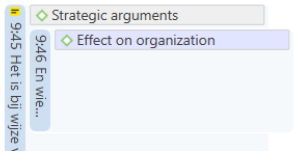
Wel door ze erbij te betrekken zeg maar. Dus door ze wat te sturen hè, af en toe eens een keer ruimte geven voor een beurs en natuurlijk op de werkvloer zullen de mensen minder naar een beurs gaan. In deze tijd is het natuurlijk helemaal anders maar wel minder dan op management niveau. Maar wel de ruimte geven om, en dat is het mooie van internet en je zegt goh moet je daar eens naar kijken ik heb nu iets moois gezien. Of je stuurt ze via Whatsapp een filmpje door. Natuurlijk de ene persoon is daar meer voor geschikt dan de ander maar zo gaat het wel leven. Dus op het moment dat je ideeën, open staat voor ideeën en het kunt faciliteren, dan gaat het, ja dan gaat het werken. Uiteindelijk moet je ze wel en soms ook gewoon eens durven te zeggen van nou probeer het maar dan. Misschien gaat het niet goed, maar dan hebben we het in ieder geval geprobeerd.

Ja. Ja oké. Dus daarin worden dan soms ook nog wel risico's of gokjes genomen terwijl van tevoren niet helemaal duidelijk is wat de resultaten gaan zijn.

Nee, dat doen we best wel vaak dat we van tevoren niet helemaal zeker weten wat het resultaat is. Natuurlijk als we zeker weten dat het mislukt dan doen we dat natuurlijk niet, maar als iemand zegt joh ik ben er echt van overtuigd en ik kan ook niet zeggen dat ik het, dat ik het niet, dat ik zeker weet dat het niet zo is. Ja, doe het, probeer het en die energie zeg maar die zorgt dat je met zijn allen. Op het moment dat je faciliteert en energie geeft en de ander de ruimte geeft om ook die energie erin te leggen ja dan kom je vooruit. Uiteindelijk zijn het de mensen die je bedrijf vooruit helpen en niet die cobot zeg maar. Dus die, ja hetzelfde voor zo'n scanner. Op het moment dat mensen enthousiast aan de slag gaan met zo'n scanner en je zorgt dat het goeie clubje bij elkaar komt ja dan gaan zij met die scanner aan de gang.

Want vooraf wordt dan wel zo veel mogelijk geprobeerd om te kijken wat de impact gaat zijn?

Ja. Het is bij wijze van spreken bij zo'n scanner zeg maar daar op het begin moet je ook gewoon ja een beetje ondernemers lef hebben om te zeggen dit gaat goed komen. En wie hebben we erbij nodig? Deze jongens, als we deze jongens koppelen dan moet het goed komen. En dan komt het vaak ook goed. Of het er nou helemaal uit komt wat je van tevoren had bedacht, in sommige gevallen komt er iets meer uit en in sommige gevallen komt er exact uit wat je hebt bedacht. En heel af en toe denk je, ja, dat hadden we toch anders moeten doen. Maar goed dat is, ik zeg altijd liever 100 beslissingen en 90 goede en 10 sturen we



Appendix D: Example coding

Technology adoption

Strategic commitment process	**Information about technology**	1.1. Ja nou dat is meestal ook natuurlijk een, ja, het zoeken op internet naar, naar oplossingen en gaan naar sommige bijeenkomsten als het gaat over het automatiseren. Daar zijn allemaal uitnodigen van de Metaalunie of andere branchegroepen, ja je moet wel bijblijven en het gaat allemaal heel erg snel.
		1.2. ik Google veel ik lees veel ik weet wel wat de merken zijn. Ik bedoel een beetje op Youtube kijk je natuurlijk heel veel wat de mogelijkheden zijn
		2.1 De leveranciers van onze machines, daar hebben we eigenlijk heel veel contact mee. Ja, zij willen natuurlijk verkopen dus zij doen ontzettend veel moeite om alle technologieën die zij ontwikkeld hebben bij ons te promoten. We gaan dan dagen naar Zwitserland of Duitsland en we krijgen dan te zien wat er in de markt is aan producten voor ons, bij ons van onze leveranciers van onze machines. Dat is de belangrijkste bron denk ik van innovaties en op het gebied van nieuwe machines
		3.1 Ja dat is eigenlijk dus het netwerk inderdaad. Dus je, dat je, ja, hebt. Je volgt de trends en de nieuwe dingen zeg maar op die gebieden. En ja wat ook wel echt werkt is, we hebben ook een netwerk hier in de buurt zeg maar van een aantal ondernemers. Dan gaan we ook 1x per jaar mee op studiereis. Behalve dit jaar haha. En dan gaan wij ook gericht naar dat land toe waar ze dan ergens goed in zijn en proberen daar dan ook wat van op te steken.
		1.5 Ja dat is eigenlijk dus het netwerk inderdaad. Dus je, dat je, ja, hebt. Je volgt de trends en de nieuwe dingen zeg maar op die gebieden. En ja wat ook wel echt werkt is, we hebben ook een netwerk hier in de buurt zeg maar van een aantal ondernemers. Dan gaan we ook 1x per jaar mee op studiereis. Behalve dit jaar haha. En dan gaan wij ook gericht naar dat land toe waar ze dan ergens goed in zijn en proberen daar dan ook wat van op te steken.
	Interest in technology	2.1. In principe moeten we er op de een of andere manier beter van worden. Of er moet een vernieuwing zijn waar we rijk van worden, waar we, het moet het proces optimaliseren, het moet het product verbeteren. Dat kan natuurlijk ook als je een bepaalde laskwaliteiten nodig hebt, met zo'n robot kun je dat altijd garanderen.
		Industry expert: Nou in principe is het zo dat iets wat op korte termijn geld op kan leveren, wordt makkelijker gedaan als iets wat op lange termijn speelt. Dus het is toch een beetje de waan van de dag die overheerst. Korte termijn politiek ten opzichte van lange termijn politiek

