Bachelor thesis Business Administration

The intention to adopt robots

Influence of perceptions and stakeholders

Public version

Name: Lucia Geurkink
Student number: s4682068

Supervisor: Dr. Robert A.W. Kok
Second reader: Dr. Peter Vaessen

Date: 22-06-2020
1st attempt

Radboud University

Preface

After a lot of hard work, I can finally present my master thesis “The intention to adopt robots – Influence of perceptions and stakeholders”. With this thesis I complete my master Innovation and Entrepreneurship, a specialisation in Business Administration at Radboud University Nijmegen.

First of all, I would like to thank my supervisor Dr. Robert Kok for his feedback and support during the writing of my thesis. I would also like to thank my second reader Dr. Peter Vaessen.

Furthermore, I would like to thank the managers I have interviewed for their cooperation in this research and the interesting insights they have provided.

Last but not least, I would like to thank my family and friends for their motivation and support during the past few months.

I hope you enjoy reading my master thesis!

Lucia Geurkink

Kranenburg (Germany), June 2020

Abstract

Previous research primarily focused on how the consumer's characteristics and perception might influence the consideration of using an innovation. So, little attention is paid to the organizational context. This study therefore tries to find an explanation for managers of manufacturing firms when deciding whether to use robots, considering that also stakeholders can play a role. This has been done based on qualitative research. Therefore, eight interviews with managers of four different manufacturing companies have been held. This research shows that the adoption intention is positively influenced if managers are convinced that robots deliver benefits, are not complex and are consistent with values, experiences and needs. Furthermore, stakeholders like employees are able to positively influence these beliefs if managers believe that they think that an innovation would be free of effort and would enhance the job performance. Thus, this can indirectly influence the manager’s adoption intention. Based on these results various recommendations for manufacturing companies, their managers and employees even as for their customers and the government have been provided. The most important one is that robots are worth investing in because they can create benefits for all these parties.

Contents

1 Introduction

1.1 Problem description

Today robots are becoming more widespread across various industries and provide many advantages (Singh, Sellappan & Kumaradhas, 2013). The use of innovative technologies like robots increase a manufacturing company's labor productivity, flexibility, controllability, delivery reliability and quality even as decrease a manufacturing company's production costs, time to market, delivery lead time, manufacturing lead time and reversal time in production environments (Browning & Heath, 2009; Hayes, Pisano, Upton & Wheelwright, 2005; Ligthart, Vaessen & Dankbaar, 2008; Reichstein & Salter, 2006; Singh et al., 2013; Upton, 1997; Zelbst, Green, Sower & Reyes, 2012). Also, robots maximize the efficiency, accuracy, speed, security and therefore the competitive advantage of a manufacturing company (Ogbemhe, Mpofu & Tlale, 2017; Singh et al., 2013). Furthermore, robots create new jobs, disburden employees, and compensate the skills shortage (Diamond, 2020; Ogbemhe et al., 2017; Singh et al., 2013).

Nevertheless, often robots and the opportunities provided by these innovative technologies are not used by manufacturing companies (Ligthart et al., 2008). More concrete, less than 30% of manufacturing companies use robots (CBS, 2019; Ligthart et al., 2008). Regarding the little use of robots mainly disadvantages are named. The biggest disadvantages of robots are high costs, old jobs getting irrelevant and the need for additional or specially trained employees (Ewing, Pigazzi, Wang & Ballantyne, 2004; Ogbemhe et al., 2017). However, most of the time those disadvantages seem to overshadow the advantages even so the advantages can be much stronger. Also, there are much more advantages than disadvantages. Nevertheless, most manufacturing companies do not use robots (Ligthart et al., 2008). Looking at the advantages mentioned, and the opportunities offered by these innovative technologies it is interesting to get to know why many managers of manufacturing companies still do not opt for robots.

This situation can be better understood by looking at the manager's adoption intention. The manager's adoption intention is of importance, because mostly the manager decides whether to use a robot and pays for it although he or she probably does not use it. So, the manager is the consumer. Therefore, adoption theory focusing on consumers is best suited to describe the manager's adoption intention (Driessen & Hillebrand, 2002). Furthermore, the adoption intention is influenced by perceptions about an innovation (Driessen & Hillebrand, 2002). Whether these perceptions do have a positive or negative impact on the adoption intention depends on several

factors like e.g. the relative advantage, complexity, or compatibility of a product (Arts, Frambach & Bijmolt, 2011; Jung, Chan-Olmsted, Park & Kim, 2012; Moore & Benbasat, 1991).

In addition, the adoption intention of a manager is influenced by different stakeholders. So, the stakeholder management perspective become of importance, because it is generally suggested that firms need to satisfy those groups who have a stake in the firm even as their employees to ensure long-term success (Freeman & McVea, 2001). This is difficult because stakeholders even as employees often differ in their interests and impact. As shown by the stakeholder model there are eight different stakeholders (Donaldson & Preston, 1995). These stakeholders can further be grouped into latent and expectant stakeholders differing in their impact based on their power, legitimacy, and urgency (Mainardes, Alves & Raposo, 2012; Mitchell, Agle & Wood, 1997). Among them the employees who are affected by the firm or can affect the firm (Donaldson & Preston, 1995). Especially, the employees affect the manager's adoption intention because they often have to use the innovation. Thus, it is of importance if the employees will accept an innovation and how this acceptance is perceived by the manager.

To describe the employees' acceptance the Technology Acceptance Model can be helpful because this model explains a person's acceptance of a technological innovation by looking at the perceived ease of use and the perceived usefulness (Davis, 1989; Nejad, Apanasevic, Markendahl & Arvidsson, 2016). So, this theory mainly focuses on using a technological innovation and therefore tries to describe the acceptance of a user (Davis, 1989; Nejad et al., 2016). Generally, employees can be users, but in the context of robotization it should not be forgotten that not all employees are users. Sometimes employees can become users by learning how to use robots, but just as well robots can replace the employees so that they get new tasks or will be fired. Furthermore, robots could raise the need for new employees who are e.g. able to use or program them.

Thus, to understand a manager's intention to adopt robots it is of importance to not only look at his or her intention, but also on the manager's perception of the employees even as on other stakeholders. This is of importance, because probably the manager makes the decision and the employees have to deal with this decision. If the employees do not support the manager's decision problems can occur. Therefore, it is of importance that the manager takes the employees' opinion into account. To do so a combination of the mentioned theories can be helpful. Furthermore, this combination is new in the context of robotization. So, there are no clear expectations which might

help to get a better and broader understanding of the manager's adoption intention which might be influenced by stakeholders like employees. This is important, because the problem that managers face is that they often do not understand why they should adopt robots or how they should convince their employees of the usefulness of robots. Therefore, this combination could provide the insights needed to understand why manufacturing companies often do not use robots and therefore why managers often do not opt for robots. So, the situation reflects a knowledge gap, because researches combining these three theories and therefore focusing on the factors that influence a manager's intention to adopt robots are hard to find.

1.2 Problem statement

The objective of this research is to combine the adoption theory with the Technology Acceptance Model and stakeholder management perspective to get to know how the relative advantage, the complexity, compatibility and the perception of employees' perceived ease of use and perceived usefulness affect the manager's intention to adopt robots.

Based on this the research question will be:

> *How is the manager's intention to adopt robots affected by the relative advantage, the complexity, the compatibility and by the perception of employees' perceived ease of use and perceived usefulness?*

1.3 Managerial relevance

This research question is especially important to managers of manufacturing companies. Managers of manufacturing companies do often not understand, see or believe the opportunities offered by these innovative technologies or do not know how to convince their employees about the usefulness of robots (Diamond, 2020; Ligthart et al., 2008; Ogbemhe et al., 2017).

As already mentioned, the problem that managers of manufacturing companies are facing is that they do not fully understand why they should use robots or how they should convince their employees of the usefulness of robots. However, managers of manufacturing companies even as their employees often believe in certain disadvantages when they are confronted with robots although the advantages can be much stronger than the disadvantages. Robots not only change job descriptions or take over tasks that make old jobs irrelevant, but also create new jobs or support employees (Diamond, 2020; Ogbemhe et al., 2017; Singh et al., 2013). Thus, the impact of robotization and why robots should be adopted is still unclear to many managers of manufacturing

companies or to their employees. Furthermore, the adoption intention is influenced by many different factors. These factors can help to explain why the impact of robotization is still unclear. In addition, these factors can help to identify and understand the real barriers regarding the intention to adopt robots.

Remembering the advantages of robots and the fact that robots are becoming more and more important is contradictory with the mostly negative attitude towards robots. So, this research can help managers of manufacturing companies or employees to understand why they should use robots and may cause that more firms will make use of robots. Thus, this research can lead to a change in managerial implications to help managers of manufacturing companies increasing their knowledge about robots even as changing their attitude towards robots and/or lead to an increase in employees' knowledge and acceptance.

1.4 Theoretical relevance

Having a look at the literature there is only little research done about the manager's intention to adopt robots. Literature is often about customers adopting products, but not about managers deciding whether to adopt a new technology. Furthermore, stakeholders like employees play an important role when managers have to decide whether to adopt robots. Employees can heavily affect the manager's intention to adopt robots, but the effect of employees even as how employees influence the manager is another topic that is only slightly researched in the context of robotization. In addition, studies combining the adoption theory, the Technology Acceptance Model and the stakeholder management perspective in the context of robotization to understand the described situation above are hard to find. The only study that could have been found combining all three theories is the one by Nejad et al. (2016) in the context of mobile payment. Although, this study covers all three theories the results could be differently in the context of robotization. Based on this it becomes clear that this research is of theoretical relevance and thus helps to cover a knowledge gap.

1.5 Scope

In this research a case study method will be used. Therefore, interviews will be held with managers of four different manufacturing companies. Furthermore, this research will combine the adoption theory, the Technology Acceptance Model, and the stakeholder management perspective.

1.6 Outline of chapter

Finally, this research tries to provide an answer to the earlier introduced research question. To do so the results of a qualitative research will be used. Furthermore, these results will be used to give an answer to the formulated research question based on the theory and to come up with a conclusion and some recommendations.

2 Theoretical framework

In chapter one the context and relevance of this research has been discussed even as the research question. To answer the research question a theoretical framework is needed. Now this theoretical framework will be provided by focusing on the adoption theory, the Technology Acceptance Model, and a stakeholder management perspective. The central concepts will be explained, a conceptual model will be created, and propositions will be formulated. Later, these propositions will be checked to be able to give an answer to the research question.

2.1 Adoption theory

The adoption theory has been chosen, because it explains why a person will (not) make use of new products like e.g. robots. So the adoption theory "offers a useful framework for studying the success of […] innovations from the perspective of the customer" (Driessen & Hillebrand, 2002). So, the customer's decision making is described by looking at the adoption process. The adoption process consists out of five phases: knowledge, conviction or persuasion, decision, implementation, and confirmation (Driessen & Hillebrand, 2002; Rogers, 1995). The first two phases show that the adoption is influenced by a customer's characteristics and perceived innovation characteristics (Driessen & Hillebrand, 2002; Sahin, 2006). The characteristics are social-economic, psychological and communication related (Driessen & Hillebrand, 2002; Sahin, 2006). The perceived innovation characteristics are the relative advantage, the compatibility, the complexity, the trialability and the observability (Driessen & Hillebrand, 2002; Sahin, 2006). Characteristics influence the speed of adoption whereas the innovation characteristics are part of the perception and thus of a customer's attitude (Driessen & Hillebrand, 2002). So, the first two phases are about becoming aware of an innovation and forming an attitude towards the innovation (Rogers, 1995). The third phase is the choice whether to adopt or reject the innovation, the fourth phase represents the real use of the innovation and the last phase is the confirmation of the decision (Driessen & Hillebrand, 2002; Sahin, 2006). This shows that there is a difference between the adoption intention and adoption behavior. The adoption intention can be seen as the decision-making process and thus the choice whether to use an innovation whereas the adoption behavior can be seen as the purchase or real use of an innovation (Arts et al, 2011). This also reflects the difference between saying and doing. Therefore, the adoption intention can be compared with the decision phase (saying) and the adoption behavior can be compared with the implementation phase (doing) of the adoption process (Arts et al., 2011; Driessen & Hillebrand, 2002; Frambach,

Barkema & Nooteboom, 1998). In the context of innovative technologies like robots it is especially interesting to have a look at the adoption intention and how it is influenced by the perceived innovation characteristics, because the adoption behavior is difficult to observe if the innovation is only slightly used.

2.1.1 Adoption intention

Adoption intention is a vague term because many different definitions exist. So, it is defined differently by different authors. Arts et al. (2011) define adoption intention as a person's craving to buy a new product. As explained by the authors "it relates to the [person's] state of mind before actual purchase behavior has occurred" (Arts et al., 2011, p. 135). Chin and Gopal (1995) in contrast say that the adoption intention represent the possibility that a person will make use of something. This shows that the adoption intention can e.g. be seen as a kind of desire, opinion, attitude, or option. Furthermore, both definitions focus on a person as a consumer. This is exactly what a manager is, but in an organizational context. The manager is the one who decides, for the organization, whether to make use of a new product like a robot and often the employees have to use it. Based on this the adoption intention will be defined as following:

> *The adoption intention is the willingness to decide whether to use a new product.*

2.1.2 Relative advantage

The relative advantage is part of the perceived innovation characteristics representing the attitude of a person towards an innovation (Waheed, Kaur, Ain & Sanni, 2015). The relative advantage is described as the degree to which an innovation is perceived as better than something existent (Rogers, 2002). Therefore, the innovation should create an advantage to replace the already existent product (Frambach et al., 1998). Furthermore, Frambach et al. (1998) add to this definition that the relative advantage has a positive impact on the adoption intention. These ideas are rooted in the adoption theory focusing on the consumer. Again, the manager is the consumer, but in an organizational context. The manager decides, based on perceptions, e.g. about the relative advantage, whether to make use of an innovation like a robot and the employees are possibly the users. Therefore, the relative advantage will be defined as following:

> *The relative advantage is the degree to which an innovation is perceived as better than an existent product.*

This shows that innovations which create advantages are often seen as valuable leading to the fact that people want them. Thus, they want to profit of these advantages. So, an advantage is associated with something positive. Therefore, it is expected that the relative advantage will have a positive effect on the adoption intention (Arts et al., 2011). In the context of robotization this means that robots will improve and simplify the manufacturing process (Ligthart et al., 2008; Moore & Benbasat, 1991; Ogbemhe et al., 2017; Singh et al., 2013). Furthermore, this means that the manager will expect that it is generally advantageous to make use of robots, because they e.g. make the total manufacturing process easier and less time consuming (Flight, D'Souza & Allaway, 2011; Ogbemhe et al., 2017; Singh et al., 2013).

However, this shows that the relative advantage has been well researched and therefore will not be part of the core, but of the basis of the following conceptual model. So, a quite concrete proposition can be formulated: It can be proposed that the manager's intention to adopt robots is positively influenced by the relative advantage.

