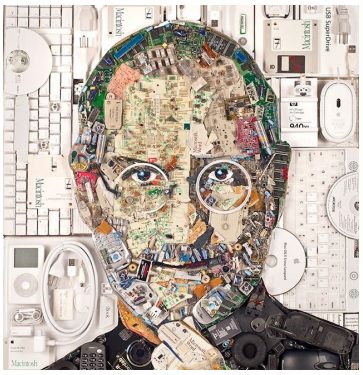
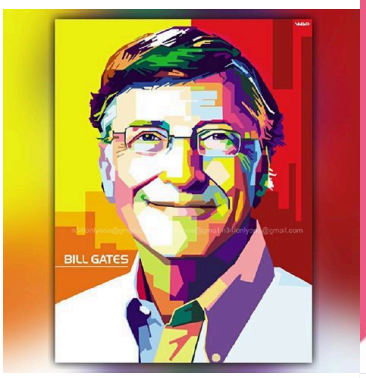
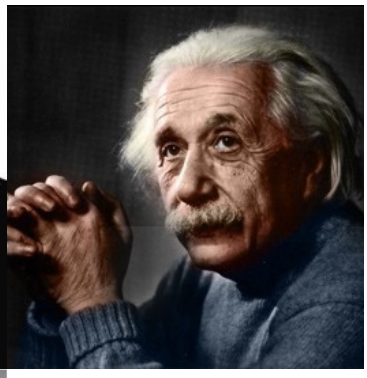
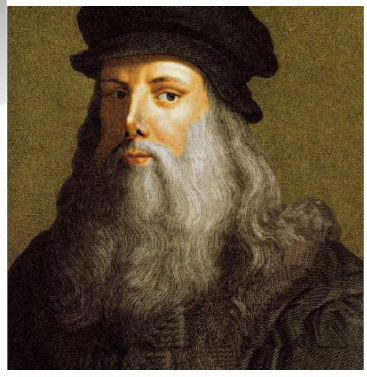
A PROFILE SKETCH OF THE ROUND PEGS IN THE SQUARE HOLES









Winners in the age of smart machines

A profile sketch of the round pegs in the square holes

BACHELOR THESIS

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International Human Resource Management
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Research commissioned by
Research-group Smart Industry & Human Capital

Client:
S. Corporaal

Assessors:
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February 28th, 2017, Enschede, the Netherlands

Preface

Dear reader,

The overall objective of this thesis is for me to earn my bachelor's degree in the study International Human Resource Management (IHRM) at Saxion University of Applied Sciences in Enschede.

This research is commissioned by the research group Smart Industry & Human Capital. In consultation with Stephan Corporaal, an Associate Lector HRM & Smart Industry as well as a researcher for TechYourFuture, we decided together how to set up this exploratory research. The cooperation between myself and the client has been very satisfying, in particular due to the involvement and continuous thinking along with Stephan himself.

I would also like to thank the Academy Human & Labour (AMA) for an informative and enjoyable study period. The warm atmosphere, the positive contact with the teachers and the singularity of the AMA have all contributed to an excellent time. In particular, I want to thank, Janina Banis - Den Hertog for her guidance, constructive comments, but especially for her excitatory views which have encouraged me to go the extra mile for my research.

Furthermore, I would also like to thank Adrianna Sokal for her constructive feedback during a large part of my research, as well as Emiel van Lieburg for his willingness to take over this role near the end. I would also like to thank Kristy McGovern and Nikita Simon for their genuine support, language wisdom, and their refreshing feedback during the process of this research.

Finally, I want to thank all the respondents who participated in my research. Thank you for your honest opinion, available time and commitment.

I hope you enjoy reading my thesis. If you have any questions, please feel free to contact me.

Sjoerd Peters
Enschede, February 28th

Abstract

Over the years the industrial production was transformed by steam power in the 19th century, by electricity in the early 20th century, and by automation in the 1970s (Lorenz, et al., 2015). Today's society is on the verge of the fourth industrial revolution, the Smart Industry. The impact of the Smart Industry will change the economy and the labor market drastically (Vermeend, 2014). Companies that do not respond to this development on time run the risk to not survive (Vermeend, 2014). Over the years it has been proven that innovation is broadly claimed to have beneficial influences on the effectiveness and long-term survival of organisations (Kanter, 1988). Hence, innovation is seen as the primary challenge for today's organisations (Volberda, Jansen, Tempelaar, Heij, 2011).

The transition into the new Smart Industry era causes drastic changes which have consequences for businesses, as well as for employees. Companies need to respond through innovation in order to survive, but the question is how? This exploratory research examines how innovative technicians can contribute to the Smart Industry by creating individual innovation within companies. Thereby it is examined what innovative technicians need, in terms of decisive competencies and work context factors, to create this individual innovation. Through research, the obstacles experiences during the job on a technician's way to individual innovation are also examined.

This study took place within the technical sector, because the research is exploratory, wherein the objectives are to identify which decisive competencies innovative technicians possess. Moreover, this research also examines what an innovative technician needs from his environment and which obstacles innovative technicians experience on the job, on their way to create innovation. In this research a total of 21 participants were involved, who can be divided into two groups namely innovative technician (n=11) and supervisor of the innovative technician (n=10).

The results conclude, that innovative technicians possess attitude competencies which they use to initiate their idea and skills competencies to realise to convert it into action. Moreover, innovative technicians require the feeling that they are free in in their work and they must be challenged in their work environment in order to show innovative behaviour. Besides, the obstacles which innovative technicians experience on their job lie in particular in the field of resistance among colleagues and delays which arise from the organisational context.