		1.5. Ja en daar heb je ook de processen duren vaak te lang en het is ook manafhankelijk. Processen duren, laat ik zeggen, Pietje doet er 2 minuten over en Jantje doet er 5 minuten over. En een robot die is nooit ziek en die, of ja nooit ziek, die kan wel een keer een onderhoudsbeurt nodig hebben. Maar die werkt op een vast tempo die je daarvoor bepaalt hebt, dus sommige processen moet je wel automatiseren om met de prijs mee te kunnen en om de kwaliteit te kunnen waarborgen.
		3.1. Nou ja, eigenlijk zijn wij. We zeggen dat voor de grap van eigenlijk wil je verdubbelen in omzet maar niet in mensen. En hoe krijg je dat dan voor elkaar. Kun je, wat kun je dus eigenlijk vervangen door mensen. En dat blijkt in de assemblage tak dat dat nog heel erg lastig is, maar in de framebouw zeg maar, dus de buisjes aan elkaar gelast worden dat stuk daar is best veel te halen nog.
		3.2 En tegelijkertijd zoek je naar technologieën die je doorlooptijd verkorten zeg maar van idee naar in de vrachtwagen zeg maar. Die tijd wil je zo kort mogelijk maken en dat zit hem in hoe snel ben je als engineer in staat dat idee op papier te zetten. Maar nog veel meer zit het hem in hoe krijg ik een structuur, hoe krijg ik het zo georganiseerd dat het vlekkeloos door de organisatie heen gaat. Daar zijn we ook eigenlijk bijna wel voortdurend aan het kijken wat zijn softwarepakketten die we moeten hebben. Moeten we daar één nieuw softwarepakket, wat betekent dat dan voor ons tekenpakket, wat betekent dat dan voor de engineers.
		1.4. Maar ik denk echt dat je straks heel moeilijk mensen zeg maar de knopjesdrukkers en die heb je nou nog wel maar dat het heel moeilijk wordt om die te krijgen.
	Consideration of technology	1.2. Er wordt gelet op maakbaarheid, er wordt gelet op welke machine zouden we dat kunnen maken en er wordt gelet op welke investering moeten we doen om dat product te kunnen maken en hoe wat kunnen we doorbelasten aan de klant om dat product te maken. Dat nemen we allemaal mee en dan gaan we in overleg met de klant van ja, we moeten er 6000 euro aan gereedschappen aanschaffen, gaan we dat verrekenen in de productprijs of gaan we dat eenmalige kosten maken we daarvan? Dus dat zijn allemaal afwegingen om een product succesvol te maken.
		3.2. Dus op een gegeven moment heb ik in het netwerk gezocht van nou wie heeft zo'n machine staan van dat merk. En daar ben ik uiteindelijk gaan kijken van hoe zit het nou praktisch met de machine. Belooft de leverancier nou echt wat die allemaal zegt. En maakt die dat ook allemaal waar.
		2.2. Ja die wordt eigenlijk wel langs die zelfde lat gelegd natuurlijk, dat die dus toe moet voegen aan het proces te versnellen. En dat is een hele belangrijke. En het moet betaald kunnen worden. Ja wat zijn criteria, ja, weet je. We zijn denk ik wel een beetje een vreemde eend

		in de bijt op dat gebied. Dus wij denken van nou het kan er wel uit, je weet wat voor stroom als die trekt, wat voor onderhoud die nodig heeft en wat de aanschaf is. Nou dan weet je wat de kosten per jaar zijn. En dan kijk je van past het in onze visie, in onze begroting ja of nee. Dat is wel het belangrijkste. Ja als die daaraan voldoet dan is het al gauw goed.
		1.3. Ja dat vind ik in dit gesprek, vind ik dat dan een hele belangrijke dat dat stel dat daar een techneut bij was geweest die echt dat product maakt die had niet zo gezeged van ja het moet er zo op en als je dit op die lijn wil maken dan moet je echt nog wel even met van hoe doe je dit, hoe wil je dat gaan doen. Dan is het meer in het daglicht van ja het moet gewoon wat schoonmaakzuil maken dan moeten we nog met dit toestel erbij komen dat kost weer 10.000 euro. Dan moeten we dat, dan moeten we het nog goed kunnen wegleggen want dat moet allemaal op schuim en op schuim dan mag er weer geen olie op zitten.
		1.5. Absoluut en vaak is het dan als het bijvoorbeeld, dat ze zelf al een onderbouwing hebben gedaan. Dat bespaart bijvoorbeeld een investering, ik noem maar wat als de investering een nieuwe mal. En een andere mal of een ander gereedschap bespaart dat bijvoorbeeld vijf uren in de week. Op een cyclustijd van een machine. Nou dan houd je dus aan het einde van het jaar houd je dus heel veel over. En dat betekent dus dat je zo'n investering, dat dit, kijk dat betekent dus dat ik voor de vijf uur dat ik daar ander werk voor kan vinden. Maar dat is een investering die heb ik in no time terugverdiend. Ja dat is dus en dat soort dingen dat zijn ook investeringen die je ook mee moet nemen. Dus met zulke dingen komen de collega's ook.
	Explicit study of technology	3.1. Ja eigenlijk zeg maar, eigenlijk maken wij en misschien is dat het makkelijkst te verklaren. Eigenlijk maken wij de machines ondergeschikt aan het proces. Dus het gaat erom dat een order zo snel mogelijk de fabriek verlaat dus dat je eigenlijk geen wachtmomenten hebt. Dat is eigenlijk een beetje de QRM methode.
		Industry expert: Maar het is gewoon zo, men heeft, heel veel bedrijven die leven bij de waan van de dag. Die gaan vandaag produceren wat vandaag nog weg moet. En als je dat jaar in jaar uit doet, dan ga je eigenlijk die manier van werken ook in, bij investeringen meenemen. Want je bent gewoon gewend om ad hoc te reageren met werken. En dan ga je niet zo makkelijk op strategisch niveau nadenken. Ja precies dus dat ze eigenlijk kijken wat vandaag goed is voor een bedrijf, en dat ze niet kijken wat over 5 jaar of 10 jaar goed is voor een bedrijf. Ja en misschien doen ze dat wel maar dan hebben ze nog zoiets als dan puntje bij paaltje komt dan is de waan van de dag die wint bijna altijd.
		1.1. Meestal schaf je een bank aan voor een aantal werkstukken en als daar wijziging in komt omdat een klant een ander werkstuk heeft wat