2.1.3 Complexity

Also, the complexity is part of the perceived innovation characteristics representing the attitude of a person towards an innovation (Waheed et al., 2015). The complexity is described as the degree to which an innovation is perceived as difficult to understand or use (Rogers, 2002). Furthermore, Frambach et al. (1998) add to this definition that the complexity has a negative impact on the adoption intention. These ideas are also rooted in the adoption theory focusing on the consumer. As already mentioned, in this research the manager is central. The manager is the consumer, but in an organizational context and therefore decides, based on perceptions, e.g. about the complexity, whether to make use of an innovation like a robot and the employees are possibly the users. Therefore, the complexity will be defined as following:

> *The complexity is the degree to which an innovation is perceived as difficult to understand or to use.*

This shows that a high degree of complexity increases the possibility of non-adoption. Therefore, an expectation about the complexity exists: It is expected that the complexity will have a negative effect on the adoption intention (Arts et al., 2011). People do not value if something is complicated and may distance oneself from it. Thus, a high degree of complexity is disadvantageous for the adoption intention. So, complexity is associated with something negative. If people do not

understand a product, they will often not use it. Also, they will remember it as something negative. In the context of robotization this means that the manager e.g. will expect that it is difficult to make use of robots, integrate robots within the manufacturing process, convince the employees of its usefulness and that it requires high mental efforts (Ewing et al., 2004; Moore & Benbasat, 1991; Ogbemhe et al., 2017). Furthermore, the manager may expect that making use of robots could be frustrating, difficult, and unclear to the employees (Moore & Benbasat, 1991). Based on this a manager may also expect that making use of robots requires a high degree of knowledge (Flight et al., 2011).

However, this shows that the complexity has been well researched and therefore will not be part of the core, but of the basis of the following conceptual model. So, a quite concrete proposition can be formulated: It can be proposed that the manager's intention to adopt robots is negatively influenced by the complexity.

2.1.4 Compatibility

Also, the compatibility is part of the perceived innovation characteristics representing the attitude of a person towards an innovation (Waheed et al., 2015). The compatibility is defined as the degree to which an innovation is perceived as consistent with existing values, experiences and needs of a person (Rogers, 2002). To this definition Frambach et al. (1998) add that the compatibility will have a positive impact on the adoption intention. Again, these ideas are rooted in the adoption theory focusing on the consumer, but in this research the manager is central. The manager is the consumer, but in an organizational context and therefore decides, based on perceptions, e.g. about the compatibility, whether to make use of an innovation like a robot and the employees are possibly the users. Therefore, the compatibility is defined as following:

> *The compatibility is the degree to which an innovation is expected to fit existing values, experiences and needs.*

This definition shows that a good compatibility will have a positive effect on the adoption intention. Therefore, a positive effect of the compatibility on the adoption intention is expected (Arts et al., 2011). People perceive products fitting their life as positive and are happy to make use of these products. So, a good or high compatibility will increase the willingness of adoption and is therefore associated with something positive. In the context of robotization this means that the manager e.g. expects that making use of robots fits the situation of the company and the way things

are done even as the manufacturing process (Ligthart et al., 2008; Moore & Benbasat, 1991; Ogbemhe et al., 2017; Singh et al., 2013). Also, it could be expected by managers that making use of robots will fit the way the company sees itself even as the fact that it is socially accepted or more concrete accepted by the employees (Flight et al., 2011).

However, this shows that the compatibility has been well researched and therefore will not be part of the core, but of the basis of the following conceptual model. So, a quite concrete proposition can be formulated: It can be proposed that the manager's intention to adopt robots is positively influenced by the compatibility.

2.2 Technology Acceptance Model

The Technology Acceptance Model has been chosen because it helps to understand the managers view on the employees who have to use the technological innovation. So, this theory helps to predict the acceptance of a new technological innovation by individuals within the firm like e.g. employees who really use it (Nejad et al., 2016). This theory shows that the acceptance is influenced by the perceived ease of use and the perceived usefulness (Nejad et al., 2016). Therefore, it is proposed that the "perceived ease of use and perceived usefulness […] determine the behavioral intention […] to use the [technological innovation]" (Dasgupta, Granger & McGarry 2002, p. 89).

2.2.1 Perceived ease of use

The perceived ease of use is part of the Technology Acceptance Model and helps to explain why stakeholder like e.g. employees would accept a new technological innovation (Dasgupta et al., 2002; Nejad et al., 2016). Thus, the perceived ease of use is the "degree to which a person believes that using a particular [innovation] would be free of effort" (Davis, 1989; Nejad et al., 2016, p. 4). Furthermore, Dasgupta et al. (2002) predict that the perceived ease of use influences the innovation usage and thus acceptance. These ideas are rooted in the Technology Acceptance Model focusing on the actual use of the technological innovation. Even if the manager is central to this research, his employees often have to use the technological innovation. So, the manager also needs to know what the employees' opinion is e.g. about the user-friendliness of the technological innovation to come up with the best decision possible. Therefore, the perceived ease of use is defined as following:

The perceived ease of use is the degree to which it is expected that using an innovation would be free of effort.

This shows that a high or a good ease of use will have a positive effect on the employees' acceptance and finally on the manager's intention to adopt whereas a low or bad ease of use will have a negative effect. Therefore, an effect on the acceptance is expected (Dasgupta et al., 2002). People perceive a technological innovation that is user-friendly as positively and enjoy making use of it, whereas people perceive a technological innovation that is not user-friendly as negatively and will not enjoy making use of it. So, a high or good ease of use will increase the willingness to accept the innovation and is therefore associated with something positive, whereas a low or bad ease of use will decrease the willingness to accept an innovation and is therefore associated with something negative. In the context of robotization this means that the employees' acceptance could influences the manager's intention to adopt robots by positively or negatively affecting the relative advantage, complexity, and compatibility.

So, it is still unknown what the effect of the perceived ease of use will be on the manager's perceived innovation characteristics and finally on the adoption intention. Thus, the manager's perception of the employees' perceived ease of use could positively or negatively influence the effect of the manager's perceived relative advantage, perceived complexity, and/or perceived compatibility on the adoption intention.

2.2.2 Perceived usefulness

The perceived usefulness is part of the Technology Acceptance Model and helps to explain why stakeholders like e.g. employees would accept a new technological innovation (Dasgupta et al., 2002; Nejad et al., 2016). Thus, the perceived usefulness is "the degree to which a person believes that using a particular [innovation] would enhance his or her job performance" (Davis, 1989; Nejad et al., 2016, p. 4). Furthermore, Dasgupta et al. (2002) predict that the perceived usefulness influences the innovation usage and thus acceptance. Again, these ideas are rooted in the Technology Acceptance Model focusing on the actual use of the technological innovation. Even if the manager is central to this research, his employees often have to use the technological innovation. So, the manager also needs to know what the employees' opinion is e.g. about the usefulness of the technological innovation to come up with the best decision possible. Therefore, the perceived usefulness is defined as following:

The perceived usefulness is the degree to which it is expected that using an innovation would enhance the job performance.

This shows that a high usefulness will have a positive effect on the employees' acceptance and finally on the manager's adoption intention whereas a low usefulness will have a negative effect. Therefore, an effect on the acceptance is expected (Dasgupta et al., 2002). People perceive a technological innovation that is useful as positively and valuable and a technological innovation that is not useful as negatively and not valuable. So, a high usefulness will increase the willingness to accept the innovation and is therefore associated with something positive, whereas a low usefulness will decrease the willingness to accept the innovation and is therefore associated with something negative. In the context of robotization this means that the employees' acceptance could influences the manager's intention to adopt a robot by positively or negatively affecting the relative advantage, complexity, and compatibility.

So, it is still unknown what the effect of the perceived usefulness will be on the manager's perceived innovation characteristics and finally on the adoption intention. Thus, the manager's perception of the employees' perceived usefulness could positively or negatively influence the effect of the manager's perceived relative advantage, perceived complexity, and/or perceived compatibility on the adoption intention.

2.3 Stakeholder management perspective

The stakeholder management perspective has been chosen, because also other actors than the employees can have an influence on or might be affected by the manager's decisions. Furthermore, also other persons or companies etc. can have an influence. So, this theory helps a manager to understand the stakeholders that might have an influence even as to come up with methods to manage these stakeholders (Freeman & McVea, 2001). Stakeholders are "any group or individual who is affected or can affect the achievement of an organization's objectives" (Freeman & McVea, 2001, p. 192). As shown by the stakeholder model there are eight different stakeholders: governments, investors, political groups, customers, communities, employees, trade associations and suppliers (Donaldson & Preston, 1995). These or a selection of them are the stakeholders a manager needs to satisfy to ensure the long-term success of the firm (Freeman & McVea, 2001).

Thus, it can be proposed that also other stakeholders than the employees will affect the adoption intention. However, the mentioned types of stakeholders can be grouped into latent stakeholders like dormant, discretionary, or demanding stakeholders or into expectant stakeholders

like dominant, dangerous, or dependent stakeholders (Mainardes et al., 2012; Mitchell et al., 1997). The classification depends on the power, legitimacy, and urgency of the particular stakeholder (Mainardes et al., 2012; Mitchell et al., 1997). Latent stakeholders possess only one of the three mentioned attributes (Mainardes et al., 2012). Therefore, dormant stakeholders possess power, discretionary stakeholders possess legitimacy and demanding stakeholders possess urgency (Mainardes et al., 2012; Mitchell et al., 1997). Expectant stakeholders possess two of the three mentioned attributes (Mainardes et al., 2012). Therefore, dominant stakeholders possess power and legitimacy, dependent stakeholders possess legitimacy and urgency and dangerous stakeholders possess power and urgency (Mainardes et al., 2012; Mitchell et al., 1997). In addition, definitive stakeholders exist possessing all three attributes (Mitchell et al., 1997). Thus, different types of stakeholders can differ in their impact on the manager's adoption intention by varying in the powerfulness, legitimacy, and urgency. So, these stakeholders could directly affect the manager's adoption intention or strengthen the effect of the manager's perceived relative advantage, perceived complexity, and/or perceived compatibility on the adoption intention.

2.4 Conceptual model

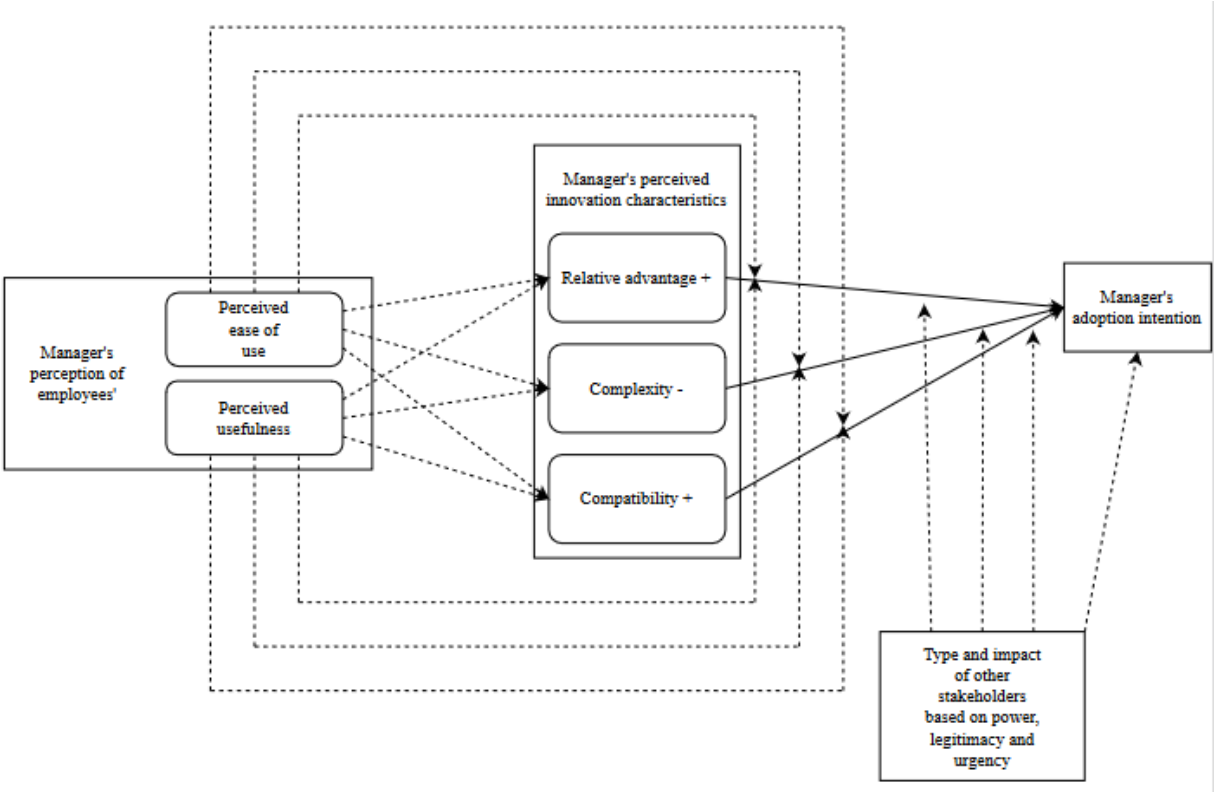

Figure 2.1: Conceptual Model

Within this conceptual model the adoption theory, the Technology Acceptance Model and the stakeholder management perspective are central (see Figure 2.1).

The conceptual model shows how the different concepts are connected. Starting with the adoption theory it can be said that the perceived innovation characteristics influence the adoption intention significantly. The perceived innovation characteristics are as already explained the relative advantage, the complexity, and the compatibility. Both the relative advantage, and the compatibility are expected to have a positive effect on the adoption intention (Arts et al., 2011). The complexity in contrast is expected to have a negative effect on the adoption intention (Arts et al., 2011). So, theory is quite sure about the impact of these perceived innovation characteristics on the adoption intention. Furthermore, only three out of five perceived innovation characteristics are used. The trialability and the observability are not used. The trialability is the degree to which an innovation can be tested, and the observability is the degree to which the results of an innovation can be seen (Rogers, 2002). These perceived innovation characteristics are not used, because it is expected that there will be no real difference in cognition. Although, robots could be observed within other organizations both innovation characteristics are not that relevant when looking at the manager's perception of the employees' perception. Furthermore, it is difficult for a company to really test respectively try out robots without buying them. Therefore, it is not needed to take these perceived innovation characteristics into account. However, the observability will become a control variable to test the propositions at a constant level (Klarmann & Feurer, 2018).

Now the focus will be on the Technology Acceptance Model. The combination of the Technology Acceptance Model and the adoption theory is new in the context of robotization. So, there are no clear expectations about what influence the manager's perception of the employees' perceived ease of use and perceived usefulness might have on the manager's perceived innovation characteristics and finally on the manager's adoption intention. Therefore, it is not known if and how the manager's view on the employees' opinion about robots might influence the manager's adoption intention. Nevertheless, in this research it is expected that the manager's perception of the employees' perceived ease of use and perceived usefulness do influence the adoption intention. Although, it is still unclear how the manager's perception of the employees' perceived ease of use and perceived usefulness do affect the adoption intention. So, significant moderation or mediation effects are expected because the impact of the manager's perceived innovation characteristics on the adoption intention could become indirect or could be strengthened by the manager's perception

of the employees' perceived ease of use or perceived usefulness. So, the manager could value his or her perception of the employees' perceived ease of use or perceived usefulness over his or her perceived innovation characteristics (vice versa). Therefore, the impact of the manager's perceived innovation characteristics on the adoption intention could become irrelevant or could be strengthened. Furthermore, the manger's perception of the employees' perceived ease of use or perceived usefulness could be (partly) striking or accord with the manager's perceived innovation characteristics. This could make the impact of the manager's perceived innovation characteristics on the adoption intention irrelevant and/or could strengthen it. This shows that there are no clear expectations about the combination of these theories and therefore reflects a knowledge gap.

Next, the stakeholder management perspective plays an important role. Not only the employees affect the manager's adoption intention, but also other stakeholders like governments, investors, political groups, customers, communities, trade associations or suppliers. These can be grouped into latent (dormant, discretionary, or demanding), expectant stakeholder (dominant, dangerous, or dependent) and definitive stakeholder based on their power, legitimacy, and urgency. So, these stakeholders or a collection of these stakeholders could directly influence the manager's adoption intention or strengthen the impact of the manager's perceived innovation characteristics on the adoption intention creating a moderation effect.