It can be concluded that the innovative technician must possess a strong attitude, which is reflected in their competencies, to initiate their innovative ideas and convert them into action by taking the initiative. For the eventual transformation the technician needs to possess skills to ensure a high-quality end product. Throughout this process, the innovative technicians must experience autonomy in their work, and moreover they must experience a challenging work environment. The supervisor must support the innovative technicians through his way of leadership by providing them herein. The success of ultimate realisation of the innovation depends on how the innovative technician deals with the obstacles which occur along the way.

The recommendations are directed at the three clients of this study. The first part of the recommendations are directed to organisations within the technical sector, followed by a concrete example. Next, a manifest is proposed which is directed to innovative technicians and call for a rebellion. The last one is a recommendation to conduct a follow-up research.

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1. Introduction

Prologue Smart Industry

Over the years the industrial production was transformed, by steam power in the 19th century, by electricity in the early 20th century, and by automation in the 1970s (Lorenz, et al., 2015). Today's society is on the verge of a new era. In the technical sector this is described as the ‘new, fourth industrial revolution' (Brynjolfsson & McAfee, 2014), which is nationally and internationally, referred to as "Smart Industry" (The Netherlands), "Industrie 4.0" (Germany), or “Smart Manufacturing" (United States) (Actie-agenda Smart Industry, 2014). It could be described as the second machine age in which machines not only supply muscle, but also brainpower in the form of robots, internet, and artificial intelligence (Brynjolfsson & McAfee, 2014). The expected influences of digitisation and new technologies will change the economy and labor market drastically in the upcoming twenty years, even more so than in the past fifty years (Vermeend, 2014).

Companies that do not respond to this development on time run the risk to not survive (Vermeend, 2014). Over the years it has been proven that innovation is broadly claimed to have beneficial influences on the effectiveness and long-term survival of organisations (Kanter, 1988). Thus, innovation is seen as the main challenge for today’s organisations (Volberda, Jansen, Tempelaar, Heij, 2011). The success of innovation is partly determined by innovative capacity, creativity and flexibility of the employees (Actieagenda, 2014; De Spiegelaere, Gyes & Hootegem, 2014; Janssen, Van de Vliert, West, 2004).

One of the changing impacts for employees is that robots and machines are besides routine tasks, also taking over non-routine tasks, such as knowledge work through digitisation (Corporaal et al., 2015). One of the consequences of this is that different types of technicians are needed by virtue of automation through robots and an emphasis on flexibility, which reduces repetitive low-skill work. However, on the other hand, it increases the need for more specialised work to reorganise the manufacturing systems and perform maintenance activities (e.g., troubleshooting, adjustments, software upgrades and greasing) (Actie-agenda Smart Industry, 2014). As a result of, it is predicted that there will be a shift from the need for ‘traditional' engineers to process engineers. Thus, it is to be expected that the disciplines, knowledge, and expertise of today will not be sufficient for the Smart Industry worker of tomorrow (Actie-agenda Smart Industry, 2014).

The transition into the new Smart Industry era causes drastic changes which has consequences for businesses, likewise for employees. Companies need to respond through innovation in order to survive, but the question is how? This exploratory research examines how innovative technicians can contribute, to the Smart Industry by creating individual innovation within companies. Thereby it is examined what innovative technicians need, in terms of decisive competencies and work context factors, to create this individual innovation. Through this it is also researched which obstacles are experienced on the job, on the way to create individual innovation.

The remainder of this chapter elaborates further upon the introduction of this research. Next, the practical relevance is described, followed by the theoretical relevance, in which the problem is elaborated on and, in addition to that the need for research is addressed. After that, the central research question and the underlying sub-questions are discussed. The chapter concludes with the thesis outline.

1.1 Client

The following subchapter introduces three different stakeholders, which all share a connection to the Smart Industry, however, in a variety of ways. Each of those will be introduced individually and further elaborated upon regarding their role and their mutual connection to one another.

TechYourFuture

Firstly, the stakeholder TechYourFuture is introduced. TechYourFuture is an intensive collaboration between the knowledge institutes Saxion, University of Twente and Windersheim - who function as a network organisation. They work together primarily with educational institutes and subsequently with companies. This form of collaboration is referred to as a Public-Public-Private Collaboration (PPPC) (TechYourFuture, 2016). The mission of TechYourFuture is to encourage and develop future technical talents so that they optimally meet the needs of employers and society. The desired outcomes of this are economic empowerment, employment, and attractiveness for the region East Netherland (TechYourFuture, 2016). To ensure that this mission is successful TechYourFuture created the following goal.

The purpose of TechYourFuture is that eight out of the twenty students choose for a technical educational program and will work in the technical sector; currently, this is five out of twenty (TechYourFuture, 2016). To achieve this goal, three core objectives are formulated, namely (1) choose (2) learn and (3) work (TechYourFuture, 2016). Firstly, foster the awareness of students concerning a study profile in; and a career choice for Science & Technology (S&T). Secondly, encourage good competence development of young people. Thirdly, timely and sustainable preparation for working in a technical environment and alignment of expectations between (future) employees and employers in the technique (TechYourFuture, 2016). The intensive collaboration between all the stakeholders will be a key factor so that the core objectives can be reached.