		eigenlijk net niet goed, goed op kan of goed op past dan ga je inderdaad kijken naar een oplossing
		2.2. Weet je kijk we waren ook nooit voor zo'n buislaser of voor een lasrobot gaan kijken als het niet zeg maar binnen de strategie überhaupt van het bedrijf of als het daar buiten zou vallen. Weet je dan, dan doen we het ook niet.
		1.3. En Duitsers hebben er iets mee van nou dit komt uit een Duitse auto, dat ze vragen van oh wat voor machinepark ga je onze producten maken. Dan willen Duitse machines, dan zul jij al eerder altijd van oh die zijn Duits gericht maar we hebben een Nederlands bedrijf en een Nederlands manier van hoe we dat product gaan maken met van dat het wel misschien een staal van een Duitser.
Technology choice process	**Defining priorities of technology**	2.1 Is het rendabel, kwaliteit, duurzaamheid. Ja ik denk dat dat de belangrijkste aspecten zijn overwegend om een technologie. En uiteraard wat de kosten zijn en of zich dat dan weer terugverdiend. Dat zijn meerdere aspecten die je daarin meeneemt. Het is niet één aspect, het zijn echt meerdere punten die het kwartje laten vallen om het wel of niet te doen. (…) of? Nou ja ik denk dat de kosten helaas inderdaad bovenaan staan. Dan de kwaliteit en dan de duurzaamheid.
		3.1 Ja toch wel eigenlijk simpel de mogelijkheden. En daar zit dan vaak, bij een scanner zitten de mogelijkheden niet in de scanner zelf maar zitten die met name in de software wat daar achter zit zeg maar. Dus hoe, ja wat genereert die scanner en wat kunnen wij daar vervolgens mee.
		1.5 Het moet, het heeft dan te maken met dat het hanteerbaar is, makkelijk programmeerbaar. Die had ik er toen straks niet bij staan maar het moet wel ook werken met de pakketten die wij hebben. Dus ik noem maar even CATCAM, dat je het eenvoudig vanaf je werkplek kunt programmeren zonder dat je bij de machine staat
		1.3 Nou we hebben een aantal kantbanken en banken en die draaien op Windows 7. Want die kantbanken bedrijf die hebben met een stuk software te maken en die hebben het getest en zo werkt het goed. En die leveren dan een machine aan maar die wil ik niet in mijn netwerk hebben. Dus dat daar moet je dan een constructie voor maken. En we willen wat bedenken, maar ik heb wel echt een firewall gemaakt met van dat dat niet meer zomaar, hé deze hebben we altijd die klikken we erin en we draaien hem. Dat zou ik altijd tegen houden. Dan zeg ik altijd, betrek mij er ook bij. Als er dan weer iets gekocht wordt dat er iets intelligentie in zit.
		2.2. Naja voor de technische haalbaarheid, in feite heb ik je dat net al uitgelegd. Die machine moet gewoon goed geserviced kunnen worden en moet ook vlot producten kunnen snijden. En de, zeg maar de machine waar we dus uiteindelijk voor gekozen hebben ging ook echt bijna 50% sneller dan die product produceren dan de concurrent.
	Impact of technology on organization	**Researcher: Oké. Maar wordt er dan wel gekeken ook wat die, wat de impact van zo'n technologie op de organisatie zou kunnen zijn?**

		3.2 Haha. Daar stel je een hele lastige vraag. Eigenlijk kan ik rustig zeggen, beperkt. Heel beperkt haha. Ik verwacht altijd dat mensen doen wat ik vraag daarin en ja soms onderschat ik dat en soms overschat ik dat ook. Ja in de mate waarin mensen daarin kunnen schakelen. **Researcher: Oké. Dus eigenlijk wordt daar van tevoren niet of weinig rekening mee gehouden in die zijn?** Ja haha, ja daar komt het in natuurlijk op neer haha.
		Industry expert: En wat ik dan bij de medewerkers merk, dat die zich vaak in de steek gelaten voelen. Ze zijn altijd gestuurd en opeens worden ze niet meer aangestuurd zonder dat ze daar goed op voorbereid zijn.
		1.4 Dus dan is zo'n cobot is volgens mij de oplossing. En dan is het wel heel lullig voor één of twee werknemers, maar ja, ik verwacht dat je niet anders kunt. Dan kun je wel zeggen van we gaan door met die groep en dan sta je straks allemaal, dat is wel heel zwart wit hoor wat ik nu schets, maar dan sta je allemaal buiten. Dat kan natuurlijk ook nooit de bedoeling zijn.
		3.1 Nee niet eigenlijk. Nee. We hebben wel gehad zeg maar toen, dat was toen zo'n beetje een lead project. Dat werd bij sommige fietsen werd die dan voor ons geval willen die veel produceren een lijntje gezet. En toen hadden een aantal van die echte, die echte die hard fietsenmakers zeg maar die hadden zoiets van och jee dat is niks voor mij. En toen zeiden wij van ja maar onze afdeling reparatie groeit ook heel hard. En daar zien wij groei in, daar mag je ook naar toe. Dus die zijn op die manier, ja, hebben we die kunnen behouden zeg maar.
		2.1 Ja, we zijn natuurlijk aan het kijken wat we nu kunnen automatiseren en daar zijn we wel mee bezig. En natuurlijk wat de financiën toelaten aan investeringen. Onze softwareprogramma's daar zijn we, dat zijn best wel, dat zijn best wel, tussen aanhalingstekens dure ontwikkelingen.
	Selection and evaluation of technology supplier	1.3 Ja als ik naar een machinepark ga dan proberen ze wel te beperken tot zeg maar 3 leveranciers. Je hebt natuurlijk de frezerij de verspaning dan zie je Kuma, Matsuura, dat zijn wel echt de merken. En dan zit er ook nog wel één ander merk maar dan houdt het ook wel op. Dat heeft er ook wel mee te maken dat als er iets met die machines is dan heb je weer monteurs intern. En dat lijkt dan een beetje op elkaar. Als je allemaal soorten machines hebt dan ja valt het niet snel uit te wisselen met elkaar. Dus ik denk ook dat zal je privé ook wel hebben, als iets goed werkt dan kies je snel voor hetzelfde merk, dat kan dan wel anders zijn maar dan moet daar wel vaak een goede reden voor zijn.
		1.5 Technisch is het dan al allemaal onderbouwd. Dan is daar, dan zijn daar bijvoorbeeld 4 machines al uitgekomen en misschien soms ook 2 want soms zijn er niet of soms is het er ook 1 omdat er puur gewoon geen goed alternatief is