2.5 Conclusion

Summing up, the combination of the adoption theory, the Technology Acceptance Model and the stakeholder management perspective will provide new insights about the manager's intention to adopt robots influenced by the employees and other possible stakeholders. Due to the fact that this combination is new in the context of robotization it is still unclear if the manager's perception of the employees' perceived ease of use and perceived usefulness moderate or mediate the positive effect that the manager's perceived relative advantage or perceived compatibility will have on the manager's adoption intention and the negative effect that the manager's perceived complexity will have on the manager's adoption intention. Furthermore, also other types of stakeholders may directly affect the manager's adoption intention or may moderate the mentioned effects on the manager's adoption intention based on their power, legitimacy, and urgency.

3 Methods

In the previous chapters the reason, goal and theory has been explained. This chapter is a justification of the way the research goal is realized, and the research question is answered. In this chapter the execution of the research will be presented.

3.1 Research strategy

A case study method is chosen for this research. A case study method, in comparison to a survey, allows in-depth exploration of a phenomenon that is not yet described (Babbie, 2010; Yin, 2014). This is important, because as already mentioned only little research has been done about the manager's intention to adopt robots even as how employees affect this decision. Also, no study could have been found that combines the adoption theory, the Technology Acceptance Model, and the stakeholder management perspective in the context of robotization. In addition, the case study method makes it possible to explore relationships that are not clear yet. Thus, a case study helps to understand a phenomenon that is not clear yet by zooming in on relationships instead of only noticing relationships (Swanborn, 2010; Yin, 2014). This is especially important when looking at the new combination of the three theories and therefore e.g. when looking at the effect that the manager's view on the employees could have on the manager's intention to adopt robots, because it is still unclear if it is a moderation or mediation effect. Based on this a case study is perfectly suited to provide the missing information needed. In addition, a case study allows to collect and interpret statements to come up with conclusions about a real phenomenon (Yin, 2014). Thus, informants can provide arguments and explain them (Yin, 2014). So, compared to a survey, the case study method allows to collect reasons and motives to explain informants decisions (Yin, 2014). This is of importance, because it helps to find an answer to the problem that managers are facing and finally an answer to the formulated research question.

3.2 Operationalization

Construct	Dimension	Questions	Source
Adoption intention		Do you intend to use robots in the future? Why or why not?	Based on Waheed et al. (2015)
		How long do you already intend to use robots?	Idem
Manager's perceived	Relative advantage	What kind of relative advantage do you see/expect when/from making use of robots? Think of the quality of	Based on Moore &

innovation characteristics		work, timesaving, simplification, organizational performance, effectiveness, or productivity.	Benbasat (1991) and Nejad et al. (2016)
		Do you see/expect any further advantages?	Idem
		Do you see/expect any disadvantages?	
		Would you say that the disadvantages overshadow the advantages of robots in the production site? Why or why not?	Based on Moore & Benbasat (1991)
	Complexity	Do you see/expect any problems or difficulties when (making) use of robots?	Based on Waheed et al. (2015)
		What (do you think) does the use of robots require? Think of special skills, a higher general level of knowledge or a considerable amount of time to learn how to use them.	Based on Flight et al. (2011)
		Could you explain why robots are/could be (possibly) difficult to use for work in the production site or why it is/could be (possibly) difficult to understand why robots are/should be used for work in the production site?	Idem
	Compatibility	Would you say that using robots is/would be compatible with the current situation of the organization? Think about the manufacturing process(es), way of working etc. Why or why not?	Based on Moore & Benbasat (1991)
Manager's perception of employees'	Perceived ease of use	Do you think that employees (would) perceive robots as user-friendly? Think about the easiness to use, learning process, user manual etc. Why or why not?	Based on Moore & Benbasat (1991)
		Do you think that employees (would) believe that robots are cumbersome to use? Why or why not?	
		Could the use of robots even be frustrating for employees? Why or why not?	
	Perceived usefulness	Would you say that employees (would) perceive robots as useful? Think about the employees' job performance, improved easiness of work, effectiveness, productivity, time saving or quality of work etc. Why or why not?	Based on Davis (1989)

Control variables	Observability	What is your position within the organization?	Idem
		How long do you work in this position?	
		How many employees work in the production site of the organization?	
		As how innovative would you describe yourself?	
		What is your attitude towards robots? Think about robots that can perform various tasks like e.g. welding, painting, packaging, 3D printing, milling, water jet cutting, assembling, polishing or pick and place.	
		Does the organization use robots? Why or why not?	
		What type of robots does/could the organization use?	
		Which tasks are/could be performed by robots? Why?	
		If these tasks are/would be performed by robots how many employees have been/could possibly be replaced by robots in the production site?	
		Have/would these employees be fired, or would they further be employed? Why?	
		Were/Would also new employees (be) needed to operate or program etc. the robots?	
		If you have to decide whether to use robots again what would your decision be?	
		Why are (not) you willing to invest in robots at all?	

To come up with a good questionnaire and to be able to give an answer to the formulated research question questions and items of valid scales from literature have been used. These scales are appropriate because they contain relevant questions and items for this research. Furthermore, additional questions have been formulated by the researcher.

Waheed et al. (2015) present a scale to measure the adoption intention in the context of e-books with five items. Thus, the context needed to be adapted. Therefore, the words eBook reader and book were replaced by robots. Also, the items were changed into questions with the addition "Why or why not?". Furthermore, not all items were appropriate in the context of robotization.

Only one item was used. In addition, one item has been formulated by the researcher as can been seen in the table above marked by “Idem”.

To formulate questions about the manager’s perceived innovation characteristics and thus about the perceived relative advantage, complexity and compatibility different scales have been used even as three question formulated by the researcher. Again, the scale of Waheed et al. (2015) have been used even as the scales by Nejad et al. (2016), Moore & Benbasat (1991) and Flight et al. (2011). Waheed et al. (2015) also contains a scale about the complexity in the context of e-books with three items. Only one out of these three items was appropriate in the context of robotization. This item has been changed into a question with the addition “Why or why not?” and the word eBook reader was replaced by robots. Also, one question has been formulated about the complexity by the researcher as marked by “Idem”. Nejad et al. (2016) contain one question about the relative advantage in the context of mobile payment which has been taken over. Thus, the word mobile payment service was replaced by robots. Furthermore, two items have been formulated by the researcher as marked by “Idem”. Moore & Benbasat (1991) contain 21 items about the three variables mentioned before in the context of PWS. Therefore, these items needed to be adapted to the context of robotization by replacing the word PWS by the word robots. Also, the items needed to be transformed into questions with the addition “Why or why not?” or partly summed up into one question. Furthermore, not all items were appropriate in the context of robotization. So, only ten items have been used. If the items are summed up, they are marked by “Think of/about…”. Flight et al. (2011) contain 21 items about the three variables mentioned before in the context of product innovation adoption. Thus, these items needed to be adapted to the context of robotization by replacing the word product by the word robots. Also, the items needed to be transformed into questions with the addition “Why or why not?” and summed up into one question marked by “Think of…”. Furthermore, not all items were appropriate in the context of robotization. Only three have been used.

To formulate questions about the manager’s perception of the employees’ perceived ease of use and perceived usefulness the scales by Moore & Benbasat (1991) and Davis (1989) have been used. Moore & Benbasat (1991) also contain eight items about the perceived ease of use in the context of PWS. Therefore, these items needed to be adapted to the context of robotization by replacing the words I, my or me by the word employees and the word PWS by the word robots. Also, the items have been changed into questions with the addition “Why or why not?” or partly

summed up into one question marked by “Think about…”. Furthermore, not all items have been used. Out of eight items five were used. Davis (1989) contains 14 items about the perceived usefulness in the context of electronic mail. Thus, these items have been adapted to the context of robotization by replacing the words I, my or me by the word employees and the words electronic mail or electronic mail system by the word robots. Also, the items were summed up into one question with the addition “Why or why not?”. Furthermore, not all items were appropriate in the context of robotization. Therefore, only six items have been used marked by “Think about…”.

Finally, control variables have been used that were formulated by the researches as marked by “Idem” and as can been seen in the table above. Thirteen in total.

Also, a pilot test has been conducted to look whether the questions are understandable. This pilot test showed that the interviews took about an hour and that the questions are suited and understandable. The answers were clear, extensive and revealing. So, the questions did not need to be changed with regards to content. However the question “As how innovative would you describe yourself?” has been moved to the general questions and the first two questions about the stakeholders were summed up into one question: “Which other types of stakeholders did/do affect your intention to adopt robots? Think of governments, investors, political groups, customers, communities, trade associations or suppliers.”. So, this pilot test helped in getting the questions more concrete. In the table above these adaptations have already been changed.

3.3 Case selection

To select cases the most important criteria have been used. Generally, there are different types of subsectors within the manufacturing industry. Ligthart et al. (2008) e.g. come up with six subsectors within the manufacturing industry: Food and luxury food, textile and paper, building material, furniture and remaining, mineral oil and chemicals, metal production and products and machines and means of transport. These are also the main subsectors identified within other studies (Graetz & Michaels, 2018; Zhang et al., 2014). However, it is important to have a look at the subsectors that provide the most opportunities for making use of robots. In addition, robots can perform various tasks like e.g. welding, painting, packaging, 3D printing, milling, water jet cutting, cutting, assembling, polishing or pick and place (Graetz & Michaels, 2018; Zhang et al., 2014; Zhou, 2017). Based on this the most opportunities for making use of robots are provided by the subsectors mineral oil and chemicals, building material, furniture and remaining, textile and paper

and means of transport. So, the cases that will be researched are: Polymer processing, wood processing, paper converting and car production.

3.4 Data collection

3.4.1 Informants

To conduct this research eight interviews have been held with eight managers of manufacturing companies within the four different subsectors. So, per case two managers of a manufacturing company have been interviewed. This will increase the reliability of the research. The cases and thus the managers who have been interviewed can be found in the following table (see Table 3.1).

Table 3.1: Cases and informants

Cases	**PlasticBX**		**WoodVK**		**PaperML**		**CarDD**	
Manufacturing industry	Chemical		Wood		Paper		Car	
Use of robots in production	No		Yes		No		Yes	
Number of employees	694		25		5		421	
Informants	**PLI13**	**PLI14**	**WOI9**	**WOI10**	**PAI7**	**PAI8**	**CAI11**	**CAI12**
Informant's function/position	Assistant to the supply chain leader	Automation technology manager	CEO	Production manager	CEO	Management assistant	Production manager	Production area manager
Duration of employment in years	2	4	9	10	8	8	11	14
Duration of the interview in minutes	39	40	40	35	38	79	49	35
Informants' innovativeness	High	High	High	High	High	High	High	High
Informants' attitude	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
Informant's willingness to use robots	High	High	High	High	High	High	High	High
Informants' willingness to invest	High	High	High	High	High	High	High	High

As shown by the table the managers are innovative and got an overall positive attitude towards robots independently of the industry, firm size or whether robots are used. Furthermore, all

managers are willing to invest into robots and to use them. Also it needs to be mentioned that the names of cases and managers are fictitious (see Appendix 4).

3.4.2 Question list

To give an answer to the research question data needs to be collected. This has been done by making use of open interviews (see Appendix 1-3). In comparison to surveys open interviews allow informants to give an answer in their own words and therefore are often more comprehensive (Yin, 2014). Furthermore, a semi-structured interview has been used. Compared to unstructured interviews, semi-structured interviews help to cover similar topics in different interviews to make them comparable by formulating and structuring the questions before (Yin, 2014). Therefore, semi-structured interviews increase the validity. Nevertheless, there has been space to ask additional questions or change order (Yin, 2014). So, compared to structured interviews, semi-structured interviews make it possible to ask more open-ended question, allowing for discussions with the interviewee (Yin, 2014). As already mentioned, the semi-structured interviews have been conducted with eight managers of manufacturing companies active in the four different subsectors. The mangers have been contacted by phone or mail dependent on the situation and via the network of the researcher or via the links provided by the supervisor.

3.5 Data processing and analysis

The interviews have been done personally in compliance with the distance regulations or via telephone and were recorded. After the interviews have been conducted the recordings were transformed into literal transcripts. A literal transcript is a detailed reproduction of what has been said during the interview. Using literal transcripts is the best method to analyse the interviews, because it increases the checkability and decreases the chance of wrong interpretations of the data (Yin, 2014). After creating these literal transcripts they have been coded. The coding has been done in a deductive manner (see Appendix 5). A deductive manner compared to an inductive manner presumes that the researcher will be guided by theoretical expectations (Yin, 2014). In this research propositions have been formulated that were used as guidelines for the coding. Furthermore, central concepts and dimensions have been determined to check whether they come back in the literal transcripts (see Appendix 5). Thus, this way of data processing increases the reliability and validity. Especially, the reliability is ensured by accurately specifying every step that has been taken in this research. Furthermore, the checkability has been increased by accurate literal transcripts and coding.

Finally, the pattern-matching analysis logic has been used. In comparison to other analysis techniques like e.g. the explanation building, time-series, logic model or cross-case synthesis the pattern-matching analysis allows to compare a predicted pattern with a revealed pattern based on the outcomes of the case study (Yin, 2014). This logic thus helps in comparing the theoretical considerations with the observed reality by "[linking] a predicted pattern that is derived from theory, with an observed pattern" (Sinkovics, 2018, p. 4). Thus, the formulated propositions were compared with what has been said during the interviews to check whether these propositions are the truth. So, compared to the other analysis techniques the pattern-matching analysis strengthens the internal validity if the propositions are confirmed (Yin, 2014). However, pattern-matching analysis is seen as more desirable than the other analysis techniques (Yin, 2014).

3.6 Research ethics

To secure that the researcher can be held accountable for her actions and that the public can trust the research the following aspects have been respected. The researcher behaved in a professional and objective way, informants have been treated with respect and the researcher took care of them. According to the current situation the researcher made use of the minimum number of informants needed to fulfil the research goal and the interviews have been done personally in compliance with the distance regulations or via telephone. Also, the researcher kept to agreements and acted sincerely. So, the researcher made sure that the research goal is known by the informants by explaining it to them in the beginning of the interviews even as that it is possible to withdraw from the research. Furthermore, confidentiality and anonymity are guaranteed by making use of fictional names. In addition, everything provided by the informants have been respected and not be valued. Just as well other peoples' work used within this research has been indicated by making use of references. The informants will be informed about the results of the research via e-mail. How informants can apply these results will be discussed in the last chapter of the research. Finally, it needs to be mentioned that this research has been reported honestly by not making up data, not misleading, avoiding bias, disclosing personal or financial interests, critically reviewing, assuming responsibility and only pursuing the goal to advance knowledge.

4 Results

In the previous chapters the reason, goal, theory and justification of the way the research goal is realized, and the research question is answered have been explained. In this chapter the results will be presented. Firstly, the cases will be described in more detail to provide a general overview. Next to that, every single aspect that could influence the manager's intention to adopt robots will be discussed. These aspects are the manager's perceived relative advantage, perceived complexity and perceived compatibility, the manager's perception of the employees' perceived ease of use and perceived usefulness even as the type and impact of other stakeholders based on power, legitimacy and urgency. Also, it will be discussed if there is a difference between small and big manufacturing companies even as between manufacturing companies using robots or not.

Therefore, information and quotes will be used from the interviews. These quotes are linked to the original Dutch and German quotes in Appendix 6. Furthermore, the interviews are part of the Appendices 7 to 14. These numbers are included in the codes for the informants.

4.1 Case description

Four manufacturing companies located in the Netherlands and in Germany have been included in this research and have been interviewed. These companies will be described below.

4.1.1 PlasticBX

PlasticBX was founded in 1981 and is a family-owned producer of plastic granulates located in Germany, Canada and the U.S.A. They offer different types of masterbatches and other products like e.g. cables. Furthermore, they focus on tailored products and on mass customization. Till now no robots are used for work in the production site. However, they would like to use industrial robots and autonomous mobile robots sometime in the near future when these robots are a little bit more mature e.g. for screen change or other work (see PLI13 & PLI14).