Research-group Smart Industry & Human Capital

The second stakeholder, the research group Smart Industry & Human Capital that is part of Saxion University of Applied Sciences, works closely together with TechYourFuture to explore the impact of technological developments on human capital. These kinds of cooperations are encouraged by all sorts of institutes, such as FME, VNO/NCW, the Dutch Chamber of Commerce and the Ministry of Economic Affairs. The aim of such collaborations is to join forces and to contribute to the acceleration of the Smart Industry. The research group Smart Industry & Human Capital works together with organisations, students, and teachers of Saxion to explore the impact of technological developments for human capital (Saxion, 2016). Hence, a lot of different disciplines offer a contribution by cooperation to explore the impact of technological developments on human capital.

The Technical sector

Finally, the third and last stakeholder of this research is the technical sector. In fact, this research will be conducted within that sector. To get a more specific picture about the connection between the technical sector and the Smart Industry, this section provides an example of a state-of-the-art company, namely ASML.

ASML is a company that is a good example of a state-of-the-art company, as CEO of ASML, Peter Wennink explains: "*When someone asks me what ASML is, I can say that we build machines that can make the most advanced chips, but what we are is a collaborative knowledge network. We are the system architect, and we are constantly looking for partners who can do certain things better than we can. We bring them together*" (Brouwers, 2016). First, some background information about ASML will be provided, followed by an example of a challenges which ASML is facing as state-of-the-art company in the Smart Industry.

ASML is the world leader in the manufacturing of advanced technology systems for the semiconductor industry. The company offers an integrated portfolio for manufacturing complex integrated circuits (also called ICs or chips) (ASML, 2015). ASML designs develops, integrates, markets and services advanced systems used by customers — the major global semiconductor manufacturers — to create chips that power a wide array of electronic, communications and information technology products (ASML, 2015). Considering Moore's Law, which says that the number of transistors on integrated circuits doubles about every two years, ASML helps to keep this alive by manufacturing lithography systems. As a result, the pace of smartphones can increase further every year (ASML, 2015).

ASML faces some more challenges, for example, regarding their labour content. Their need calls for more specialised technicians to manufacture lithography systems which are very specialised. That is why the jobs are cut into specialised areas, such as troubleshooter, quality engineer, software upgrader, process analyst and competence technician. Nevertheless, the boundaries between the specialised areas are not always clear. This results in the fact that some people are flooded with work while others are bored. This indicates that ASML is dealing with a shift towards more process engineers, which is accompanied by clashes. This proves that ASML is in center of a transition into the new Smart Industry era.

It is apparent that all three described stakeholders have their own connection with Smart Industry and have been brought together in this research due to their connection. The next section elaborates on the practical relevance of the Smart Industry.

1.2 Practical relevance

Following the introduction of this research and the stakeholders, next in order is the explanation of the practical relevance of this research. To do so, firstly the impact of several drastic changes as a result of technological developments are discussed. Afterwards the durability of knowledge and expertise is described in more detail, and lastly, the interdependence between education and the working field will be explained.

The transition into the new Smart Industry era requires a new type of technician. This transition is due to several drastic changes that have occurred because of technological developments that are related to the Smart Industry. Examples of that are labor content or business models (Vermeend, 2014). An illustration of this phenomenon is the profound automation and robotics of production lines and in addition to that the disappearance of routine work. Examples for companies at which this is prevalent are for instance Foxconn, at which robots replace factory workers in the production process. Another example is the changing business model of Uber, an online taxi company which does not possess any taxis itself. Uber uses innovative technology combined with local drivers. By using this pioneering business strategy Uber has grown into one of the largest taxi companies in the world.

In addition to this, the knowledge and expertise that technicians possess today are no longer adequate for the evolved work of tomorrow (Actieagenda Smart Industry, 2014). What this means that it is important to keep up-to-date with different developments in the market. ASML is familiar with this situation as their technological advances also increase more rapidly. The consequence of this is that the level of knowledge and expertise among the workforce is increasingly becoming fragile. ASML responds to this trend by selecting employees primarily on competencies, so that they have the capability to meet to such developments (ASML, 2015). Examples of these competencies are out-of-the-box thinking and adaptability.

Another problem is that there is a mismatch between the expectations and demands of employers and the supply of young technicians (Vos et al., 2014), which is why companies have difficulties in recruiting valuable staff (FME, 2015). There is an apparent gap between the expectations that employers have with regard to the skills that future employees should possess and the skills which technical-graduates do possess. This difference leads to the supposed paradox in which the technical sector complains about a shortage of young, new inflow in the technique sector (Vos et al., 2014), while 'technical students have difficulties to find an internship (Vos et al., 2014). This is due to the fact that educational institutes, and companies in the technical sector do not collaborate sufficiently, whereby young technicians are not adequately prepared for the changed labor-content in the Dutch industry (TechYourFuture, 2016). This poses as a problem, when considering the assumption of Vos et al. (2014), that organisations in the high-tech industry need young technicians shortly who possess 21st-century skills. This demand for young technicians who possess 21st-century skills arises from the radical development of the content of work, because of several technological advances (Actieagenda Smart Industry, 2014). Hence, there is a strong interdependence between education and the working field, which is made more visible through the developments in the Smart Industry.