		3.2 En ja zo'n selectie hebben wij in dit geval vrij snel gedaan door bij een aantal bedrijven. Een bedrijf had een aantal andere scanners gehad en getest. En die ja daar hebben we ook open over gediscussieerd. Dit zagen we daar, dit zagen we daar, dit zagen we daar. Dus ik zou in ons geval voor die twee gaan. En zo zijn wij, hebben we eigenlijk die eerste slag al overgeslagen en zijn naar twee partijen gegaan. En uiteindelijk echt de diepte in met één. Dat was gewoon goed. Ja en als het goed is, is het goed. En je kijkt naar referenties, je kijkt waar ze zitten en in ons geval zie je vaak in de auto industrie zitten best wel wat parallellen zeg maar met ons. Naja en als het in de auto industrie goed genoeg is dan vaak ook wel hier.
		3.2 Uiteindelijk hebben we twee leverancier geselecteerd en uiteindelijk is dat er eentje geworden. Daar hebben we op die beurs dus ook nog gekeken of er nog andere merken zijn die we wellicht over het hoofd zouden zien en daar stonden ook beide merken op gedemonstreerd en die bleken uiteindelijk ook wel de beste technieken in huis te hebben.
		2.2 Uiteindelijk hebben we twee leverancier geselecteerd en uiteindelijk is dat er eentje geworden. Daar hebben we op die beurs dus ook nog gekeken of er nog andere merken zijn die we wellicht over het hoofd zouden zien en daar stonden ook beide merken op gedemonstreerd en die bleken uiteindelijk ook wel de beste technieken in huis te hebben.
		3.1 Ja dat speelt al wel de informatie die bekend is zeg maar via de leverancier. Want vaak zijn er ook nog geen hele uitgebreide studies naar gedaan. Dus daar moet je het dan wel vaak wel mee doen. Dus ik denk dat je over een jaar of vijf wel veel studies hebt in kunststof 3D printen wat daar wel of niet goed aan is, maar dat is nu nog niet bekend.
Financial justification process	**Financial/ strategic arguments**	2.1 Daar wordt naar gekeken, dus het moet zich wel terugverdienen die investering. Ik denk dat dat het belangrijkste, en op wat voor manier maakt niet uit. Dat het zegmaar de kwaliteit of dat het in de aantallen is of dat het voor de fysieke belasting voor een medewerker is. Als het zich maar op de één of andere manier terugverdient.
		Industry expert: Dat is ook een, iets wat ik al heel vaak heb moeten verliezen. Want het is vaak je gaat deze 10.000 euro voordeliger, ja maar die ander die heeft een terugverdientijd die voor een derde korter is. Dat is weer dat korte termijn denken hè wat daarin speelt.
		3.2 En het mooie is, dat is het mooie van een familiebedrijf zoals dit is het gaat niet altijd om een kloppende ROI binnen twee jaar zeg maar. Een 3D printer die verdienen wij echt niet terug in twee jaar, maar we zetten hem er wel neer zodat wij over zes jaar een voorsprong hebben zeg maar.
		1.1 Dus dat gaat altijd in overleg en we maken toch uiteindelijk samen die keuze maar dat is wel met een bepaalde onderbouwing natuurlijk en ook een bepaalde richting waar je heen wil. Kijk het kan ook met de toekomstvisie te maken hebben. Van een van de aandeelhouders

		die zegt, maar nee dat wil ik niet dat dat gaat gebeuren. Dan zullen wij ons daar op moeten gaan inrichten.
		1.5 En een robot die is nooit ziek en die, of ja nooit ziek, die kan wel een keer een onderhoudsbeurt nodig hebben. Maar die werkt op een vast tempo die je daarvoor bepaalt hebt, dus sommige processen moet je wel automatiseren om met de prijs mee te kunnen en om de kwaliteit te kunnen waarborgen.
	Intrapersonal/ political arguments	3.2 Ja, maar eigenlijk wil je die ontwikkelingen wil je, ja, zoveel mogelijk kanten. Kijk de urgentie, kijk een hoofd productie heeft een andere urgentie dan een hoofd montage, maar dat wil niet zeggen dat die vanuit mijn rol misschien denkt ik moet eerst met de montage aan de slag want daar lopen we het eerst vast. En het mooie is, nu lopen die dingen parallel, je bent nu en met de montage bezig en nog steeds kan die productieleiding kan met zijn intelligente dingen aan de slag zodat dat eigenlijk continu, ja parallel blijft lopen. Dus het een hoeft eigenlijk, moet niet hoeven wachten op het ander.
		1.3 En dan een deel van de directie is dan nog van de eerste en tweede generatie is 55-60+. Die zitten nog met het beeld van, niet moeilijk doen het is allemaal al af. En ik ben echt van, bang dat dat er toch een safety lek zit en dat je uiteindelijk een datalek krijgt en ja we hebben nou sinds twee jaar een ICT maandgesprek met het management wie van de derde generatie is toch alweer een jongere generatie. Snapt ook wat meer wat, hoe ik het doe. En die, ja communiceert dan met de tweede generatie om te reguleren met waarom, waarom kost het zoveel ICT, het is veel meer geworden en ze snappen ook meer van waarom ik daar bij in het team wil zitten.
		1.2 We zijn een middelgroot bedrijf in de frezerij hebben we eigenlijk niet heel veel klanten. We hebben goede klanten die veel afnemen dus daar ben je een beetje op ingericht en als dan één klant afscheid van je neemt dan ben je meteen weer, dan heb je zomaar 20% minder werk. En dat is ja, en heel gevaarlijk uiteraard, maar een nieuwe klant aantrekken is toch best wel moeilijk in deze tijd.
		3.1 Nee de eerste, de voorselectie wordt wel gemaakt op managers niveau zeg maar. En dan ook wel de middel laag erin meegenomen. En uiteindelijk de selectie zeg maar dan wordt degene erbij betrokken die ermee moet werken. Ja. Kijk want soms weten hun ook niet van het bestaan van nieuwe technieken en nieuwe technologieën enzo. Dan is dat wel wat lastiger.
		2.1 En verder voeren we gesprekken met onze klanten van wat willen ze, wat verwachten ze. Omdat we dan ook graag dat ze mee willen doen op het gebied van engineering. Dan kijken we soms ook van dan moeten we ook met de klant mee en dan gaan we ook iets investeren omdat de klant graag iets bedacht heeft wat we nu niet kunnen maken. Maar dan wel, dan moeten we wel overleggen met de klant of zij willen meebetalen met de investering. Het is in overleg met de klant, het is heel breed.