4.1.2 WoodVK

WoodVK is a family-owned producer of pallets located in the Netherlands with more than 25 years of experience. They offer two different types of pallets even as wooded boxes. Furthermore, they focus on tailored products and on mass production. For work in the productions site four robots are used to increase quality, speed and flexibility. These robots are industrial robots that have been used successfully for several years to put in covers and to stack the finished pallets. So, these robots will also be used in the future (see WOI9 & WOI10).

4.1.3 PaperML

PaperML is a family-owned producer of sterilization products located in the Netherlands with about 20 years of experience. They offer different products like e.g. filters or indicators for the medical, dental and veterinary industry. Till now no robots are used for work in the production site. However, they would like to use industrial robots to produce a whole product package when the demand is growing and consequently the company has to grow (see PAI7 & PAI8).

4.1.4 CarDD

CarDD was founded in 1832 and is a producer of components for the automotive industry located in Germany. They e.g. offer cross members, reinforcements, brackets, safety belt or axle attachments. Furthermore, they focus on mass production. To do so they use different robots for work in the production site. These robots are industrial robots that have been used successfully for years to swivel and transport the parts and for welding. So, these robots will also be used in the future (see CAI11 & CAI12).

4.1.5 Comparison of cases and informants

To provide a general overview the following table with the results of the interviews has been provided. This table not only helps to clarify whether and why there is an influence of the basic factors (relative advantage, complexity and compatibility), but also of the manager's perception of the employees. (see Table 4.1).

Table 4.1: Results

	Cases	PlasticBX		WoodVK		PaperML		CarDD	
	Informants	PLI13	PLI14	WOI9	WOI10	PAI7	PAI8	CAI11	CAI12
	Use of robots	No		Yes		No		Yes	
	Number of employees	694		25		5		421	
Impact on manager's perceived relative advantage	Manager's perception of the employees' perceived ease of use	Positive	No	Positive	Positive	Positive	No	Positive	Positive
	Manager's perception of the employees' perceived usefulness	Positive	Positive	Positive	Positive	Positive	No	Positive	Positive
Impact on manager's perceived complexity	Manager's perception of the employees' perceived ease of use	Positive	Positive	Positive	No	Positive	No	No	No
	Manager's perception of the employees' perceived usefulness	Positive	No	No	No	Positive	No	Positive	No
Impact on manager's perceived compatibility	Manager's perception of the employees' perceived ease of use	Positive	No	No	Positive	Positive	No	No	No
	Manager's perception of the employees' perceived usefulness	Positive	Positive	No	No	Positive	No	Positive	Positive
Impact on manager's adoption intention	Manager's perceived relative advantage	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Manager's perceived complexity	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Manager's perceived compatibility	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Manager's perception of the employees' perceived ease of use	Indirect positive	Indirect positive	Indirect positive	Indirect positive	Indirect positive	No	Indirect positive	Indirect positive
	Manager's perception of the employees' perceived usefulness	Indirect positive	Indirect positive	Indirect positive	Indirect positive	Indirect positive	No	Indirect positive	Indirect positive

WoodVK and CarDD already use robots for work in the production site whereas PlasticBX and PaperML would like to use robots for work in the production site in the future. WoodVK and CarDD both use industrial robots for different tasks. WoodVK uses robots to put in covers and to stack the finished pallets, whereas CarDD uses robots to swivel and transport the parts and for welding. In addition, both companies are positive about robots and explain that robots belong to the companies. Furthermore, they intend to use robots even in the future (see WOI9, WOI10, CAI11 & CAI12). Till now PlasticBX and PaperML both do not use robots for work in the production site for different reasons. PlasticBX would like to use industrial robots even as autonomous mobile robots e.g. for screen change or other work when these robots are a little bit more mature. PaperML would like to use industrial robots to produce a whole product package when the demand is growing. So, both intend to use robots and are positive about the use of robots (see PAI7, PAI8, PLI13 & PLI14).

4.2 Manager's perceived relative advantage

The interviews show that the manager's perceived relative advantage does have a positive influence on the adoption intention. From the informants' answers there is a clear indication that the relative advantage of robots is an increased and improved productivity: *"That [the relative advantage] is purely the […] productivity. That is the most important thing to us."* (PAI7). Furthermore, this will positively influence the intention to adopt robots. This is the case because using robots and thus to get an increased and improved productivity enables a manufacturing company to produce more, faster and at lower costs, to reduce mistakes or to even stay more focused. As illustrated by the CEO from WoodVK (WOI9) *"It [a robot] does what it is supposed to do. It is effective, it is reliable, it is fast, it is user-friendly, it is easy to maintain."* Some informants like the CEO from WoodVK (WOI9) even highlighted that robots are never ill and thus will do what they are supposed to do: *"[…] it [the robot] is there every day, is never sick and does not complain that it is tired that it is heavy."*

Nevertheless, also disadvantages have been mentioned. The biggest disadvantage seems to be that robots are really expensive due to the costs of purchase or maintenance costs. However, the production area manager from CarDD (CAI12) clearly stated: *"[…] I would not perceive it as a serious disadvantage."* Thus, the relative advantage seems to be much stronger than the disadvantages. In addition, the production manager from CarDD (CAI11) explained that the robotization is unstoppable for manufacturing companies: *"[…] robot automation will continue to move in. All in all, exactly where there are heavily loaded workplaces. […] where the indoor air is very very bad, where the heat is very very high, simply difficult working conditions […] there such automation will be promoted."*

This shows that the manager's perceived relative advantage does have a positive influence on the manager's intention to adopt robots. According to the informants robots will become more and more important to manufacturing companies, based on the relative advantage which is greater than that of previous machines or ways of working. Therefore the following proposition is formulated:

> *Proposition 1: The manager's perceived relative advantage positively influences the manager's adoption intention.*

However, also the manager's perception of the employees' perceived ease of use and perceived usefulness could influence the manager's perceived relative advantage and thus its impact on the adoption intention. The two penultimate paragraphs of this chapter will focus on these possible influences.

Finally, it needs to be mentioned that for this proposition there is neither a difference between small and big manufacturing companies nor a difference between manufacturing companies using robots and manufacturing companies not using robots.

4.3 Manager's perceived complexity

The interviews show that the perceived complexity positively influences the adoption intention. However, a negative influence was expected due to the fact that innovations could be difficult to understand or used. When looking at the answers provided by the informants this does not seem to be the case, although special knowledge, training or safety equipment is needed which might make the use of robots more complex or the fact that people always need to follow the safety regulations. However, from the informant's answers there is a clear indication that the manager's perceived complexity will have a positive influence on the manager's intention to adopt robots. Therefore, the CEO from WoodVK (WOI9) e.g. explained that the safety regulations or equipment might be a disadvantage, but not big enough to negatively influence the adoption intention: *"Therefore [to use robots], you do not need higher mathematics or university. […] everyone can […] work with them."* Furthermore, robots seem to be easy to understand and use because they are programmed by the producer and handbooks or even apps are available explaining how to use them. In addition, the automation technology manager from PlasticBX (PLI14) explained that problems are often *"[…] not robot-related […], but […] firm-related."* The same goes for the management assistant from PaperML who does not see problems regarding the use of robots at all (PAI8): *"I cannot think of anything."*

This shows that the manager's perceived complexity does have a positive influence on the manager's intention to adopt robots. According to the informants it is not really difficult to understand or use robots so that the perceived complexity is low. Therefore the following proposition is formulated:

> *Proposition 2: The manager's perceived complexity positively influences the manager's adoption intention.*

However, also the manager's perception of the employees' perceived ease of use and perceived usefulness could influence the manager's perceived complexity and thus its impact on the adoption intention. The two penultimate paragraphs of this chapter will focus on these possible influences.

Finally, it needs to be mentioned that for this proposition there is neither a difference between small and big manufacturing companies nor a difference between manufacturing companies using robots and manufacturing companies not using robots.

4.4 Manager's perceived compatibility

Also, the interviews show that the perceived compatibility positively influences the adoption intention. From the informants' answers there is a clear indication that the compatibility positively influences the intention to adopt robots. This is the case because it is getting harder to find employees, robots can perform tasks that the employees are no longer allowed to do (such as lifting heavy things), robots can help to optimize processes, robots can help to save space and robots fit to mass-produce which is often important to manufacturing companies. Therefore, the production area manager from CarDD (CAI12) said: *"[…] automotive [manufacturing companies] and robots always belong together."* The same goes for the production manager from CarDD (CAI11): *"[…] just as the youngest children in school today possess a cell phone [...], robotics belongs to manufacturing companies."* This indicates that robots are part of the technological development. Thus, the informants feel like they would miss the connection or would be left behind without robots: *"Horse and carriage are over."* (PAI8). The production manager from CarDD (CAI11) illustrated this as well: *"Frustrating would be if young people would come to our company and we would not have [robots], […] because they say where am I here? In the Middle Ages?"* They also highlighted that it is important to go along with the technological development to survive: *"If I do not go along I will die and when I am dead I cannot pay my employees or the company cannot pay its employees, you do not make money and you have nothing to eat at the end of the month."* (PLI13). However, some manufacturing companies may think that robots are not yet suitable for them, although this is not the case because robots can be adjusted to make them fit. As explained by the CEO from PaperML (PAI7): *"[…] a little bit handcrafting, adjusting […] modifying to make it fit. This is also possible with a robot. You are able to help. You can make somewhere a strip or a clip or a feather that says if it goes crooked then just straighten it or it will make it against it so that a sensor is activated."*

This shows that the manager's perceived compatibility does have a positive influence on the manager's intention to adopt robots. Regarding the informants, robots are part of the developments of today and thus fit existing values, experiences and needs. Therefore the following proposition is formulated:

> *Proposition 3: The manager's perceived compatibility positively influences the manager's adoption intention.*

However, also the manager's perception of the employees' perceived ease of use and perceived usefulness could influence the manager's perceived compatibility and thus its impact on the adoption intention. The two penultimate paragraphs of this chapter will focus on these possible influences.

Finally, it needs to be mentioned that for this proposition there is neither a difference between small and big manufacturing companies nor a difference between manufacturing companies using robots and manufacturing companies not using robots.

4.5 Manager's perception of employees' perceived ease of use

As already explained during the theory chapter it is not clear yet if the manager's perception of the employees' perceived ease of use has a direct or indirect influence on the manager's adoption intention. The interviews show that the manager's perception of the employees' perceived ease of use has an indirect and positive influence on the adoption intention. Thus, through affecting the manager's perceived relative advantage, perceived complexity and/or perceived compatibility, the manager's perception of the employees' perceived ease of use will have an impact on the manager's adoption intention. Why this is the case will become clear when looking at the statements provided by the informants, but firstly it will be described if the informants believe that their employees perceive robots as user-friendly.

Based on the informants' answers there is a clear indication that they believe that robots are perceived as user-friendly by their employees and that this will have an influence on their intention to adopt robots. This is the case because today using robots is often part of an employee's apprenticeship and if not they will get trainings on how to use them. In addition, the robots are preprogrammed by the producer so that everyone should easily be able to use them. Therefore it seems to be that managers think that robots are seen as a supportive tool by employees. Especially, the CEO from WoodVK (WOI9) experienced: *"[…] boys [employees] find a robot fantastic. That*

makes their job much easier." The same goes for the production manager from CarDD (CAI11): *"They [employees] are […] grateful. It [robot] is simply part of it."* More concrete, the production manager from WoodVK (WOI10) highlighted: *"You [employees] only need three buttons to turn it on. So it cannot be easier or more user-friendly."*

The only thing managers might have recognized which could be perceived as difficult by the employees is that they always have to stick to safety rules or security measures. Therefore, the informants indicated that it is important to select the right employees who are able and willing to use robots: *"Robots are not suitable for everyone and that applies to machines in general. Some people [employees] do not want to or cannot use machines [robots] and then you should not place such people [employees] there. So you really always have to place the right person [employee] there [...] who that wants and can do and is not afraid of it."* (PAI7). So, if this is the case it seems like that managers perceive that employees will perceive robots as user-friendly.

Furthermore, from the informants' answers there is a clear indication that making use of robots would not be a reason to fire employees increasing the fact that informants believe that their employees perceive robots as user-friendly. As explained by the CEO from PaperML (PAI7): *"[…] you do not do it [purchase robots] to fire people [employees]."* Thus, it seems to be that managers perceive that employees do not think that robots are a threat, but a kind of support and therefore user-friendly. This is exactly what the production manager from CarDD (CAI11) experienced: *"In our company nobody [employees] says today […] the robot took my job away. […] and honestly the robot also does a lot of work that a human [employee] did not like to do in the past. So if you have to transport very heavy parts from top to bottom or have to turn them over […], then the [employees] are happy [when robots do it]."* Therefore, this is a clear indication that the informants think that their employees perceive or would perceive robots as user-friendly.

Now that it is clear that managers believe that employees perceive robots as user-friendly, it needs to be clarified whether this influences the manager's perceived relative advantage, perceived complexity and perceived compatibility.

4.5.1 Influence on the manager's perceived relative advantage

Starting with the influence on the manager's perceived relative advantage it can be indicated based on the informants' answers that almost all informants think that their perception of the employees' perceived ease of use positively influences their perceived relative advantage. Only two of them indicate that their perception of the employees' perceived ease of use would not influence their

perceived relative advantage. Especially, the automation technology manager from PlasticBX (PLI14) thinks that his perception of the employees' perceived ease of use does not influence his perceived relative advantage: *"They [employees] do not influence me at all. So if someone comes is shit or goofy [robots]. So this does not affect my personal opinion."* However, the employees' perceived user-friendliness can also be seen as an advantage on its own which may cause (because this is positive) that the manager's perception of the employees perceived ease of use positively reinforces the manager's perceived relative advantage. This is also what most of the informants experienced or belief. The CEO from WoodVK (WOI9) especially experienced that his perception of the employees' perceived user-friendliness reinforces his perceived advantages of robots because he thinks that his employees see the robots just as positive as himself: *"In the end the impact is of course really great. Look, of course I could place a robot here, but if the employee says I will not work with it or I cannot work with it or he or she comes to work sick every day, than the robot has no aim. So if an employee says I cannot or do not want to work with it, it would be very stupid to buy them, […] [but] when a robot is purchased they will be involved and we have never seen anyone saying yes but I do not want it [a robot]."*

4.5.2 Influence on the manager's perceived complexity

Looking at the influence of the manager's perception of the employees' perceived ease of use on the manager's perceived complexity two different opinions exist. Based on the informants' answers a clear indication is given that some informants think that their perception of the employees' perceived ease of use does not influence their perceived complexity and others do think that it has an influence.

The manager's perception of the employees' perceived ease of use seems on the one hand side to not influences the manager's perceived complexity due to the attitude of a manager or when the manager perceives the complexity as too small: *"Problems somehow or other have to be solved. Ease of use does not matter [it] does not help […]."*(CAI12).

On the other hand side the manager's perception of the employees' perceived ease of use can have a positive influence on the manager's perceived complexity if it helps to reduces this complexity. This can be the case if managers e.g. perceive the employees' criticism as constructive and will use it to reduce the complexity: *"Actually, I am […] on the positive side because there is also positive criticism. So it is not always negative because one [an employee] complains or has*

another view. […] Only criticism can improve things. So in that sense it is rather positive." (PLI14).

4.5.3 Influence on the manager's perceived compatibility

Finally, looking at the influence of the manager's perception of the employees' perceived ease of use on the manager's perceived compatibility also two different opinions exist. Based on the informants' answers a clear indication is given that some informants think that their perception of the employees' perceived ease of use does not influence their perceived compatibility and other do think that it has an influence.