Thus, the practical relevance of this paper is clear as it is pivotal to respond to the developments. (1) the profound automation and robotics of production lines leads to the disappearance of routine work (Foxconn) & changing business models through innovative technology (Uber). (2) knowledge and expertise are no longer adequate for the evolved work of tomorrow. (3) an apparent gap between the desired skills which young technicians should possess according to employers and which technical-graduates actually do possess, which arise from the transition into new Smart Industry era.

1.3 Theoretical relevance

The previous segment provided several practical examples with regard to why the transition into the new Smart Industry era requires a new type of technician. This section focuses on the aspect of what is already known in theory. This subchapter firstly discusses (1) what previous studies indicated the necessary competencies to be and how these are called, and lastly (2) the exploratory research of the research group Smart Industry & Human Capital about the expectations of employers towards (young) technicians.

As previously mentioned, the ‘new type of technician' must possess different competencies because their role changes through the transition towards the Smart Industry era. Several studies investigate what these competencies exactly are and how these competencies called. These studies mostly refer to the 21st-century skills; an overarching concept for the knowledge, skills, and dispositions which people need to possess to be able to make a contribution to the knowledge society. However, the use of different terminology is standard through various studies, which may cause confusion at first. Therefore, Voogt & Roblin (2010) have conducted research which combines several models about 21st-century skills. This research showed that in the examined models much emphasis is placed on the need for a precise definition of 21st-century skills.

To provide more clarity about which competencies the new type of technician must possess the research group Smart Industry & Human Capital conducted an exploratory research about the expectations of employers towards (young) technicians. This research resulted in a list of competencies, which were identified to be important for the technician of the future to possess. Key findings are that employers consider it to be important that a technician is capable of communication with colleagues, suppliers, and customers. More specifically, the technicians need to be able to communicate on different levels (from customer to another discipline) and purposes (from sales to in-depth work content). Customer intimacy, customer focus, and commercial skills are necessary for working in multidisciplinary teams (Corporaal et al., 2015).

Hence, the research of Corporaal et al. (2015) indicated that employers expect that the technician of today must possess different competencies because their role is changing into a rather marketing-oriented position: someone who can make quick connections between people; can sell himself; and is constantly looking for new possibilities. Knowing this will lead to a better insight in which competencies are seen as important in the Smart Industry according to employers, but the research lacks knowledge about which competencies are actually possessed by technicians. Moreover, it is not solely interesting to know the competencies that the technician needs to possess, but also how these can be fostered. Therefor is a necessity.
For a follow-up study that identifies which competencies technicians possess and what is needed to foster these. The next subchapter elaborates on how this will be approached in this research.

1.4 Objectives

This research arose from a question of the (primary) client, the research-group Smart Industry & Human Capital. Earlier in this chapter it was described that the companies need to respond through innovation in order to survive the transition into the new Smart Industry era. This exploratory research examines how innovative technicians can contribute to the Smart Industry. The first objective of this research is to identify which decisive competencies innovative technicians possess. Moreover, the aim of this study is more than just knowing what these decisive competencies are. As knowing these competencies enables one to also foster them, this research also examines what an innovative technician needs from his environment. Through measuring which work-context an employer needs to provide to a technician, for him to be innovative, the determination can be made which factors are beneficial for innovative behaviour and which factors are not. Additionally, this research examines which obstacles innovative technicians experience on the job, on their way to create innovation. Through measuring which obstacles an innovative technicians experiences on the job, on their way to create innovation, the forms of such obstacles are not only identified, but moreover it can be determined which actions can be taken to deal with this form of resistance.

Since multiple stakeholders are part of this study, it has been decided to describe to describe the objective of this research separately for each stakeholder.

The research-group Smart Industry & Human Capital

The added value of this study for the primary client, the research-group Smart Industry & Human Capital, is that they gain new knowledge about which competencies are important in the Smart Industry. They already had previous knowledge about which competencies were seen as pivotal amongst employers, but this research will supplement that with which decisive competencies innovative technicians actually do possess. Additionally, new insights about which work context factors are beneficial to foster innovative behaviour are provided as well as the kind of obstacles that are experienced by innovative technicians and which actions can be taken to overcome these. The research group can use this knowledge to advice businesses on what an innovative technicians requires in order to create individual innovation so as to make a contribution to the Smart Industry. Moreover, the research group can use this knowledge in collaboration with educational institutes to update education curricula for the Smart Industry era.

The Technical sector

Similar to the added value that this research has for the research-group Smart Industry and Human capital, the technical sector in general also benefits from this research due to the same reasons. Fostering the competencies of the innovative technicians is beneficial for the transition into the Smart Industry, because it increases their innovativeness. Additionally, businesses gain insights about what an innovative technician requires from his employers organisation in order to show innovative behaviour. Through that, organisations in the technical sector can more specifically stimulate innovative behaviour among their employees, which is vital to ensure a smooth transition into the Smart Industry era. Furthermore, by knowing which obstacles innovative technicians experience on the job, on their way to create innovation, companies have the opportunity to make in order to prevent these.

TechYourFuture

The added value for TechYourFuture is that the acquired knowledge from this research can be used for educational purposes. The knowledge of which decisive competencies an innovative technician possesses is beneficial information, which can be used to redefine educational courses so that they are fit for the jobs of the future.

A further ambition of this research is to provide the stakeholders with several recommendations, that will originate from the results of the study, which will be focused on how individual innovation can be stimulated. The next chapter provides theoretical information about why the fostering of individual innovation is beneficial.

From the formulated problem the following central research question is posed:

Main question

- What do innovative technicians need, in terms of decisive competencies and work context factors, in order to create individual innovation so as to make a contribution to the Smart Industry?