Perceived usefulness

Technology makes the job easier	**Mental effort**	1.1. Ja nou kijk het is, er komt altijd wel weer een vorm van stress bij. Maar dat was in het verleden zo dan maakte je er 10 op een dag en nu kun je er bijvoorbeeld 30 op een dag maken maar dat ja verandert niks aan de zaak dat wij dan rekenen met 30 op een dag en vroeger met 10 op een dag. Dus, maar is dat een bepaalde vorm van stress ja of nee? Kijk ik vind stress ook een heel erg breed begrip kijk als iemand storing krijgt, daar kan die medewerker niets aan doen.
		2.1 Dat is dan wel het nadeel van, kijk als je een bedrijf hebt 15 jaar en je begint eigenlijk met niks en je hebt een relatief eenvoudig machinepark en je groeit door naar een geavanceerd machinepark met automatisering, niet iedereen is daarvoor geschikt om in dit tempo mee te groeien. Dat zien we wel. Dat is wel een, niet iedereen is daar geschikt voor.
		1.2 Want je hebt een aantal groepje mensen wat eigenlijk altijd de rugzak al vol heeft zeggen we dan maar en je moet eigenlijk zorgen dat die mensen die daar onder zitten dat die ook mee gaan daarin dat we werk beter kunnen verdelen en nieuwe technologieën die helpen daar zeker in mee.
		3.2 Dus het verandert en op het moment dat je dat bespreekbaar maakt zeg maar dan, ja, op het moment dat je het dan echt niet meer leuk vindt doordat je werk echt veel eenvoudiger wordt. Ja dan schuift het wel weer door. Dan krijg je iemand van een ander niveau die het, die eenvoudiger werk leuk vindt.
		Ja uhum. En dus minder saai werk wordt, het werk wordt ook een stuk gemakkelijker erdoor. **Researcher: Ja. Oké, maar het wordt dus ook makkelijker. En op welke manier bedoel je dat?** Nou ja goed op het moment dat zij telkens moeten controleren en dus de rolmaat erlangs houden om iets precies aan de maat te krijgen of in elkaar klikken en het is op dat moment al in de tolerantie aan de maat. Dat wordt een handeling, een handeling wordt minder maar ook het zelf oppassen dat het wel goed allemaal zit. Dus afwijkingen worden minder en het wordt voor hun ook makkelijker om een goed product te maken. Dat zijn allemaal argumenten waar men wel enthousiast over is. **Researcher: Oké dus eigenlijk zowel fysiek worden er minder handelingen hoeven uitgevoerd te worden en ook mentaal hebben ze misschien minder druk wat ze erover hoeven te maken?** Ja precies
	Physical effort	1.4 Dus als collega zijnde heb je minder verwacht ik dezelfde handelingen ook dezelfde bewegingen. Dat is natuurlijk voor je gewrichten ook niet al te best dus dat is een bijkomen voordeel denk ik.

		2.1 Nou we hadden eerst een lasersnijmachine daar moest je een plaat op leggen en een laser sneed dan de producten eruit en haalde je de plaat eraf. Inmiddels hebben we meerdere laser bed snijmachines. Daar wordt je mee ontlast. Het gewicht van zo'n plaat, het is best wel. Die nieuwe machine heeft het allemaal geautomatiseerd en dat is wel een, ja, een mooie stap zeg maar in die ontwikkeling. Dus er is nog steeds mankracht nodig om hem te bedienen, maar er is steeds minder mankracht nodig om zeg maar fysiek het werk te leveren.
		3.2 Ja het moet, het moet het werk of de kwaliteit beter maken of het werk eenvoudiger maken. Ja ze moeten het werk snappen zeg maar. Ze moeten weten wat ze moeten doen om die machine op de juiste manier te benutten en op het moment dat ze die machine op de juiste manier kunnen benutten dan hebben ze of een mooier eindproduct of ze hebben handelingen geëlimineerd die ze vroeger, ja die ze niet zo, ja gewoon simpele handelingen. Kijk pak je een lasrobot dat is ook een mooie, als je een lasrobot als een bedreiging doet. Ze hebben nog steeds evenveel laswerk ze hoeven alleen in de zin van ze kunnen nog steeds de hele dag bezig zijn met lassen. Maar dan doen ze nog meer lassen met de hand die een robot heeft die zijn ook super strak en supergoed waardoor het repeterende gehalte afneemt en daardoor ook weer geaccepteerd.
		1.1 Fysiek denk ik dat het juist minder is geworden. Hè dat dat allemaal, vooral, kijk voor de zwaardere dingen worden er sowieso steeds meer oplossingen gezocht. Met til hulp of met kranen wat vroeger met twee man erop moest worden getild, dat doet er nou eentje met een kraan. Fysiek denk ik dat het een stuk lichter is geworden als vroeger
		1.3 En als die klaar is dan klokt die weer uit en geeft die op van ik heb er 100 juiste producten en drie gingen mis. Dat moet natuurlijk wel gevolgd worden voor het ruwe materiaal. Maar die man die het invult kun je ook heel makkelijk zeggen van dan geven we hem een telefoon met een scherm. Daarop kan die zien wat moet ik doen, dit kan oproepen ik druk op een knop, ik ga beginnen en dat is ook heel makkelijk
Technology makes the job more useful	**Job performance**	1.5 Ja en daar heb je ook de processen duren vaak te lang en het is ook manafhankelijk. Processen duren, laat ik zeggen, Pietje doet er 2 minuten over en Jantje doet er 5 minuten over. En een robot die is nooit ziek en die, of ja nooit ziek, die kan wel een keer een onderhoudsbeurt nodig hebben. Maar die werkt op een vast tempo die je daarvoor bepaalt hebt, dus sommige processen moet je wel automatiseren om met de prijs mee te kunnen en om de kwaliteit te kunnen waarborgen.
		3.1 Maar zo al doende lerend, ja, kom je dan toch weer tot dat de kwaliteit weer omhoog gaat. En de fouten in de productie naar beneden
		2.2 Dus afwijkingen worden minder en het wordt voor hun ook makkelijker om een goed product te maken. Dat zijn allemaal argumenten waar men wel enthousiast over is.
		2.1 En als je dan naar de lasrobot kijkt, dan kan je daarmee ook een gegarandeerde kwaliteit levert dan met mankracht. Natuurlijk hebben we vakmensen in huis die, maar bij een lasrobot heb je en constante kwaliteit die 100.000 keer hetzelfde is.