The manager's perception of the employees' perceived ease of use seems on the one hand side to not influence the manager's perceived compatibility if the informants believe that other aspects like the manufacturing process are more important than their perception of the employees' perceived ease of use: *"I think you have the manufacturing concept in mind first. How do you want to do it, how do you want to solve it? […] I think if the [employees' perceived] ease of use is good […] is no issue in the first step of automation."* (CAI11).

On the other hand side the manager's perception of the employees' perceived ease of use can positively influence the manager's perceived compatibility. Thus, some informants believe that robots are compatible if they perceive that their employees want and like to work with robots: *"[…] if it [a robot] is [perceived as] user-friendly [by the employees] it would also suit the way of working. It is especially easy to operate, easy and quick to set up and that is something that is mainly for a production company. Because this is just about numbers."* (WOI10).

4.5.4 Influence on the manager's adoption intention

Based on the previous paragraphs there is a clear indication that the manager's perception of the employees' perceived ease of use will not directly influence the manager's intention to adopt robots, but will influence the manager's perceived relative advantage, perceived complexity and/or perceived compatibility. This is the case because mostly the manager's perception of the employees' perceived ease of use is not core when deciding whether to use robots, but other aspects like the manufacturing process are more important. As illustrated by the automation technology manager from PlasticBX (PLI14) you sometimes have to go for what is good for the company with less consideration of the employee's opinion: *"I think that in some points this [my perception of the employees' perceived ease of use] […] is taken into account in the decision, […] but sometimes […] you just have to put something down […]."* The same goes for the production area manager

from CarDD (CAI12): *"So we are already trying […] to involve the employees as early as possible so that their […] thoughts also [flow in], they work with it [robots] every day and if you can use the potential and achieve improvements, we would like to incorporate this as early as possible […]. […] the decision [whether to use robots] will not directly be affected by the employees."* Thus it seems like the manager's perception of the employee's perceived ease of use is important, but not more important than the usefulness or other aspects of robots in general. Especially, the CEO from WoodVK (WOI9) experienced this when deciding whether to buy a new robot. Although he knew that employees would like to have a new robot this was ignored, because it conflicts with his to low perceived relative advantage of this robot: *"[…] if a robot […] does not work and still costs that amount and has more disadvantages on top of those that I just mentioned, then it will not be purchased [regardless of employees' opinions]."*

Also, it is conspicuous that one informant highlighted that he will not be influenced by the employees or by his perception of the employees' perceived ease of use at all: *"[…] you [I] do not allow anyone to interfere […]"* (PAI8). Furthermore, the management assistant from PaperML (PAI8) illustrated that there is no choice, because somehow or other robots will be used due to technical advances: *"[…] it [the robotization] cannot be stopped."*

This shows that the manager's perception of the employees' perceived ease of use cannot or can only indirectly influence the adoption intention. This also means that there is no direct influence on the manager's intention to adopt robots. This is the case because the manager's perception of the employees' perceived ease of use can influence the manager's perceived relative advantage, perceived complexity and/or perceived compatibility which then will influence the manager's intention to adopt robots. Furthermore, this indirect influence would be positive, because it is generally expected that employees think that using robots would be free of effort. Therefore the following propositions are formulated:

> *Proposition 4a: The manager's perception of the employees' perceived ease of use can indirectly and positively influence the manager's adoption intention through positively influencing the manager's perceived relative advantage, perceived complexity and/or perceived compatibility.*

Proposition 4b: The manager's perception of the employees' perceived ease of use cannot influence the manager's adoption intention if the manager does not allow himself to be influenced by his employees.

Finally, it needs to be mentioned that for these propositions there is neither a difference between small and big manufacturing companies nor a difference between manufacturing companies using robots and manufacturing companies not using robots.

4.6 Manager's perception of employees' perceived usefulness

As already explained during the theory chapter it is not clear yet if the manager's perception of the employees' perceived usefulness has a direct or indirect influence on the manager's adoption intention. Especially, the interviews show that the manager's perception of the employees' perceived usefulness has an indirect and positive influence on the adoption intention. Thus, through affecting the manager's perceived relative advantage, perceived complexity and/or perceived compatibility the manager's perception of the employees' perceived usefulness will have an impact on the adoption intention. Why this is the case will become clear when looking at the statements provided by the informants, but firstly it will be described if the informants believe whether their employees perceive robots as useful.

Based on the informants' answers there is a clear indication that they believe that robots are perceived as useful by their employees and that this will have an influence on their intention to adopt robots. This is the case because robots often perform less challenging or even stultifying tasks employees do not like or employees in general have to perform fewer physical activities. The assistant to the supply chain leader from PlasticBX (PLI13) mentioned that he perceives that using robots can be good for the employees' health: *"[…] when I [the employees] have to perform fewer physical tasks. Then I [the employee] have less pain."* The same goes for the management assistant from PaperML (PAI8): *"[…] if someone has to do the same 10000 times [this] is deadly […] we do not have autists […]."* Thus, it seems like that managers believe that robots are perceived as useful by the employees because they make their work easier. In addition, robots can take over tasks the employees are no longer allowed to do and therefore make work easier. Even as explained by the management assistant from PaperML (PAI8) who believes that employees do like this: *"They [employees] find it easy themselves [robots]. They [employees] like it [robots]."* These are clear indications that the informants think that their employees perceive or would perceive robots as useful.

Now that it is clear that robots are perceived as useful, it needs to be clarified whether this can influence the manager's perceived relative advantage, perceived complexity and perceived compatibility.

4.6.1 Influence on the manager's perceived relative advantage

Starting with the influence on the manager's perceived relative advantage it can be indicated based on the informants' answers that almost all informants think that the employees' perceived usefulness reinforces their perceived relative advantage. This is the case because managers often think that their employees perceive robots as useful based on the same advantages they associate with robots: *"The [my perception of the employees' perceived] usefulness reinforces the […] existing advantages [I see of robots]. Also because the employees are relieved."* (CAI12). Some of the informants even highlighted that they perceive that the employees experience the robots as so useful that they cannot imagine a system without them so that they became standard based on their usefulness: *"[…] the robot […] is […] standard, then the human being [employee] does not expect a system to come again without a robot […]."* (CAI11).

4.6.2 Influence on the manager's perceived complexity

Looking at the influence of the manager's perception of the employees' perceived usefulness on the manager's perceived complexity two different opinions exist. Based on the informants' answers a clear indication is given that some informants think that their perception of the employees' perceived usefulness does not influence their perceived complexity and others do think that it has an influence.

The manager's perception of the employees' perceived usefulness seems on the one hand side to not influence the manager's perceived complexity due to the attitude of a manager or when the complexity is perceived as too small: *"No matter what the problem is, it has to be solved. That [my perception of the employees' perceived usefulness] does not really matter."* (CAI12). Additionally, the CEO from WoodVK (WOI9) explained: *"[…] they [my perceived complexity] is so low with a robot that it is not really there. […] So, that [my perception of the employees' perceived usefulness] does not really have an effect."*

On the other hand side it can have a positive influence if the manager's perceived complexity could be reduced with help of his or her perception of the employees' perceived usefulness. This is possible because the manager's perceived complexity of robots will be minimized or is getting less relevant if he or she perceive that employees experience robots as

useful. Especially, the assistant to the supply chain leader from PlasticBX (PLI13) would expect that his perceived complexity would be reduced if he believe that employees do think that robots are useful: *"[…] they [perceptions of the employees' perceived usefulness] have a positive impact. Problems will be reduced."*

4.6.3 Influence on the manager's perceived compatibility

Finally, looking at the influence of the manager' perception of the employees' perceived usefulness on the manager's perceived compatibility two different opinions exist. Based on the informants' answers a clear indication is given that some informants think that their perception of the employees' perceived usefulness does not influence their perceived compatibility and other do think that it has an influence.

The manager's perception of the employees' perceived usefulness seems on the one hand side to not influence the manager's perceived compatibility if the informants believe that it is not core and thus other aspects like the manufacturing process are more important. The CEO from WoodVK (WOI9) illustrated: *"A robot suits the company or not. But [how I perceive] the usefulness experienced by the employees has no influence on it [my perceived compatibility]."*

On the other hand side the manager's perception of the employees' perceived usefulness can positively influence the manager's perceived compatibility. Thus, some informants believe that the compatibility of robots can be increased if they perceive that the employees who work with them every day perceive these robots as useful. As illustrated by the production manager from CarDD (CAI11): *"I think […] the robot […] is […] standard […] so that the human being [employee] does not expect a system to come again without a robot […]."* Thus, it seems to be that robots can become an integral part of the manufacturing company if managers perceive that employees experience robots as useful. Informants also indicate that if they perceive that a robot is perceived as useful by the employees this often matches the company's goals and thus is in line with their perceived compatibility. Therefore, the automation technology manager from PlasticBX (PLI14) illustrated that he thinks that his opinion about the employees' perceived usefulness would reinforce his perceived compatibility of robots if they are in line: *"Yes it [robot] fits. […] that [my perception of the employees' perceived ease of use] would only reinforce my opinion. Add the icing on the cake. So it is positive if the other [employee] agrees."*

4.6.4 Influence on the manager's adoption intention

Based on the previous paragraphs there is a clear indication that the manager's perception of the employees' perceived usefulness will not directly influence the manager's intention to adopt robots, but will influence the manager's perceived relative advantage, perceived complexity or perceived compatibility. This is the case because other aspects like e.g. the profitability of robots are more important or the fact that robots perfectly match the production processes. Nevertheless, also the manager's perception of the employees' perceived usefulness matters. Especially, the automation technology manager from PlasticBX (PLI14) highlighted: *"If I am not only working against windmills, it is of course easier if the view of the employees [fits], in my view […]."* So, it seems to be important for manager to consider the employees' perceived usefulness when deciding whether to use robots.

Again it is conspicuous that one informant highlighted that he will not be influenced by the employees or by his perception of the employees' perceived usefulness at all: *"[…] you [I] do not allow anyone to interfere […]"* (PAI8). Furthermore, the management assistant from PaperML (PAI8) illustrated that there is no choice, because somehow or other robots will be used due to technical advances: *"[…] it [the robotization] cannot be stopped."*

This shows that the manager's perception of the employees' perceived usefulness cannot or can indirectly influence the adoption intention. So, there is no direct influence on manager's intention to adopt robots. This is the case because the manager's perception of the employees' perceived usefulness can influence the manager's perceived relative advantage, perceived complexity and/or perceived compatibility which then will influence the manager's intention to adopt robots. Furthermore, this indirect influence would be positive, because generally it is expected that the employees think that using robots would enhance the job performance. Therefore the following propositions are formulated:

> *Proposition 5a: The manager's perception of the employees' perceived usefulness can indirectly and positively influence the manager's adoption intention through positively influencing the manager's perceived relative advantage, perceived complexity and/or perceived compatibility.*

Proposition 5b: The manager's perception of the employees' perceived usefulness cannot influence the manager's adoption intention if the manager does not allow himself to be influenced by his employees.

Finally, it needs to be mentioned that for these propositions there is neither a difference between small and big manufacturing companies nor a difference between manufacturing companies using robots and manufacturing companies not using robots.

4.7 Type and impact of other stakeholders based on power, legitimacy and urgency

The following table presents the results of the interviews regarding the type and impact of other stakeholders based on their power, legitimacy and urgency (see table 4.2).

Table 4.2 Type and impact of other stakeholders based on power, legitimacy and urgency

Cases	PlasticBX		WoodVK		PaperML		CarDD	
Informants	PLI13	PLI14	WOI9	WOI10	PAI7	PAI8	CAI11	CAI12
Use of robots	No		Yes		No		Yes	
Number of employees	694		25		5		421	
Impact on relative advantage	No	No	No	-	No	No	No	No
Impact on complexity	No	No	No	-	No	No	No	No
Impact on compatibility	No	No	No	No	No	No	No	No
Impact on adoption intention	No	No	No	-	No	No	+	+

As the table shows the majority of the informants believe that other stakeholders do not influence their intention to adopt robots. This is the case because stakeholders do not matter to them when deciding whether to adopt robots. As illustrated by the CEO from WoodVK (WOI9): *"[…] [stakeholders have] no impact. We decide whether a robot will be installed or not."* The automation technology manager from PlasticBX (PLI14) almost gives the same answer: *"[…] the decision [is up to] the company […]."* Thus, it seems to be the case that stakeholders do neither have a direct impact on the manager's adoption intention nor an indirect impact on the manager's perceived relative advantages, perceived complexity or perceived compatibility if managers do not allow themselves to be influenced by stakeholders. As illustrated by the management assistant from PaperML (PAI8): *"[…] the stakeholders do not determine whether we are going to develop."* Nevertheless, it could also be that stakeholders do have an unconscious influence, although managers say that there is no influence. This is illustrated by the assistant to the supply chain leader

from PlasticBX (PLI13) who thinks that stakeholders: *"Can [only] inspire you to make a decision."*

In contrast, a few informants believe that stakeholders can have a direct or indirect influence on the intention to adopt robots. Especially, the government and customers seem to have an impact. The production manager from WoodVK (WOI10) illustrated why the government has an indirect impact: *"You increasingly have to comply with things [safety measures] if you want to work with robots."* Thus, it seems to be a negative impact due to the fact that these safety measures cannot be changed, but managers have to follow them if they want to use robots. So there is no choice: *"If we do not comply with [these safety measures,] we simply cannot use those robots, but we need them for production. So we're going to stick to it."* (WOI10). So, such safety measures can possibly reduce the advantages and increase the problems a manufacturing company faces in relation to robots, but not their suitability. This suitability depends on other things like e.g. the manufacturing process. Furthermore, it can be predicted that the government's impact depends on its power and legitimacy which creates authority causing that companies and thus their managers have no other choice than to obey. In contrast, another informant believes that the government's impact is direct: *"[There are] legal circumstances that I have to comply."* (CAI12). Thus, it seems to be something that is necessary, but do neither influence advantages or problems associated with robots nor the suitability of robots. Thus, it is only soberly taken note of it. So, there is a direct and positive impact on the manager's intention to adopt robots. This also shows that it depends on the manager's perspective whether the government does have a direct or indirect impact. Furthermore, customers can have a direct and positive impact. As highlighted by the production area manager from CarDD (CAI12): *"[…] [stakeholders have] a positive effect, because […] customers assume that we use robots."* Thus, it seems to be presupposed that robots will be used within manufacturing companies which may cause that robots will be used. Therefore, it can be predicted that the customers' impact is based on legitimacy and urgency.

This shows that other stakeholders can have an impact. These stakeholders are especially the government and customers. Both differ in their impact. The government's impact is based on power and legitimacy which creates authority. So, they are expectant stakeholders and thus dominant stakeholders. The customers' impact is based on legitimacy and urgency. So, they are expectant stakeholders too and thus dependent stakeholders. In addition, their impact can be

positive or negative even as direct or indirect. However, it is also possible that stakeholders do not have an impact at all. Therefore the following propositions are formulated:

Proposition 6a: Dominant stakeholders can indirectly and negatively influence the manager's adoption intention through negatively influencing the manager's perceived relative advantage, and perceived complexity.

Proposition 6b: Dominant stakeholders can directly and positively influence the manager's adoption intention if of certain regulations or necessities are soberly noted by the manager.

Proposition 6c: Dependent stakeholders can directly and positively influence the manager's adoption intention if they presupposed that a manufacturing company use robots.

Proposition 6d: Other types of stakeholders cannot influence the manager's adoption intention if the manager does not allow himself to be influenced by these stakeholders.

Finally, it needs to be mentioned that for these propositions there is neither a difference between small and big manufacturing companies nor a difference between manufacturing companies using robots and manufacturing companies not using robots.