Sub-questions

1. Which specific competencies does an innovative technician possess?
2. What does the innovative technician require from an organisation in order to show innovative behaviour?
3. Which obstacles does an innovative technician experience on the job, on his way to create individual innovation?

1.5 Thesis outline

This thesis is about which competencies are decisive for an innovative technician to contribute to the Smart Industry and is composed of six chapters. The second chapter contains the theoretical framework and elaborates upon aspects which support the theoretical research. This theoretical framework is merged into a conceptual model that is supported by qualitative research. Chapter three consists the research population, the research method, the interview protocols, and the analysis method. Chapter four discusses the results of the qualitative research. The conclusion and discussion are elaborated on in chapter five, and the main question is answered by the most relevant insights from the research. Also, the limitations of this study and suggestions for future research are discussed. Chapter six discusses the recommendations which are drawn up from the basis of the conclusions of this research. The recommendations are split up and directed to the clients of this research.

2. Theoretical framework

The main essence of the introductory chapter is that companies need to adapt drastically through using innovation in order to survive, as a result of the advancement of the Smart Industry. This exploratory research examines how innovative technicians can contribute to that. This chapter introduces the theoretical framework which is focused on individual innovation. Firstly, the origin of individual innovation is described, followed by the link to a practical example and a further elaboration where innovation originates from. Secondly, the potential competencies that innovative technicians possess will be described. Henceforward, the work context factors which influence individual innovation will be introduced, as well as several conditional factors that have an effect on individual innovation. Finally, the chapter draws to an end by illustrating the theoretical model. This model includes all the factor which are described above.

2.1 The origins of individual innovation

The following section addresses where individual innovation originates from.

Innovation begins at, the individual level with the action-taking of an employee to generate creative ideas (Kanter, 1988) to solve job-related problems or incongruities with which he is confronted (Janssen, Van de Vliert, & West, 2004). By modifying oneself or the work environment through innovation, the employee could achieve results, such as improved performance or personal growth (Janssen, Van de Vliert, & West, 2004). 'Innovative work behaviour is all employee behaviour focused on the formation, introduction or application (within a role, group, or organisation) of ideas, processes, products or procedures that are new and supposedly beneficial for the relevant compatibility' (De Spiegelaere, Gyes & Hootegem, 2014, p.144). This description is called innovative work behaviour. Moreover, an innovative culture is a requirement for a creative employee to be able to translate ideas into innovative products (Janssen, Van de Vliert, & West, 2004). Innovation means that there are changes that take place in a series of processes and is therefore almost never an individual performance of one employee himself (Janssen, Van de Vliert, West, 2004). Thus, working in a team and collaboration are key factors for an innovative employee.

Consequently, the innovative success of organisations is partly dependent on the innovative capacity of employees. The success rate of individual innovation depends on several aspects (Janssen, Van de Vliert, & West, 2004). Therefore the following aspects will be examined in this research; the work context and conditional factors, but first, the next section elaborates on the first aspect: the competencies.

2.2 Competencies

The following section will address the competencies which are associated with innovative technicians in the technical sector. These competencies are the eight highest scored desired competencies of the technician in the 21st century, according to employers, based on the research of Ebenau (2016), namely *proactivity, business knowledge, adaptability, multidisciplinary knowledge, accurate / quality oriented, collaboration, dealing with uncertainty, and creativity/ innovation.* The competencies consist of various domains such as knowledge, skills, and attitude. The secondary segment of this section explains the competencies in more detail.

Proactivity

The first competence which is advantageous for a technician to possess is proactivity. Proactivity is described as proactive behaviour which is acquired on one's initiative (Unsworth and Parker, 2003) and is, therefore, a significant predictor of entrepreneurial behaviour (Rauch, Wiklund, Lumpkin and Frese, 2009). Different aspects compose to what is known as proactivity. The first point is voicing your opinion, which is crucial according to employers (Corporaal et al., 2015). Expressing your opinion includes the ability to give expression to your desires, interests, and views in a transparent and respectful manner (Van Der Bijl, 2015). The second aspect is taking the initiative, such as motivating themselves to develop professional competencies and demonstrating an eagerness to keep learning (Binkley et al., 2012; Partnership for 21st Century Learnings, 2015). The final aspect is the attitude to continuously improve themselves and advance their development (Corporal et al., 2015). Continuous improvement can be achieved by refining their performance, through analysis and evaluation to gain insight into which aspects they could improve themselves (Binkley et al., 2012). Therefore, technicians must shape their career path and herein set realistic goals for themselves (Thijs et al., 2014), whereby courses and programs can be of a supportive character (Corporaal et al., 2015).

Business knowledge

Business knowledge as competence is becoming exceedingly important, as employees works more frequently in collaboration with colleagues from other disciplines and, in order to do so, they need to possess knowledge of the other disciplines (Sethi et al., 2001), but also have the ability to communicate with these disciplines (Birchall et al., 2006). Through collaborating with other disciplines, the employee gains business knowledge and develops business insight. Business knowledge is described as a core competence, although this is not acquired during the education (Birchall et al., 2006). An aspect of business knowledge is financing, such as the ability to understand which impact operations have on, for example, the profitability of a company (Corporal et al., 2015). The understanding of economic and financial issues which are related to the work of the technician are also crucial, so that they comprehend what it takes to compete in the market (Nguyen, 1998). Another aspect of business knowledge is the understanding of processes. At heart, it is important that the employee has an understanding of the full production process and is aware of the influence of their contribution to this (Nguyen, 1998). In addition to that, the employee must understand what is expected from him organisationally (Nguyen, 1998), so he can adjust his actions accordingly (Corporal et al., 2015). For the future, the employee must be able to overlook and control their processes. In other words this mean that they understand the consequences of certain actions (Corporal et al., 2015). For this, they must possess certain skills, such as problem-solving, coordination and organising efficiently (Nguyen, 1998).