		1.3 Dat nu door een mens wordt gedaan en een mens die doet dat altijd anders. Die voelt dat en heeft sneller in de gaten met van oh, oh daar is daar heeft iets ingezeten en nou is de maatvoering niet goed. En een robot is dom, blind. Die heeft, die gaat alleen maar door. En goede producten maken is moeilijker als afkeur maken als we als verkeerde producten.
	Valuable job	1.1 Nou ik denk dat bij ons en daar hebben we het met heel veel medewerkers hebben we daar ook over gesproken, het automatiseren geeft gewoon een hele andere uitdaging. Ik denk dat het alleen maar leuker wordt want als jij continu hele dagen alleen maar hetzelfde moet doen en dat is natuurlijk erg geestdodend en eentonig werk en dan zit er soms gewoon totaal 0,0 uitdaging in
		1.5 Om te kijken hoe kunnen we dat proces zo optimaliseren dat wij ten eerste interessant werk kunnen doen en dat, je moet je ook voorstellen dat die mensen die, die specialisten, die zijn ook op zoek naar elke keer wel naar een uitdaging. Ze willen niet continu hetzelfde doen. En dat moet je toch doen door ze heel veel cursussen te laten doen, ik bedoel omscholing elke keer of om ze dingen te kunnen laten programmeren bijvoorbeeld om een robot aan de gang te krijgen. Dat je niet per definitie meer vieze handen hebt, want dat is vaak een eis van de jeugd, van de nieuwe jeugd dat ze dat niet meer willen. Want bij ons kun je, kun je ja van de grond af eten bijna.
		3.1 Dus die mensen die groeiden zelf mee en degenen die dat niet konden zeg maar die geven dan nog je hebt altijd wat onderhoudend werk na een robot proces zeg maar. Dus die bleven dan dat soort werkzaamheden doen en daar hoefden ze ook niet, niemand hoefde ook weg zeg maar. En dat is denk ik wel ons voordeel daarin. Daarom ook een nieuwe technologie eigenlijk wel omarmd worden want het maakt hun werk, het saaie repeterende werk dat werd door de robot gedaan of dat werd weg geautomatiseerd en ja dan heb je toch wel iets waar wat meer vakwerk voor nodig was dat bleef. En dus het werk werd eigenlijk leuker, minder repeterend. En ja. Ook weer uitdagender dus.
		2.2 maar op het moment dat zo'n machine dan komt en draait en men ziet dat dat het uiteindelijk de wat in de ogen van de lasser de stomme producten daarheen gaan. Of de lastige producten of een collectie waar geen uitdaging in zit dan ziet men dan is dan creëer je daarmee toch wel acceptatie binnen het bedrijf.
		3.2 Ja ik denk dat dat niet, dat dat vaak niet het geval is. Ik denk dat het werk, ja de meeste dingen die je automatiseert maken niet per definitie het werk leuk. Dus het verandert en op het moment dat je dat bespreekbaar maakt zeg maar dan, ja, op het moment dat je het dan echt niet meer leuk vindt doordat je werk echt veel eenvoudiger wordt. Ja dan schuift het wel weer door. Dan krijg je iemand van een ander niveau die het, die eenvoudiger werk leuk vindt. En op het moment dat je werk onder je niveau moet doen dan wordt niemand blij.
	Efficiency	1.1 Dus die omspantijd van dat ene werkstuk wat klaar is, daardoor staat die spil niet meer stil. Bij ons is de uitdaging altijd dat je de spil van de

Technology increase productivity		machine zoveel mogelijk uren maakt, want zolang die spil draait en slagen maakt, worden er werkstukken klaar gemaakt. Maar als de spil stil staat dan levert die bank je niks op. Dus wij zijn alleen maar aan het bedenken, hoe kunnen we die spil nou zo lang mogelijk laten draaien zonder dat daar direct handjes voor nodig zijn. Dat is eigenlijk het enige waar we mee bezig zijn, maar dat zijn we eigenlijk al een jaar of 20 jaar zijn.
		2.2 Wat ik je straks al zei, uiteindelijk moet het echt, zo'n machine heeft natuurlijk ook nog restwaarde die berekenen we ook netjes mee. Hoe lang gaat zo'n ding mee? Hoeveel produceert die per uur? Was ook nog een overweging en wat uiteindelijk bleek is dat ook de goedkope machine ook, als je een lengte buis of koker verwerkt had dat die een veel groter reststuk had wat die in de klauw had. Dus de efficiëntie uit de koker was ook, was ook een reden om, om mee te wegen dat is ook een financieel argument uiteindelijk.
		2.1 Het is niet van, nou als we een technologie zien; kunnen we er wat mee, willen we er wat mee. En als we het gezien hebben is het toepasbaar of hoe kunnen we hiermee sneller produceren. In het geval van die lasrobot is het zo dat we producten ook gewoon goedkoper kunnen leveren. Doordat er sneller gelast kan worden. Dus dat zijn overwegingen die de hoofdrol spelen, helaas misschien.
		1.4 En nu hebben we ik weet niet hoeveel programma's er nou in staan en ja bij hele moeilijke producten dat scheelt ons enorm veel tijd. Je ziet gewoon het voordeel ervan. Normaal ben je twee uur aan het programmeren ja dat gaat nu veel sneller. Je hebt vaste waardes en je hebt software die schiet het er allemaal in.
		3.2 In de basis willen we onze montagetijd verkorten zeg maar. En dat niet zo zeer om kostprijs te reduceren, dat is mooi maar het is met name dat we in de piektijd zeg maar zoveel mogelijk fietsen kunnen realiseren. Onze uitdaging is altijd om, zeker nu in deze periode van het jaar, om altijd aan de klantvraag te kunnen voldoen. En daar heb je zoek je eigenlijk continu naar technologieën om dat te versnellen.
	Effectiveness	1.1 Dan moet alles samenkomen om dus in een willekeurige volgorde, die kun je natuurlijk wel prioriteren, dat je dan bepaalde werkstukken wil ik dan er zoveel van in de week hebben en dan gaat het softwarepakket zelf aan het rekenen hoe vaak die dan het werkstukje naar binnen moet doen of het tafeltje naar binnen moet maar daar kunnen er wel meerdere op zitten. Om dus uiteindelijk op het einde van de rit zoveel werkstukken van die, zoveel werkstukken van die, zoveel van die klaar te hebben.
		1.2 Ja. Dat is het mooiste dat je niet afhankelijk bent van één product en dat je meer universele producten kunt bewerken. Daar kan je spanmiddelen op inrichten, kijk als dat formaat een kubus is of wat groter, of schoenendoos. Dat formaat moet je alles voor in huis hebben om te kunnen verspanen.
		3.1 En als je daarbij inpast, in die gedachte dan zul je ik zei al we willen eigenlijk in eigen huis alles kunnen maken en doen en dat we dat niet