4.8 Adjusted conceptual model

To present the formulated propositions and thus to present the main findings an adjusted conceptual model has been developed (see Figure 4.1).

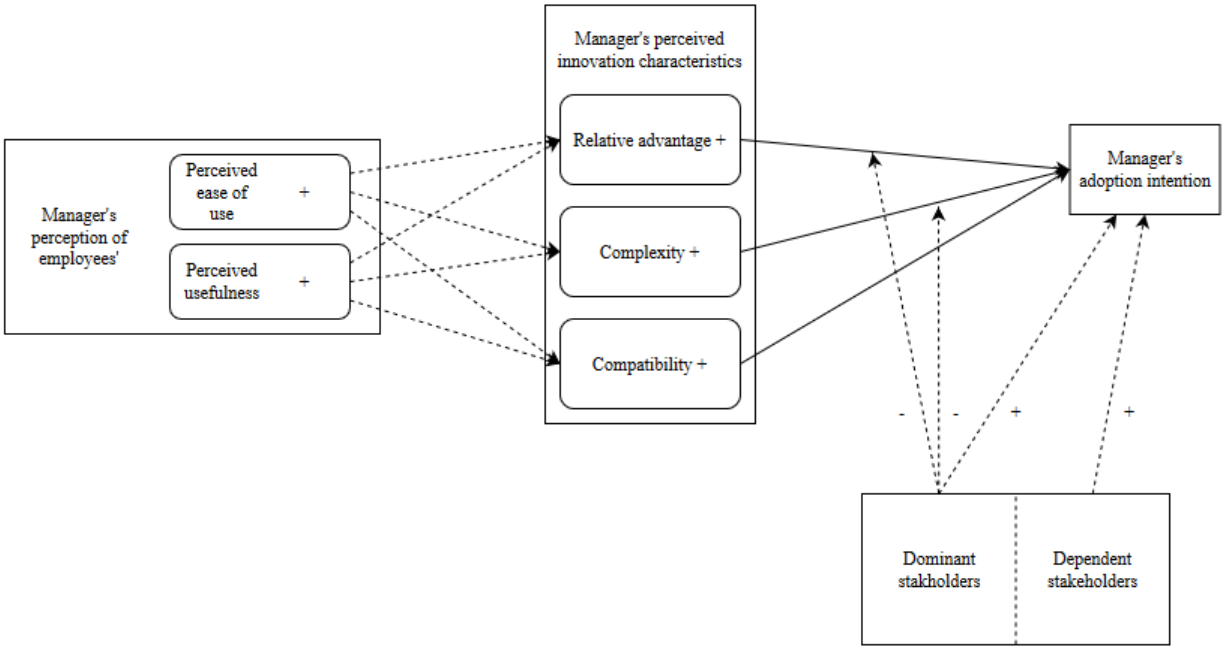

Figure 4.1: Adjusted Conceptual Model

Figure 4.1 shows that the basic model and thus all three of the manager's perceived innovation characteristics will positively influence the manager's adoption intention. Furthermore, the manager's perception of the employees' perceived ease of use and perceived usefulness both can have no influence on the manager's adoption intention or an indirect and positive influence on the manager's adoption intention through positively influencing the manager's perceived relative advantage, perceived complexity and/or the perceived compatibility. Also, both dominant and dependent stakeholders can have a direct and positive impact on the manager's intention to adopt robots. In addition, dominant stakeholders can even have an indirect and negative impact on the manager's adoption intention. These findings will be explained in more detail in the following chapter.

5 Conclusion and discussion

In the previous chapters the reason, goal, theory, justification of the way the research goal is realized, and the results have been presented. In this chapter an answer will be given to the research question. First, a conclusion will be drawn. Then recommendations will be given and finally the limitations and suggestions for future research will be discussed.

5.1 Conclusion

In this research the manager's intention to adopt robots was central. More concrete it was studied how the relative advantage, the complexity, compatibility and the perception of employees' perceived ease of use and perceived usefulness affect the manager's intention to adopt robots. Furthermore, the influence of other stakeholders based on their power, legitimacy and urgency was studied. Therefore, this research tried to find an answer to the earlier introduced research question:

> *How is the manager's intention to adopt robots affected by the relative advantage, the complexity, the compatibility and by the perception of employees' perceived ease of use and perceived usefulness?*

To be able to give an answer to this research eight managers of manufacturing companies within different subsectors have been interviews. The main findings (see Figure 4.1) of these interviews will now be discussed.

5.1.1 Manager's perceived innovation characteristics

The manager's perceived innovation characteristics (perceived relative advantage, perceived complexity and perceived compatibility) and thus the basis of the model does have a positive influence on the manager's intention to adopt robots. This is the case because robots will become more and more important to manufacturing companies. Meaning that managers perceive the advantages of robots as greater than those of previous machines or ways of working, because robots especially increase a manufacturing company's productivity. Furthermore, managers seem to perceive that robots are easy to understand or use e.g. due to the fact that robots are preprogrammed, or handbooks exist. In addition, robots became part of the developments of today. Therefore, managers perceive that they fit existing values, experiences and needs.

5.1.2 Manager's perception of the employees' perceived ease of use and perceived usefulness

Likewise, the manager's perception of the employees' perceived ease of use and perceived usefulness can have a positive influence on the manager's perceived relative advantage, perceived

complexity and/or perceived compatibility, because managers generally expected that the employees think that using robots would be free of effort and enhance the job performance. This shows that the manager's perception of the employees' perceived ease of use and perceived usefulness can have an indirect and positive impact on the manager's intention to adopt robots through positively influencing all or a few of the manager's perceived innovation characteristics. Besides, it is also possible that there is no influence at all on the manager's perceived innovation characteristics. If this is the case managers often decide on their own whether to adopt robots and are not interested in the employees' opinions. They do not allow themselves to be influenced by the employees.

5.1.3 Type and impact of other stakeholder based on power, legitimacy and urgency

Also, other stakeholders can have an impact on the manager's intention to adopt robots. If they have an impact this can be direct or indirect even as positive or negative. This mainly depends on the type of stakeholders. The stakeholders that might have an impact are dominant or dependent stakeholders. Dominant stakeholders like e.g. the government might have a negative impact on the manager's perceived relative advantage and perceived complexity due to regulations etc. they have to obey. This can reduce advantages or even increase the complexity. Only the compatibility will not be influenced, because it depends on other aspects if a robot fits the manufacturing company like e.g. on the manufacturing process. Nevertheless, these dominant stakeholders can also have a direct impact even as the dependent stakeholders like e.g. the customers. A direct impact is expected to be positive because customers often presuppose that manufacturing companies use robots. However, stakeholders can also have no influence because managers do not allow themselves to be influenced by them.

5.2 Theoretical implications

This research has interesting theoretical implications.

Firstly, this research generally confirms existing adoption theory (Driessen & Hillebrand, 2002). As expected the relative advantage and the compatibility have a positive influence on the adoption intention (Driessen & Hillebrand, 2002). Only the complexity does not have the expected influence on the adoption intention. The influence is positive while it should have been negative (Driessen & Hillebrand, 2002).

Furthermore, this research focuses on the manager's intention to adopt robots not only influenced by the manager's perceived innovation characteristics but also by the manager's

perception of the employees' perceived ease of use or perceived usefulness. This is an important topic because literature is often about customers adopting products, but not about managers deciding whether to adopt a new technology and also not about stakeholders like employees influencing the manager's adoption intention. So, studies combining the adoption theory, the Technology Acceptance Model and the stakeholder management perspective in the context of robotization are hard to find. This shows that previous research has mainly focused on the influence of the consumer's perception of innovation characteristics on the adoption intention (Flight et al., 2011; Jung et al., 2012; Moore & Benbasat, 1991; Waheed et al., 2015). However, this research focuses on manager's adopting robots influenced by their perceived innovation characteristics and by their perception of the employees' perceived ease of use and perceived usefulness. This not only helps to further expand existing theory, but also to fill a gap in the theory. Especially, considering that only one study by Nejad et al. (2016) could have been found combining all three theories in the context of mobile payment with different results. So, at the same time, this research contributes to existing theory it also contrasts with existing theory. On the one hand side this research contributes to existing theory because it clarifies if and how stakeholders like the employees can affect the manager's adoption intention. On the other hand side this research contrasts with existing theory due to the fact and as already mentioned the complexity does have a positive influence on the adoption intention while a negative influence was expected. However, this is consistent with other research focusing on the adoption of services (Arts, et al., 2011). A possible reason could be that robots and especially aspects of robots that might be difficult like e.g. the maintenance or programming could be seen as part of a service. This could be the case, because often producers of robots offer to take over the difficult maintenance or programming (Cole, 2018). Another reason could perhaps be that consumers underestimate the possible negative aspect of the complexity and are too enthusiastic about the innovation (Wood & Moreau, 2006). Also, before actually using an innovation, consumers often attach more value to the properties of a product than to the complexity (Thompson, Hamilton & Rust, 2005).

5.3 Practical recommendations

This research mainly yields important recommendations for manufacturing companies, their managers and employees even as for their customers or the government.

5.3.1 For manufacturing companies, their managers and employees

First of all, the results show that the manager's perceived innovation characteristics play an important role in the adoption intention. The relative advantage, as well as the complexity and compatibility, positively influence the adoption intention. This shows that robots are considered to be better than a normal machine or the standard way of working. Managers also expect robots to be in line with existing values, experiences and needs and not to be difficult to understand or use. As a result, the use of robots is an opportunity for manufacturing companies and their managers to improve the production processes and quality, to be more flexible, productive or faster, to possibly enter new markets or to increase profits and decrease costs.

Next, the results show that also the manager's perception of the employees' perceived ease of use and perceived usefulness play an important role. Both can positively influence the manager's perceived innovation characteristics and finally the adoption intention if employees expect robots to be free of effort and that they enhance the job performance . Thus, the employees' opinion matters. Meaning that managers on the one hand side think about possible advantages for employees and how to increase them like the discharge, health improvement or the simplification of work. On the other hand side managers even think about possible consequences for the employees and how to minimize them e.g. by handling the criticism of the employees or by trying to make sure that no jobs are lost. Nevertheless, managers should make their employees aware of the fact that they care about them. By this, possible uncertainties or negative thoughts of the employees can be minimized, the advantages of robots for the employees become clear and the acceptance of robots can be increased. Furthermore, this shows that there is a chance for the employees to talk about their feelings, thoughts or desires so that they can be considered by the managers.

5.3.2 For customers

In addition, the use of robots is also advantageous for customers of manufacturing companies. Customers can especially profit from the advantages mentioned in the beginning. More concrete it is also profitable to customers if the manufacturing companies production processes and quality will be improved, if the manufacturing company gets more flexible, productive and faster or if their costs will be decreased. Then customers can expect better products, faster produced and maybe cheaper.

5.3.3 For the government

Finally, manufacturing companies using robots can be interesting for the government, because robots can disburden employees, create new jobs or even compensate the skills shortage. When employees e.g. are relieved by robots or robots even take over dangerous tasks, they become less sick. This can save a lot of money and thus be an incentive to invest in manufacturing companies using robots. Therefore, the government could offer subsidy to manufacturing companies when they make use of robots. This may result in more manufacturing companies using robots, which again contributes to health improvement.

5.4 Limitations and future research

This research has several limitations which will be discussed in the following.

The first limitation is the amount of cases. Only four manufacturing companies in the Netherlands and in Germany within different subsectors have been selected and two interviews per manufacturing company have been held. Thus generalizability is low. Therefore, is becomes questionable whether the results can reflect the reality. This offers a possibility for future research. Future research could focus on more cases and thus on other manufacturing companies within different subsectors and in different countries to increase the generalizability. Furthermore, even a quantitative research could be conducted to increase the generalizability. In addition, a quantitative research could help to check the results of this research through obtaining more objective and accurate results.

The second limitation is that also other theory than the Technology acceptance Model could have been combined with the adoption theory. If other theory like e.g. the theory of reasoned action would have been used the results could be differently. However, this offers a possibility for future research. Future research could therefore check if and how results would differ when using another theory than the Technology Acceptance Model. This could provide interesting new insights and a more consistent view on the manager's intention to adopt robots.

The third limitation is that only the manager's perceived innovation characteristics have been considered. In addition to the manager's perceived innovation characteristics also the characteristics of the manager itself could be important. Within this research aspects such as the manager's innovativeness were only considered to a minor extent. This means that a research including more characteristics of the manager could lead to different results. However, this offers

a possibility for future research. Future research could focus on additional characteristics of managers to provide a more consistent view on the manager's intention to adopt robots.

The last limitation is that it has been only focused on the manager's perspective of the employees' perceived ease of use and perceived usefulness. Thus, results could be different if the employees themselves would be interviewed. However, this offers a possibility for future research. Future research could focus on both the manager's perspective and the employees' perspective. This could lead to interesting new insights.

References

Arts, J. W., Frambach, R. T., & Bijmolt, T. H. (2011). Generalizations on consumer innovation adoption: A meta-analysis on drivers of intention and behavior. *International Journal of Research in Marketing, 28*(2), 134-144. doi: 10.1016/j.ijresmar.2010.11.002

Babbie, E. (2010). The practice of social research. Wadsworth: Cengage Learning

Browning, T. R., & Heath, R. D. (2009). Reconceptualizing the effects of lean on production costs with evidence from the F-22 program. *Journal of operations management, 27*(1), 23-44. doi: 10.1016/j.jom.2008.03.009

CBS. (2019, October 18). *7 procent bedrijven gebruikt robots*. Retrieved from https://www.cbs.nl/nl-nl/nieuws/2019/42/7-procent-bedrijven-gebruikt-robots.

Chin, W. W., & Gopal, A. (1995). Adoption intention in GSS – Relative importance of beliefs. *Data Base for Advances in Information Systems, 26*(2-3), 42-64. https://doi-org.ru.idm.oclc.org/10.1145/217278.217285

Cole, J. (2018). Predictive Maintenance Service Reduces Robot Breakdowns. *Modern Machine Shop, 91*(1), 166-166.

Dasgupta, S., Granger, M., & McGarry, N. (2002). User acceptance of e-collaboration technology: A7 n extension of the technology acceptance model. *Group Decision and Negotiation*, *11*(2), 87-100. doi: 10.1023/A:1015221710638

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly, 13*(3), 319-340. doi: 10.2307/249008

Diamond, A. M. (2020). Robots and Computers Enhance Us More Than They Replace Us. *The American Economist*, *65*(1), 4-10. doi: 10.1177/0569434518792674

Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of management Review*, *20*(1), 65-91. doi: 10.5465/AMR.1995.9503271992

Driessen, P. H., & Hillebrand, B. (2002). Adoption and Diffusion of Green Innovations. In G. C. Bartels & W. J. A. Nelissen (Eds.), *Marketing for Sustainability: Towards Transactional Policy-Making* (pp. 343-355). Amsterdam: IOS Press.

Ewing, D. R., Pigazzi, A., Wang, Y., & Ballantyne, G. H. (2004). Robots in the operating room—the history. *Seminars in laparoscopic Surgery*, *11*(2), 63-71.