Adaptability

Adaptability is an important competence for technicians to possess, because of ever-changing technologies amplified by constant changing demands in the labor market (CPB, 2012; Van Est and Kool, 2015). Adaptability is defined differently in many sources, such as flexibility. The model of Partnership for 21st Century Learning (P21) describes adaptability as the ability to adapt to varied roles, jobs responsibilities, contexts, and schedules, complemented with the capacity to work effectively in a climate of constant changing priorities in combination with ambiguity (Partnership for 21st Century Learnings, 2015). This corresponds to the exploratory study (Corporaal et al., 2015) which additionally suggests that employees must be able to take over the work of colleagues if the situation demands it.

Multidisciplinary knowledge

In addition to the previous competencies, the multidisciplinary knowledge competence is growing considerably in importance, as technical functions are becoming more versatile (SEO, 2013). As a result of recent developments in the technical sector, the need for collaboration between different disciplines will increase, because this is the only way for organisations to continue to innovate (Sethi et al., 2001). Multidisciplinary knowledge includes a broad range of abilities, such as speaking languages of multiple disciplines. To make this collaboration a success, technicians must possess knowledge (see business knowledge) of others disciplines and have the ability to communicate with various disciplines (Birchall et al., 2006). The communication with different disciplines occurs for example with nanotechnology, which blends molecular biology, protein chemistry, biochemistry, and other specialties with each other (Davies, Fidler, & Gorbis, 2011). Additionally, it is important to have knowledge about the customer and the sector in which the company operates. A growing emphasis is placed upon the importance that a technician is able to advise, communicate and negotiate with a client (Corporaal et al., 2015). Thus, knowledge of the customer, in combination with the awareness of the technician is a requirement for the technician to develop products with the customer (Birchall et al., 2006; Corporaal et al., 2015).

Accurate work & high-quality output

Moreover, another important competence for technicians to possess is the ability to work accurately and deliver high-quality output. The importance of this competence has grown over the years through more complex machines and the introduction of quality programs (Corporal et al., 2015). The result of the employee must be of high quality, and they must take responsibility for continuously being critical with regard to the quality of their work (Partnership for 21st Century Learnings, 2015), but also for the work of others (Hoekstra & Sluijs, 2003). To ensure the quality of own work, employees should be able to ask for feedback from others (Corporaal et al., 2015). In the delivery of a qualitative result, one must not only focus on the importance of "what," but more so on the importance of the "how" as that is equally important. This can for example be reached by the means of effective collaboration & cooperation with teams as well as effective management of time and projects (Partnership for 21st Century Learnings, 2015). Furthermore ‘accurate work’ includes precise, meticulous and flawless execution of activities (VSNU-NOA, 2010). On account of increasingly sophisticated and high-tech machines and products, it is important that employees proceed meticulously in every action. Employees need to be aware of the importance of precision engineering (Nguyen, 1998) and of the fact that a small mistake can have significant consequences, which could lead to a damage that can cost the company millions of euros (Corporal et al., 2015).

Collaboration

Alongside that, technicians must be able to collaborate with others to make innovation possible. ’Collaborate’ is closely related to ‘communication,' the one is not possible without the other. Collaboration is composed of several parts, such as collaboration with other disciplines. The aspect collaboration with other disciplines has already been partially described in Multidisciplinary knowledge but will be further supplemented by this section. For an excellent cooperation, it is important to respond open-mindedly to different ideas and values as well as conduct oneself in a respectable, professional manner (Binkley et al., 2012). In addition to that, all parties involved must take responsibility for consolidated results (Partnership for 21st Century Learnings, 2015). When a problem arise while working on a common goal, an employee should be able to devote to making a contribution to a joint solution (Burkhardt et al., 2003). While working together, the colleagues must be able to give constructive feedback to each other, so that they can learn from each other (Burkhardt et al., 2003).

Dealing with uncertainty

Dealing with uncertainty is another necessary competence for technicians to possess. The demand for employees who can operate in an uncertain environment is growing. This is due to increasing complexity, more different outcomes, and a rapid pace in the working environment. Thus, employees must possess the ability to deal with conflicting interests as well as tight deadlines (Corporal et al., 2015). It frequently occurs that an employee simultaneously works on multiple products, whereby it is important that they can shift quickly between changing expectations(Corporal et al., 2015). Hence, it is crucial that the employee can adapt to different roles, job responsibilities and work environments (Partnership for 21st Century Learnings, 2015).