		zeg maar van heel ver hoeven te halen. Maar dat hebben we een aantal jaren geleden, hebben we reshoring gedaan zeg maar
		1.5 We kunnen door optimalisering, optimalisaties kunnen we ook wel zorgen dat we misschien wat capaciteit vrij krijgen. Dus dat we meer tijd overhouden waardoor we ook wat meer producten erop kunnen toevoegen
		Industry expert: Je ziet bijvoorbeeld ook dat series steeds kleiner aan het worden zijn. En dat wil dus ook zeggen als de series kleiner worden dan moet er vaker omgesteld worden, dan moet er dus op een andere manier georganiseerd worden.

Characteristics of the relationship

Creating understanding for change	Het heeft geen nut om een bank aan te schaffen of een nieuw iets naar binnen te halen waar ik iemand niet achter staat of denkt dat het beter kan of wat dan ook, dan heeft het absoluut geen zin. Dus dat gaat altijd in overleg en we maken toch uiteindelijk samen die keuze maar dat is wel met een bepaalde onderbouwing natuurlijk en ook een bepaalde richting waar je heen wil. Kijk het kan ook met de toekomstvisie te maken hebben. Van een van de aandeelhouders die zegt, maar nee dat wil ik niet dat dat gaat gebeuren. Dan zullen wij ons daar op moeten gaan inrichten. Maar ook dat gaat in goed overleg.
	1.2 Uh ja dan wordt die er toch doorgedrukt want ik heb, we hebben nu een aantal jaren geleden een machine aangeschaft. En waarvan ik heb gezegd, ik zou het niet doen. Ook op een aantal manieren verteld, van dat vind ik zonde geld. Maar dan worden ze bang als zij een subsidieproject hebben of weet ik veel wat. Maar het is dus nog steeds niet wat, de machine staat hier nu drie jaar met een robot wat niet werkt. Ja dat wordt niet gedragen.
	2.1 Alleen dat we proberen met die voorlichting mensen duidelijk te maken dat de verwachting van de effecten, geven voorlichting aan de mensen van nou dit gaat het worden. We denken dat dit misschien verruiming gaat geven op dit gebied en dat dit de effecten zullen zijn
	3.1 En nu hebben wij eigenlijk zeg maar toen we dat doorlopen hadden toen hadden we met de kerstborrel een visionair uitgenodigd. Een trendwatcher. En die heeft zeg maar de wereld geschetst voor over tien jaar en daar zat iedereen op het puntje van zijn stoel. Er werd laag en hoog gesprongen dat maakte niet uit. En toen hadden ze allemaal zoiets van oké zeg maar wat er moet gebeuren, want we snappen wel dat de wereld gaat veranderen. En dat is wel mooi. Daar werden ze wel door aangezet zeg maar weet je wel. Achterover in de stoel hangen was toen wel voorbij.
	3.2 Op het moment dat je eenvoudig repeteerbaar werk weghaalt bij de medewerker dan is de medewerker daar blij voor. En uiteindelijk wil de klant niet betalen voor simpel repeteerbaar werk. Dus je creëert, vaak is het dien je hetzelfde belang zeg maar alleen ja moet je het op twee verschillende manieren uitleggen.
Involving employees in technology adoption process	Ja dat vind ik in dit gesprek, vind ik dat dan een hele belangrijke dat dat 1.3 stel dat daar een techneut bij was geweest die echt dat product maakt die had niet zo gezegd van ja het moet er zo op en als je dit op die lijn wil maken dan moet je echt nog wel even met van hoe doe je dit, hoe wil je dat gaan doen. Dan is het meer in het daglicht