Flight, R. L., D'Souza, G., & Allaway, A. W. (2011). Characteristics-based innovation adoption:

scale and model validation. *Journal of Product & Brand Management, 20*(5), 343-355. doi: 10.1108/10610421111157874

Frambach, R. T., Barkema, H. G., Nooteboom, B., & Wedel, M. (1998). Adoption of a service innovation in the business market: an empirical test of supply-side variables. *Journal of Business Research, 41*(2), 161-174. doi: 10.1016/S0148-2963(97)00005-2

Freeman, R. E., & McVea, J. (2001). A stakeholder approach to strategic management. *The Blackwell handbook of strategic management, 1*(2), 189-207. http://dx.doi.org/10.2139/ssrn.263511

Graetz, G., & Michaels, G. (2018). Robots at work. *Review of Economics and Statistics, 100*(5), 753-768. doi:10.1162/rest_a_00754

Hayes, R., Pisano, G., Upton, D., & Wheelwright, S. (2005), Operations, strategy and technology: Pursuing 593 the competitive edge. Wiley, New Jersey

Jung, J., Chan-Olmsted, S., Park, B., & Kim, Y. (2012). Factors affecting e-book reader awareness, interest, and intention to use. *New Media & Society, 14*(2), 204-224. https://doi-org.ru.idm.oclc.org/10.1177/1461444811410407

Klarmann, M., & Feurer, S. (2018). Control variables in marketing research. *Marketing ZFP, 40*(2), 26-40. doi: 10.15358/0344-1369-2018-2-26

Ligthart, P. E. M., Vaessen, P. M. M., & Dankbaar, B. (2008). *Innovatie van Productie Onderzoeksrapportage van de European Manufacturing Survey (EMS) in de Nederlandse Maakindustrie*. Retrieved from WorldCat.org database. onbekend: Radboud Universiteit Nijmegen.

Mainardes, E. W., Alves, H., & Raposo, M. (2012). A model for stakeholder classification and stakeholder relationships. *Management decision, 50*(1), 1861-1879. doi: 10.1108/00251741211279648

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of management review*, *22*(4), 853-886. doi: 10.5465/AMR.1997.9711022105

Moore, G. C., & Benbasat, I. (1991). Development of an Instrument to Measure the Perception of Adopting an Information Technology Innovation. *Information Systems Research*, *2*(3), 192-222. doi: 10.1287/isre.2.3.192

Nejad, M. G., Apanasevic, T., Markendahl, J., & Arvidsson, N. (2016). Stakeholders'

expectations of mobile payment in retail: lessons from Sweden. *International Journal of Bank Marketing, 34*(1), 37-61. doi: 10.1108/IJBM-06-2014-0064

Ogbemhe, J., Mpofu, K., & Tlale, N. S. (2017). Achieving sustainability in manufacturing using robotic methodologies. *Procedia Manufacturing, 8,* 440-446. https://doi-org.ru.idm.oclc.org/10.1016/j.promfg.2017.02.056

Reichstein, T., & Salter, A. (2006). Investigating the sources of process innovation among UK manufacturing firms. *Industrial and Corporate change, 15*(4), 653-682. doi: 10.1093/icc/dtl014

Rogers, E. M. (1995). Lessons for guidelines from the diffusion of innovations. *Joint Commission Journal on Quality and Patient Safety, 21*(7), 324-328.

Rogers, E. M. (2002). Diffusion of preventive innovations. *Addictive Behaviors, 27*(6), 989-993.

Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *Turkish Online Journal of Educational Technology-TOJET, 5*(2), 14-23. Retrieved from https://files.eric.ed.gov/fulltext/EJ1102473.pdf

Singh, B., Sellappan, N., & Kumaradhas, P. (2013). Evolution of industrial robots and their applications. *International Journal of emerging technology and advanced engineering, 3*(5), 763-768.

Sinkovics, N. (2018). Pattern matching in qualitative analysis. *The sage handbook of qualitative business and management research methods*, 468-485.

Swanborn, P.G. (2010). Case studies: What, why and how? London: Sage Publications Ltd

Thompson, D. V., Hamilton, R. W., & Rust, R. T. (2005). Feature fatigue: When product capabilities become too much of a good thing. *Journal of Marketing Research, 42*(4), 431-442. doi: 10.1509/jmkr.2005.42.4.431

Upton, D. M. (1997). Process range in manufacturing: an empirical study of flexibility. *Management Science, 43*(8), 1079-1092. doi: 10.1287/mnsc.43.8.1079

Waheed, M., Kaur, K., Ain, N., & Sanni, A. (2015). Emotional attachment and multidimensional self-efficacy: extension of innovation diffusion theory in the context of eBook reader. *Behaviour & Information Technology, 34*(12), 1147-1159. doi: 10.1080/0144929X.2015.1004648

Wood, S. L., & Moreau, C. P. (2006). From fear to loathing? How emotion influences the

evaluation and early use of innovations. *Journal of Marketing, 70*(3), 44-57. doi: 10.1509/jmkg.70.3.44

Yin, R. K. (2014). Case Study Research. Applied Social Research Methods (5e ed). California, United States of America: Sage Publications Inc..

Zelbst, P., Green, K., Sower, V., & Reyes, P. (2012), Impact of RFID on manufacturing effectiveness and efficiency, *International Journal of Operations & Production Management, 32*(3), 329–350. doi: 10.1108/01443571211212600

Zhang, G. Q., Li, X., Boca, R., Newkirk, J., Zhang, B., Fuhlbrigge, T. A., Feng, H. K., & Hunt, N. J. (2014). Use of industrial robots in additive manufacturing-a survey and feasibility study. *ISR/Robotik 2014*, 1-6.

Zhou, W. (2017). Robots change the global manufacturing market. *Control Engineering, 64*(2), 7.

Appendix 1: Questionnaire

The overall goal of this research is to get to know when manufacturing companies use robots and to find an explanation why still more than 70% of those manufacturing companies do not use robots. Therefore, this interview will focus on your intention as a manager to adopt robots even as on the role employees play or other stakeholders. The interview starts with some general questions about you and the company. Thereafter, we will focus on the adoption intention in more detail.

Also, it needs to be mention that the interview will be recorded and that it is possible to withdraw from the interview at any time. Furthermore, sensitive information will be protected and if wanted you and/or the company will be anonymized.

General questions

1. What is your position within the organisation?
    a. How long do you work in this position?
2. How many employees work in the production site of the organization?
3. As how innovative would you describe yourself?

Adoption intention

First, we will talk about your intention to adopt robots for work in the production site.

4. What is your attitude towards robots? Think about robots that can perform various tasks like e.g. welding, painting, packaging, 3D printing, milling, water jet cutting, assembling, polishing or pick and place.
5. Does the organisation use robots? Why or why not? If so/not:
    a. What type of robots does/could the organization use?
    b. Which tasks are/could be performed by robots? Why?
        i. If these tasks are/would be performed by robots how many employees have been/could possibly be replaced by robots in the production site?
            - Have/would these employees be fired, or would they further be employed? Why?
        ii. Were/Would also new employees (be) needed to operate or program etc. the robots?
    c. If you have to decide whether to use robots again what would your decision be?
    d. Do you intend to use robots in the future? Why or why not? If so/not:
        i. How long do you already intend to use robots?
        ii. Why are (not) you willing to invest in robots at all?

Relative advantage

Now we will talk about the advantages you may associate with robots for work in the production sites.

6. What kind of relative advantage do you see/expect when/from making use of robots? Think of the quality of work, timesaving, simplification, organizational performance, effectiveness, or productivity.
    a. Do you see any further advantages?
7. Do you see/expect any disadvantages?
    a. Would you say that the disadvantages overshadow the advantages of robots in the production site? Why or why not?
8. How did/does your perceived relative advantage affect your intention to adopt robots?
    a. More positively or negatively?
    b. Why?

Complexity

After talking about the perceived advantages or even disadvantages of robots, we will talk about the difficulties you may associate with robots for work in the productions site.

9. Could you explain why robots are/could be (possibly) difficult to use for work in the production site or why it is/could be (possibly) difficult to understand why robots are/should be used for work in the production site?
10. Do you see/expect any problems or difficulties when (making) use of robots?
11. What (do you think) does the use of robots require? Think of special skills, a higher general level of knowledge or a considerable amount of time to learn how to use them.
12. How did/does your perceived complexity affect your intention to adopt robots?
    a. More positively or negatively?
    b. Why?

Compatibility

Now we will talk about the compatibility of robots. Compatibility means e.g. that making use of robots would be possible for the company.

13. Would you say that using robots is/would be compatible with the current situation of the organization? Think about the manufacturing process(es), way of working etc. Why or why not?
14. How did/does your perceived compatibility affect your intention to adopt robots?
    a. More positively or negatively?
    b. Why?

Manager's perception of employees' perceived ease of use and perceived usefulness

After talking about your intention to adopt robots for work in the production site we will focus on how employees affect your intention.

Employees' perceived ease of use

First, we will look at your perception about an employees' perceived user-friendliness of robots for work in the production site.

15. Do you think that employees (would) perceive robots as user-friendly? Think about the easiness to use, learning process, user manual etc. Why or why not?
16. Do you think that employees (would) believe that robots are cumbersome to use? Why or why not?
    a. Could the use of robots even be frustrating for employees? Why or why not?
17. How did/does the employees' perceived user-friendliness of robots affect the advantages you may associate with robots?
    a. More positively or negatively?
    b. Why?
18. How did/does the employees' perceived user-friendliness of robots affect the difficulties you may associate with robots?
    a. More positively or negatively?
    b. Why?
19. How did/does the employees' perceived user-friendliness of robots affect your perceived compatibility of robots with the manufacturing process or organisation?
    a. More positively or negatively?
    b. Why?
20. How did/does your perception about an employees' perceived user-friendliness of robots affect your intention to adopt robots?
    a. More positively or negatively?
    b. Why?

Employees' perceived usefulness

Next, we will look at your perception about an employees' perceived usefulness of robots for work in the production site.

21. Would you say that employees (would) perceive robots as useful? Think about the employees' job performance, improved easiness of work, effectiveness, productivity, time saving or quality of work etc. Why or why not?
22. How did/does the employees' perceived usefulness of robots affect the advantages you may associate with robots?
    a. More positively or negatively?
    b. Why?
23. How did/does the employees' perceived usefulness of robots affect the difficulties you may associate with robots?
    a. More positively or negatively?
    b. Why?

24. How did/does the employees' perceived usefulness of robots affect your perceived compatibility of robots with the manufacturing process or organisation?
    a. More positively or negatively?
    b. Why?
25. How did/does your perception about an employees' perceived usefulness of robots affect your intention to adopt robots?
    a. More positively or more negatively?
    b. Why?

<u>Other stakeholders</u>

Finally, we will talk about other stakeholders that (may) affect your intention to adopt robots.

26. Which other types of stakeholders did/do affect your intention to adopt robots? Think of governments, investors, political groups, customers, communities, trade associations or suppliers.
    a. How did/do these stakeholders affect your intention to adopt robots?
        i. More positively or negatively?
        ii. Why?
        iii. How did/do those stakeholders differ in their impact? Think about the power, legitimacy, and urgency.
    b. Did/Do these stakeholders also affect the advantages you may associate with robots?
        i. More positively or negatively?
        ii. Why?
        iii. How did/do those stakeholders differ in their impact? Think about the power, legitimacy, and urgency.
    c. Did/Do these stakeholders also affect the difficulties you may associate with robots?
        i. More positively or negatively?
        ii. Why?
        iii. How did/do those stakeholders differ in their impact? Think about the power, legitimacy, and urgency.
    d. Did/Do these stakeholders also affect your perceived compatibility of robots with the manufacturing process or organisation?
        i. More positively or negatively?
        ii. Why?
        iii. How did/do those stakeholders differ in their impact? Think about the power, legitimacy, and urgency.

This is the end of the interview. How do you want to be informed about the findings?

Thank you for participating.

Appendix 2: Dutch version of the questionnaire

Het doel van dit onderzoek is om erachter te komen wanneer maakbedrijven gebruik maken van robots en waarom nog steeds meer dan 70% van deze maakbedrijven geen robots gebruiken. Daarom zal de focus van dit interview liggen op uw intentie als een manager om robots te adapteren en op de rol die medewerkers of andere stakeholders kunnen spelen. Het interview zal beginnen met een paar algemene vragen over u en de onderneming. Vervolgens zal dieper worden ingegaan op de adoptie intentie.

Verder zal het interview worden opgenomen. Ook is het mogelijk om het interview te allen tijde te beëindigen. Vertrouwelijke informatie zal worden beschermd en het is mogelijk u en/of het bedrijf anoniem te maken.

<u>Algemene vragen</u>

1. Wat is uw positie binnen het bedrijf?
    a. Hoe lang werkt u al in deze positie?
2. Hoeveel medewerkers werken in de productie?
3. Hoe innovatief zou u uzelf beschrijven?

<u>Adoptie intentie</u>

Als eerste zullen we het hebben over uw intentie om robots te adopteren voor het maakproces.

4. Wat is uw houding tegenover robots? Denk aan robots die bijvoorbeeld 3D kunnen printen, iets bewerken, frezen, snijden, lassen, assembleren, polijsten, pakken, verplaatsen etc.
5. Maakt het bedrijf gebruik van robots? Waarom of waarom niet?
    a. Wat voor een soort robots gebruikt/zou het bedrijf kunnen gebruiken?
    b. Voor welke taken zijn/zullen deze robots van toepassing (zijn)? Waarom?
        i. Hoeveel medewerkers hebben in de productie gewerkt/werken in de productie die (mogelijk) door robots te vervangen werk doen/deden?
            - Zijn/zullen deze medewerkers ontslagen of meegenomen worden? Waarom?
        ii. Zijn/zullen nieuwe medewerkers nodig geweest/zijn voor bijv. het gebruik maken of programmeren van robots?
    c. Zult u nog een keer van robots gebruik maken als u het opnieuw moet beslissen? Waarom of waarom niet?
    d. Bent u van plan om in de toekomst gebruik te gaan maken van robots? Waarom of waarom niet?
        i. Hoe lang bent u al van plan om gebruik te gaan maken van robots?
        ii. Waarom wilt u (niet) investeren in robots?

Relatieve voordeel

Nu zullen we het hebben over de voordelen die u (mogelijk) in verband (zou) brengen met robots voor het maakproces.

6. Wat is het (verwachte) relatief voordeel van het gebruik maken van robots? Denk aan de kwaliteit van het werk, tijdsbesparing, vereenvoudiging, prestatievermogen van het bedrijf, effectiviteit of productiviteit.
    a. Zijn er nog andere voordelen?
7. Ziet/Verwacht u enige nadelen?
    a. Wegen de nadelen van robots zwaarder dan de voordelen?/Zullen de nadelen van robots zwaarder wegen dan de voordelen? Waarom of waarom niet?
8. Hoe beïnvloedde/ beïnvloedt het waargenomen relatieve voordeel uw intentie om robots te adapteren?
    a. Eerder positief of negatief?
    b. Waarom?

Complexiteit

Nu we het hebben gehad over de voordelen en nadelen van robots, gaan we over naar de problemen die uw (mogelijk) in verband (zou) brengen met robots voor het maakproces.

9. Kunt u uitleggen waarom robots (mogelijk) moeilijk te gebruiken zijn/zullen zijn binnen het maakproces of waarom het (mogelijk) moeilijk lijkt/zou lijken robots binnen het maakproces te gebruiken?
10. Wat voor problemen brengt u/zal u in verband (brengen) met het gebruik maken van robots?
11. Wat is nodig om gebruik te kunnen maken van robots? Denk aan speciale vaardigheden, uitgebreide kennis of tijd om te leren.
12. Hoe beïnvloedde/beïnvloedt de waargenomen complexiteit uw intentie om robots te adapteren?
    a. Eerder positief of negatief?
    b. Waarom?

Compatibiliteit

Nu zullen we het hebben over de compatibiliteit van robots. Compatibiliteit betekent bijvoorbeeld dat het voor een bedrijf mogelijk is om gebruik te maken van robots.

13. Denkt u dat het gebruik maken van robots past/zal passen bij de momentele situatie van het bedrijf? Denk aan het bereidingsproces, de manier van werken, etc. Waarom of waarom niet?
14. Hoe beïnvloedde/beïnvloedt de waargenomen compatibiliteit uw intentie om robots te adapteren?

a. Eerder positief of negatief?
b. Waarom?