Creativity / Innovation

Finally, the last desired competence for technicians to possess is Creativity / Innovation. This competence is composed of several components, such as to think out-of-the-box, to apply existing knowledge in order to create new ideas, and to generate unconventional solutions. This paragraph discusses several of these components. An employee must be curious and have an entrepreneurial attitude, whereby they explore the boundaries of the discipline and the technical possibilities. Subsequently, they must be able to broaden those limits and invent new relations (Corporaal et al., 2015). To create innovative products, the employee must dare to take risks (Thijs et al., 2014). When they make a mistake, or a problem arises, they are considered capable of evaluating these errors and taking advantage of these learning opportunities for the future (Partnership for 21st Century Learnings, 2015; Thijs et al., 2014). Another aspect which is necessary to create innovative products is the ability to apply existing knowledge to generate new ideas in order to improve products or processes (International Society for Technology in Education, 2015) or responses beyond that which is routine or rule-based (Davies, Fidler, & Gorbis, 2011). The outcome of this can subsequently be beneficial for the employer and help them gain competitive advantage in comparison to their rivals (Corporaal et al., 2015). Furthermore, an employee must think along with the wishes of the customer so that they can generate unique solutions. This corresponds with what was described in multidisciplinary knowledge earlier. It is important to have knowledge about creative techniques and be able to think on a detailed level so that one can jointly explore the boundaries of technical possibilities (Corporal et al., 2015).

2.3 Work context factors

To achieve individual innovation, both competencies, as well as work context factors, are critical. Following the introduction of the competencies which are associated with innovative technicians in the technique, the next section elaborates upon the work context factors. This part elaborates further by addressing the topics of; (1) challenge, (2) variety, (3) autonomy, and (4) leadership.

Challenge

The first section addresses the aspects of challenge. Challenge in the workplace is a subjective and complex job feature; several types of research define this concept in various ways (Preenen, Vianen, Pater & Geerlink, 2011). Davies and Easterby-Smit (1984) define challenge as: ‘work activities which cannot be executed through traditional ways or routines and therefore require new ways of working.' In other respects, McCauley, Ruderman, Ohlott & Morrow (1994) define it: ‘as job characteristics with the ability and motivation to learn.’ The concept of challenge consists of several aspects, such as solving and dealing with new or difficult problems, job complexity, and problem-solving.

Fundamentally, challenge is defined as the ability to learn new things and the complex nature of tasks — also referred to as the degree of capacity assessment (Preenen, Vianen, Pater & Geerlink, 2011). This description is a reference to the fact that capabilities can be tested and used (Hackman & Oldham, 1976). For example, it involves tasks that are so complex that existing routines are no longer applicable and wherein one has no training or experience to solve the task (Locke & Latham, 2004). Thus, when one lacks the necessary knowledge on how to execute a procedure, one's own ideas and creativity are of importance in order to reach the goal (Holmes & Srivastava, 2002). The above description is usually operationalised with solving and dealing with new or difficult problems (Amabile, Hill, Hennessy & Tighe, 1996). Executing tasks on the job which are complex and challenging to perform (Job Complexity) (Morgeson & Humphrey, 2006), and devising unique ideas or solutions (Problem Solving) (Morgeson & Humphrey, 2006). Edwards et al. (2000) found that complexity is a definite factor that is derived from work that involves complex tasks, requires numerous high level skills, is more mentally demanding and challenging and is likely to have positive motivational outcomes. The research of Zald et al. (2008) shows that novel behaviour, such as trying something new or risky, triggers the release of dopamine, a chemical that helps to keep you motivated and eager to be innovative. Hence, challenge is an important work context factor to enable innovation.

Variety

Variety refers to the degree to which a job requires employees to perform a broad range of tasks on the job (Morgeson & Humphrey, 2006). By definition, it is similar to notions of task enlargement; however that is not an appropriate comparison as task enlargement itself merely makes the job structurally bigger. Task enrichment, on the other hand, provides an opportunity for the employee's psychological growth (Herzberg, 1968). Thus, it depends on the variety of tasks that are necessary to properly perform a job (Harvey, 1991; Ilgen & Hollenbeck, 1991) as well as the extent to which a job appeals to the different skills and talents of an employee (Hackman & Oldham, 1976). Jobs that involve the performance of several work activities are likely to be more enjoyable and interesting to perform (Sims, Szilagyi, & Keljer, 1976).

Autonomy

People have a natural need for autonomy (Parker & Ohly, 2008) which can be facilitated by providing a motivating environment that consists of a right mix of guidance and support, and at the same time provides a satisfying degree of freedom as well (Ryan & Deci, 2000). One way how autonomy is defined is in an environment that offers the right degree of freedom in setting goals and ways to achieve these aims (Newell & Van Ryzin, 2007) and the freedom to make mistakes and learn from them (Parker, Williams & Turner, 2006). Empirical research of Parker et al. (2006) shows that autonomy has a strong positive effect on innovative behaviour. Autonomy includes three interrelated aspects centred on freedom in (a) work scheduling, (b) decision-making, and (c) work methods (Morgeson & Humphrey, 2006).

Leadership

Leadership is the extent to which a supervisor offers inspiration, guidance, support, and coaching (Babin & Boles, 1996) and can make or break innovative ideas (Saunders, Sheppard, Knight, & Roth, 1992). The effectiveness of the implementation of the innovative ideas depends on a supportive supervisory style (Axtell et al., 2000). During the past twenty years, there has been a shift in the leadership research from 'transactional' models to theories that focus on 'transformational' or 'charismatic' leadership (Den Hoogh, Hartog & Koopman, 2004).

Leaders who reward efforts of employees characterise transactional leadership models. While charismatic or transformational leaders are known for giving extra meaning to work, with the result that employees are willing and able to do more than is expected of them (Bass, 1985).