	van ja het moet gewoon wat schoonmaakzuil maken dan moeten we nog met dit toestel erbij komen dat kost weer 10.000 euro. Dan moeten we dat, dan moeten we het nog goed kunnen wegleggen want dat moet allemaal op schuim en op schuim dan mag er weer geen olie op zitten.
	1.4 Ja. Het is een investering wat we moeten doen en heeft het nut voor de organisatie, laten we het maar gewoon zo benoemen. Ja. Dus zo is dat gegaan. En zo werkt het ook met die houtafdeling dat, dat we daar toen zijn verbeterslagen gemaakt. Heb ik ook een presentatie gemaakt en voorgelegd en ook nadelen bijgezet van dat zijn nadeel of dat is een voordeel je moet alles gewoon benoemen. Je moet niet alleen de mooie dingen erin zetten dat is gewoon super belangrijk. Je kunt alles wel gewoon heel mooi voorzetten, voorspiegelen, maar als blijkt dat dat niet zo is ja dan sta je daar en dan schiet ook alles mis.
	Industry expert: Ja absoluut. Je hebt er gewoon als ondernemer heel veel invloed op. Ik heb ook verschillende keren discussies gehad met ondernemers die zoiets hadden van nou, de mensen die denken niet mee. Ik denk van nou, bijvoorbeeld als het dan technisch zo is, stuur ze naar dan naar de technici toe en hij geeft ze allemaal een gerichte opdracht mee om ergens iets uit te zoeken en daarover terug te rapporteren. En als je nou vijf man het toegestuurde hebt en je laat ze dat met elkaar delen en zelf ook bij dan komt die discussie vanzelf wel op gang. Dat zijn gewoon trucjes leidinggevende trucjes die je uit kan halen.
	3.2 Dus ik denk daar het niveau het toelaat en je neem ze, je neemt ze altijd serieus en op het moment dat je denkt dat je het uigelegd krijgt je het begint uit te leggen dan heb je in mijn optiek 99% van de medewerkers hebben het beste voor met het bedrijf. En uiteindelijk ook met zichzelf. Maar dat ja ik denk echt dat communicatie is echt in alles de sleutel.
	2.1 En dan krijg je dus ook meer, kijk die jongen van die buislaser die heel snel die bepaalde type wilde hebben. Is zo betrokken hè, het is echt zijn kindje geworden. Die wilde hij ook, daar is hij helemaal verliefd op, dat is mooi. Die is zo betrokken, die gaat daar helemaal voor. Dat is echt de beste keuze die we ooit gemaakt hebben haha
Educate people to work with technologies	1.4 Ja haha maar dat komt misschien ook wel omdat, die zijn nog niet zo heel lang hier dus die zijn nu nog helemaal, die zijn we nog aan het opleiden dus die vinden dat natuurlijk helemaal perfect en is dat voor hun misschien alweer een stap verder. Dus het kan best zijn dat zij ook met een jaar ofzo zeggen van, geweldig dit is het helemaal. Verwacht ik wel. Maar die zijn nou drukker met hun eigen, ja, kennis eigenlijk te vergaren om alles onder de knie te krijgen.
	Industry expert: Wat je vaak ziet is, dan wordt op een gegeven moment dan wordt de lasrobot ingezet. En de man, die lasser die moet opeens met zo'n lasrobot gaan werken. Ja dat is verkeerd. Als je namelijk eerst een opleiding geeft voor die lasrobot en het dan pas neerzet dan wordt je al nieuwsgierig naar hoe zal dat in de praktijk werken. En als die dan komt dan wordt die geprikkeld van even kijken of ik het goed onthouden heb en noem maar op. Dan is er nieuwsgierigheid. Maar komt die eerst en pas een maand later mag je daar een opleiding voor volgen dan heb je al een negatief gevoel erbij gekregen.
	3.1 En toen hebben we tegen de engineers gezegd, kijk eens een nieuw speeltje. En ga eens kijken wat de mogelijkheden van het apparaat zijn en het allereerste wat ze gemaakt hadden, want het was vlak voor kerst, waren kerststerren. Daar begon het eigenlijk mee en gaandeweg bij ons die daarmee begonnen zijn en die dachten, ja dan

	moeten ze anders leren denken hè. Voorheen moesten ze in gaten denken en nou kunnen ze in opbouw denken. Maar heb je een stuk staal en er moeten gaten uit gehaald worden, en dit is dan andersom. Dat bouw je op. En op die manier al doende lerend zeg maar, je gaat op een gegeven moment vier van die printertjes staan er dan die dan zeg maar 24 uur per dag draaien
	3.2 In de praktijk blijkt eigenlijk dat we voldoende kennis opdoen zeg maar voor onze eigen producten, dus we printen nu alleen nog maar voor partners en voor onszelf. En degene die op 3D printstel zit zeg maar dat is de ambassadeur van 3D printen. Kunst is eigenlijk niet om 3D te printen, ja dat is ook een vak, maar de kunst is, de echte kunst is om alle andere engineers de mogelijkheden en de potentie en de voorwaarden zeg maar te laten zien en mee leren om te gaan zodat de techniek ja eigenlijk geabsorbeerd wordt.
Employee development possibilities	1.5 Nou het zorgt gewoon voor verschuiving van de werkzaamheden. Het zorgt ervoor dat wij mensen ook meer kunnen, kunnen, middels cursussen of een vorm van omscholing kunnen doen. En dan moet ik zeggen dat er ook heel veel handjes zijn die ik noem het maar of afbramen of dat soort werkzaamheden dat zou mogelijk komen te vervallen.
	1.1 Want als jij te ver gaat voor een medewerker dan heeft dat natuurlijk weinig zin. Maar de medewerkers moeten zichzelf ook willen ontwikkelen en blijven ontwikkelen want het gaat gewoon heel hard in onze branche. Dat geldt voor heel veel dingen, maar het gaat heel hard en ik denk wel dat alle, alle nieuwe dingen is niet altijd dat het ten gunste is, het ligt er ook aan wat de reden is van die vernieuwing.
	1.4 Ik denk dat het een stukje wrijving is dat je toch meer kennis gaat krijgen, verwacht ik. Daar gaat het eigenlijk om dat jij, nou er zijn mensen die willen natuurlijk die beginnen ergens en dat ze een knopje mogen drukken dat vinden ze geweldig. Maar ik denk als jij in de techniek zit achter een kantbank staat dan lijkt mij dat wel een stukje verrijking om daar mee te werken.
	3.1 Dus zeg maar die lassers die zijn ondertussen ook een aantal daarvan zijn robotprogrammeur geworden en bedienen de robot. Die hebben we dan omgeschoold en in het begin ging dat gewoon met dan werd dat door de leverancier gedaan. Die schoolde de mensen dan om met het programmeren en het gebruik van de robot en dan hebben we nu denk ik inmiddels 8 robots staan
	2.1 Dat zien we wel. Dat is wel een, niet iedereen is daar geschikt voor. Jongeren bijvoorbeeld kunnen heel snel denken, heel snel schakelen. Jij zit ook in die generatie, jij kunt met je telefoon computeren, je kan eigenlijk drie dingen tegelijk doen en je kan ook heel snel in je hoofd die connecties leggen. Mensen zeg maar boven de 50 dat zijn denk ik uitzonderingen die dat kunnen, dus als je dan een bedrijf gaat automatiseren, ook op ICT gebied, dat is lastig. Daar kan niet iedereen in mee.