De managers waarneming van de door de medewerkers waargenomen gebruiksvriendelijkheid en bruikbaarheid

Nu we het hebben gehad over uw intentie om robots te adapteren, gaan we over naar het effect dat medewerkers kunnen hebben op uw intentie.

Medewerkers waargenomen gebruiksvriendelijkheid

Als eerste zullen we het hebben over uw waarneming van de door de medewerkers waargenomen gebruiksvriendelijkheid van robots voor het maakproces.

15. Denkt u dat de medewerkers robots als gebruiksvriendelijk (zullen) waarnemen? Denk aan de vereenvoudiging van het gebruik, leerproces, gebruiksaanwijzing etc.. Waarom of waarom niet?
16. Denkt u dat medewerkers denken dat robots moeilijk te gebruiken (zullen) zijn? Waarom of waarom niet?
    a. Kan het gebruik maken van robots ook frustrerend zijn voor de medewerkers? Waarom of waarom niet?
17. Wat voor een invloed heeft de door de medewerkers waargenomen gebruiksvriendelijkheid van robots op de voordelen (gehad) die u in verband brengt met robots?
    a. Eerder positief of negatief?
    b. Waarom?
18. Wat voor een invloed heeft de door de medewerkers waargenomen gebruiksvriendelijkheid van robots op de problemen (gehad) die u in verband breng met robots?
    a. Eerder positief of negatief?
    b. Waarom?
19. Wat voor een invloed heeft de door de medewerkers waargenomen gebruiksvriendelijkheid van robots op de/u verwachte compatibiliteit van robots met het maakproces of met het bedrijf (gehad)?
    a. Eerder positief of negatief?
    b. Waarom?
20. Hoe beïnvloedde/beïnvloedt de medewerkers waargenomen gebruiksvriendelijkheid van robots uw intentie om robots te adapteren?
    a. Eerder positief of negatief?
    b. Waarom?

Medewerkers waargenomen bruikbaarheid

Nu zullen we het hebben over uw waarneming van de medewerkers waargenomen bruikbaarheid van robots voor het maakproces.

21. Denkt u dat de medewerkers robots als bruikbaar (zullen) waarnemen? Denk aan het arbeidsvermogen van de medewerkers, verbeterde eenvoudigheid van het werk, effectiviteit, productiviteit, tijdsbesparing of kwaliteit van het werk et. Waarom of waarom niet?
22. Wat voor een invloed heeft de door de medewerkers waargenomen bruikbaarheid van robots op de voordelen (gehad) die u in verband breng met robots?
    a. Eerder positief of negatief?
    b. Waarom?
23. Wat voor een invloed heeft de door de medewerkers waargenomen bruikbaarheid van robots op de problemen (gehad) die u in verband breng met robots?
    a. Eerder positief of negatief?
    b. Waarom?
24. Wat voor een invloed heeft de door de medewerkers waargenomen bruikbaarheid van robots op de/u verwachte compatibiliteit van robots met het maakproces of met het bedrijf (gehad)?
    a. Eerder positief of negatief?
    b. Waarom?
25. Hoe beïnvloedde/beïnvloedt de medewerkers waargenomen bruikbaarheid van robots uw intentie om robots te adapteren?
    a. Eerder positief of negatief?
    b. Waarom?

Andere stakeholders

Als laatste zullen we het hebben over andere stakeholders die een effect (zullen kunnen) hebben (gehad) op uw intentie om robots te adapteren voor het maakproces.

26. Welke andere stakeholders een effect op uw intentie om robots te adapteren (gehad)? Denk aan de overheid, investeerders, politieke groepen, het publiek, bedrijfsverenigingen of leveranciers.
    a. Hoe beïnvloedde/beïnvloeden deze stakeholders uw intentie om robots te adapteren?
        i. Eerder positief of negatief?
        ii. Waarom?
        iii. Hoe verschillen deze stakeholders van invloed? Denk aan de machtigheid, legitimiteit en urgentie.
    b. Beïnvloedde/Beïnvloeden deze stakeholders ook de voordelen die u in verband brengt met robots?
        i. Eerder positief of negatief?

ii. Waarom?
iii. Hoe verschillen deze stakeholders van invloed? Denk aan de machtigheid, legitimiteit en urgentie.

c. Beïnvloedde/Beïnvloeden deze stakeholders ook de problemen die u in verband brengt met robots?
   i. Eerder positief of negatief?
   ii. Waarom?
   iii. Hoe verschillen deze stakeholders van invloed? Denk aan de machtigheid, legitimiteit en urgentie.
d. Beïnvloedde/Beïnvloeden deze stakeholders ook de (mogelijke) compatibiliteit van robots die u ziet met het maakproces of met de organisatie?
   i. Eerder positief of negatief?
   ii. Waarom?
   iii. Hoe verschillen deze stakeholders van invloed? Denk aan de machtigheid, legitimiteit en urgentie.

Dat is het einde van het interview. Hoe zou u willen worden geïnformeerd over de resultaten van dit onderzoek?

Bedankt voor uw deelname.

Appendix 3: German version of the questionnaire

Das Ziel dieser Masterarbeit ist es, in Erfahrung zu bringen, wann Herstellerfirmen Roboter nutzen und warum bis jetzt mehr als 70% dieser Firmen keine Roboter nutzen. Daher liegt der Fokus auf dem Manager und seiner Absicht Roboter zu nutzen oder auch nicht sowie auf der Rolle die Mitarbeiter und andere Interessensgruppen dabei spielen.

Ebenfalls ist zu erwähnen, dass das Interview aufgenommen wird und es möglich ist, es zu jedem beliebigen Zeitpunkt ab zu brechen. Sensible Daten werden geschützt und auf Wunsch werden Sie und/oder das Unternehmen anonymisiert.

Allgemeine Fragen

Beginnen wir mit einigen allgemeinen Fragen zu Ihrer Person und dem Unternehmen.

1. Welche Position haben Sie innerhalb des Unternehmens?
   a. Seit wann haben Sie diese Position?
2. Wie viele Angestellte des Unternehmens arbeiten in der Produktion?
3. Wie innovativ würden Sie sich selbst beschreiben?

Beabsichtigung der Nutzung

Als nächstes werden wir uns darüber unterhalten, inwieweit Sie Roboter für die Produktion beabsichtigen zu nutzen bzw. bereits nutzen und akzeptieren.

4. Welche Einstellung haben Sie gegenüber Robotern? Denken Sie bitte an Roboter, die schweißen, zeichnen, verpacken, 3D drucken, fräsen, wasserstrahlschneiden, montieren, polieren, etwas packen oder bewegen können.
5. Nutzt das Unternehmen Roboter? Warum oder warum nicht? Wenn ja/nicht:
   a. Was für Sorten Roboter nutzen/könnten Sie nutzen?
   b. Welche Aufgaben übernehmen/könnten diese Roboter übernehmen? Warum?
      i. Wie viele Mitarbeiter wurden/würden durch Roboter ersetzt, nachdem/wenn diese die soeben genannten Aufgaben übernehmen?
         - Wurden/würden diese Mitarbeiter gekündigt oder anderweitig beschäftigt (werden)? Warum?
      ii. Waren/wären neue Mitarbeiter nötig, um diese Roboter z.B. zu bedienen oder programmieren?
   c. Wie würde Ihre Entscheidung ausfallen, wenn Sie nochmals entscheiden müssten Roboter zu nutzen?
   d. Beabsichtigen Sie in der Zukunft Roboter zu nutzen? Warum oder warum nicht? Wenn ja/nicht:
      i. Wie lange beabsichtigen Sie bereits Roboter zu nutzen?
      ii. Warum wollen Sie (nicht) in Roboter investieren?

Relativer Vorteil

Nun werden wir uns über die Vorteile unterhalten, die Sie (möglicherweise) mit Robotern assoziieren.

6. Welche Art von relativem Vorteil entsteht/erwarten Sie durch die Nutzung von Robotern? Denken Sie an die Qualität der Arbeit, das Zeitersparnis, die Vereinfachung, die Leistung des Unternehmens, die Effektivität oder Produktivität.
    a. Sehen Sie noch andere Vorteile?
7. Sehen/erwarten Sie irgendwelche Nachteile?
    a. Denken Sie, dass die Nachteile gegenüber den Vorteilen von Robotern überwiegen? Warum oder warum nicht?
8. Beschreiben Sie bitte, wie der wahrgenommene relative Vorteil Ihre Absicht Roboter zu nutzen beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?

Komplexität

Nachdem wir uns über die Vor- und Nachteile von Robotern unterhalten haben, sollten wir über die (möglichen) Schwierigkeiten oder Probleme, die Sie mit der Nutzung von Robotern in der Produktion assoziieren, sprechen.

9. Können Sie erklären, warum es (möglicherweise) schwierig ist/sein könnte Roboter innerhalb des Produktionsprozesses zu nutzen bzw. das Verständnis zur Nutzung von Robotern im Produktionsprozess (möglicherweise) als schwierig erscheint/erscheinen könnte?
10. Welche Probleme oder Schwierigkeiten sehen/erwarten Sie bei der Nutzung von Robotern in der Produktion?
11. Was ist laut Ihnen nötig, um Roboter zu nutzen? Denken Sie an spezielle Fähigkeiten/Fertigkeiten, benötigtes Wissen oder die benötigte Zeit zum Erlernen der Nutzung.
12. Beschreiben Sie bitte wie die wahrgenommene Komplexität Ihre Absicht Roboter zu nutzen beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?

Kompatibilität

Nun werden wir uns über die Kompatibilität von Robotern unterhalten. Mit Kompatibilität ist z.B. gemeint, dass die Nutzung für das Unternehmen überhaupt möglich ist, also Roboter zum Unternehmen passen (würden).

13. Würden Sie sagen, dass Roboter mit der momentanen Situation des Unternehmens kompatibel sind/wären? Denken Sie an den Herstellungsprozess, die Art des Arbeitens etc. Warum oder warum nicht?
14. Beschreiben Sie bitte, wie die wahrgenommene Kompatibilität die Absicht Roboter zu nutzen beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?

<u>Die vom Manager wahrgenommene Einstellung der Mitarbeiter bezüglich der Wahrnehmung der Benutzerfreundlichkeit und Nützlichkeit von Robotern</u>

Nachdem wir über Ihre Absicht, Roboter zu nutzen, gesprochen haben, werden wir uns nun darauf fokussieren, wie diese, Ihrer Wahrnehmung nach, durch die Mitarbeiter und deren Akzeptanz von Robotern beeinflusst wird.

<u>Die vom Mitarbeiter wahrgenommene Benutzerfreundlichkeit</u>

Als erstes werden wir über Ihre Wahrnehmung, der von Mitarbeitern wahrgenommenen Benutzerfreundlichkeit von Robotern, sprechen.

15. Denken Sie, dass die Mitarbeiter Roboter als benutzerfreundlich erachten (würden)? Denken Sie an die Leichtigkeit der Nutzung, den Lernprozess, die Bedienungsanleitung etc. Warum oder warum nicht?
16. Denken Sie, dass die Mitarbeiter glauben (würden), dass Roboter schwer zu nutzen sind? Warum oder warum nicht?
    a. Könnte die Nutzung sogar frustrierend für Mitarbeiter sein? Warum oder warum nicht?
17. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommene Benutzerfreundlichkeit von Robotern, die Vorteile beeinflusst hat/beeinflussen würde, die Sie mit Robotern assoziieren?
    a. Eher positiv oder negativ?
    b. Warum?
18. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommene Benutzerfreundlichkeit von Robotern, die Schwierigkeiten oder Probleme beeinflusst haben/beeinflussen würde, die Sie mit Robotern assoziieren?
    a. Eher positiv oder negativ?
    b. Warum?
19. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommene Benutzerfreundlichkeit von Robotern, die von Ihnen (möglicherweise) erwartete Kompatibilität von Robotern mit dem Herstellungsprozess oder dem Unternehmen beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?

20. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommenen Benutzerfreundlichkeit von Robotern, Ihre Absicht Roboter zu nutzen, beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?

Die vom Mitarbeiter wahrgenommene Nützlichkeit

Als nächstes werden wir uns über Ihre Wahrnehmung, der von Mitarbeitern wahrgenommenen Nützlichkeit von Robotern, unterhalten.

21. Würden Sie sagen, dass die Mitarbeiter Roboter als nützlich erachten (würden)? Denken Sie an die Arbeitsleistung, Vereinfachung der Arbeit, Effektivität, Produktivität, Zeitersparnis oder Qualität der Arbeit etc. Warum oder warum nicht?
22. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommene Nützlichkeit von Robotern die Vorteile beeinflusst hat/beeinflussen würde, die Sie mit Robotern assoziieren?
    a. Eher positiv oder negativ?
    b. Warum?
23. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommene Nützlichkeit von Robotern die Schwierigkeiten oder Probleme beeinflusst hat/beeinflussen würde, die Sie mit Robotern assoziieren?
    a. Eher positiv oder negativ?
    b. Warum?
24. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommene Nützlichkeit von Robotern, die von Ihnen (möglicherweise) erwartete Kompatibilität von Robotern mit dem Herstellungsprozess oder dem Unternehmen beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?
25. Beschreiben Sie bitte, wie die vom Mitarbeiter wahrgenommenen Nützlichkeit von Robotern, Ihre Akzeptanz von Robotern beeinflusst hat/beeinflussen würde?
    a. Eher positiv oder negativ?
    b. Warum?

Andere Interessensgruppen

Zum Schluss werden wir uns noch über andere Interessensgruppen unterhalten, die möglicherweise Ihre Absicht, Roboter in der Produktion zu nutzen, beeinflusst haben/beeinflussen.

26. Welche andere Interessensgruppen beeinflussten/beeinflussen Ihre Absicht Roboter zu nutzen? Denken Sie an die Regierung, Investoren, politische Gruppen, Öffentlichkeit, Handelsverbände oder Lieferanten.

a. Wie beeinflussten/würden diese Interessensgruppen Ihre Absicht Roboter zu nutzen (beeinflussen)?
    i. Eher positiv oder negativ?
    ii. Warum?
    iii. Wie unterschieden/würden sich diese Interessensgruppen in ihrem Einfluss (unterscheiden)? Denken Sie an ihre Macht, Legitimität und Dringlichkeit.
b. Beeinflussten/Würden diese Interessensgruppen auch die Vorteile, die Sie mit Robotern assoziieren (beeinflussen)?
    i. Eher positiv oder negativ?
    ii. Warum?
    iii. Wie unterschieden/würden sich diese Interessensgruppen in ihrem Einfluss (unterscheiden)? Denken Sie an ihre Macht, Legitimität und Dringlichkeit.
c. Beeinflussten/Würden diese Interessensgruppen auch die Probleme, die Sie mit Robotern assoziieren (beeinflussen)?
    i. Eher positiv oder negativ?
    ii. Warum?
    iii. Wie unterschieden/würden sich diese Interessensgruppen in ihrem Einfluss (unterscheiden)? Denken Sie an ihre Macht, Legitimität und Dringlichkeit.
d. Beeinflussten/Würden diese Interessensgruppen auch die von Ihnen (möglicherweise) erwartete Kompatibilität von Robotern mit dem Herstellungsprozess oder dem Unternehmen (beeinflussen)?
    i. Eher positiv oder negativ?
    ii. Warum?
    iii. Wie unterschieden/würden sich diese Interessensgruppen in ihrem Einfluss (unterscheiden)? Denken Sie an ihre Macht, Legitimität und Dringlichkeit.

Dies ist das Ende des Interviews.

Wie wollen Sie über das Ergebnis der Masterarbeit informiert werden?

Danke für Ihre Zeit und Teilnahme an diesem Interview.