There are conflicting theories and evidence surrounding supportive leadership in relationship to proactivity. On the one hand, it can be difficult for supervisors to support proactive behaviour, because it can be threatening, for instance when employees question their supervisor's decisions and challenge accepted practices (Frese & Fay, 2001). On the other hand, in a context of self-steering teams, Manz and Sims (1987) showed the influence of managers "Leading others to lead themselves" (p. 119) through, for example, encouraging employees to be aware of their own performance, to have high expectations, and to set their own goals. Thus, there is a sharp contradiction.

The conflicting evidence and opinion about the role of supervisory support in promoting proactive behaviour may partly be caused by a failure to consider what appropriate "support" is for this type of performance. Some traditional supervisory aspects may encourage passivity, such as implementing suggestions from employees. Although one can see this as supportive, it may also reduce employees' motivation to realise the idea themselves, and can thereby lower expectations for employees' self-steering behaviours (Parker, Williams & Turner, 2006). In contrast, other supportive behaviours, such as those that help individuals to be self-managing and self-directed, are likely to enhance proactivity (Manz & Sims, 1987).

2.4 Conditional factors on innovation

The previous section described various work context factors which have an effect on individual innovation, but there are more factors which affect individual innovation that are not part of the work context. These factors are referred to as 'conditional factors on innovation.' This section elaborates further by addressing the topics of; (1) supportive co-workers, (2) stimulatory organisational context, and (3) low level of uncertainty avoidance culture.

Supportive co-workers

Mutual trust between colleagues was found to be an antecedent of proactive work behaviour (Parker, Williams & Turner, 2006). First, trust implies that colleagues will accept mistakes as learning experiences (Costigan, Ilter, & Berman, 1998). Second, when being supported with the trust of colleagues innovators are more likely to feel more open to change and in control. Finally, given trust embodies risk taking (McAllister, 1995), which ensures that innovators are more likely to "take the risk" to feel ownership. Thus, mutual trust among colleagues helps to create an environment in which innovators are willing to take the risk of "owning" broader goals. Nevertheless, colleagues can be expected to resist an employee's innovative idea for change, through, for example, demonstratively maintaining the old work style. This resistance stems from the fact that the resisting co-workers have the tendency to avoid insecurity and stress which comes as a result of the change (Janssen, 2003). This friction can cause emerging conflicts among the innovator and colleagues, and may therefore cause the innovator to have less positive feelings about the relationships with his co-workers (Janssen, 2003). However, it would be an exaggeration to assert that co-workers always obstruct or support innovative employees. Thus, it is important that the generated innovative ideas are further elaborated and ultimately worked out into specific changes in, for example, tasks and procedures (Kanter, 1988). For the reasons given above, the process of developing and implementing these changes can lead to interpersonal conflict. Whether such conflict will result in beneficial or costly outcomes, depends on the skills of the innovator paired with the motivation of co-workers to resolve the emerging issues about innovative change (Janssen, Van de Vliert, & West, 2004).

Stimulatory organisational context

Another moderator of conditional factors of innovation is the organisational context of the company, in which the innovation takes place (Janssen, Van de Vliert, & West, 2004). The type of organisational structure possibly influences the regulation of the process and outcomes of the employee's innovation. It is distanced between two types of organisation structures, namely mechanistic and organic. If an innovative approach takes place in a mechanistic organisation, which is designed to protect predictable courses of actions, it would be more likely to result in conflict, when comparing it with an organisation which has an organic structure. Organically structured organisations stimulate employees to adapt innovatively to rapidly changing situations and uncommon circumstances (Mintzberg, 1979). Thus, the type of organisation structure can be expected to have an influence on the conflict-provoking effects of innovation behaviour which determines the success or failure of the innovative idea (Janssen, Van de Vliert, & West, 2004).

Low level of uncertainty avoidance culture

Finally, the last moderator is national culture, something where no one can evade from. It will, without any hesitation, make a difference in the outcome of an innovative idea whether the idea is proposed in a country that is keen on new ideas (e.g., South Africa) or in a country that advocates ideas that have stood the test of time (e.g., Japan) (Inglehart, Basanez, & Moreno, 1998). Thus, employees that work in cultures that advocate ideas that have proven over time (southern Europe, South America, and North-East Asia) feel more threatened by the unknown or uncertain situation than employees that work in cultures which are keen on new ideas (northern Europe, North America, and South-East Asia) (Hofstede, 2001). The fear of uncertain situations has the likely effect that employees overestimate the dark sides of innovative contributions and thereby don't see the possible bright sides which may arise out of the innovative idea. The research of Shane (1995) has shown that employees in countries with more uncertainty-avoidant cultures are less in champion innovations in several aspects. For example, the fact that they hamper creative solutions to existing problems by failing to provide with the necessary autonomy to solve the problem. Moreover, they fail to convince other essential stakeholders within the organisation to provide support for innovations (Janssen, Van de Vliert, & West, 2004).

In summary, the described conditional factors on innovation can have a positive influence on individual innovation if they are advantageous, such as supportive co-workers, stimulatory organisational context and a low level of uncertainty avoidance culture. If these conditional factors are not beneficial for individual innovation, then it will have detrimental consequences.

2.5 Conceptual model

Figure 2.1 illustrates the conceptual model which includes the characteristics that contribute to individual innovation. This chapter clarified the concepts and constructs of this research through scientific literature. The next chapter elaborates in more detail upon the research method that is used to measure these concepts.

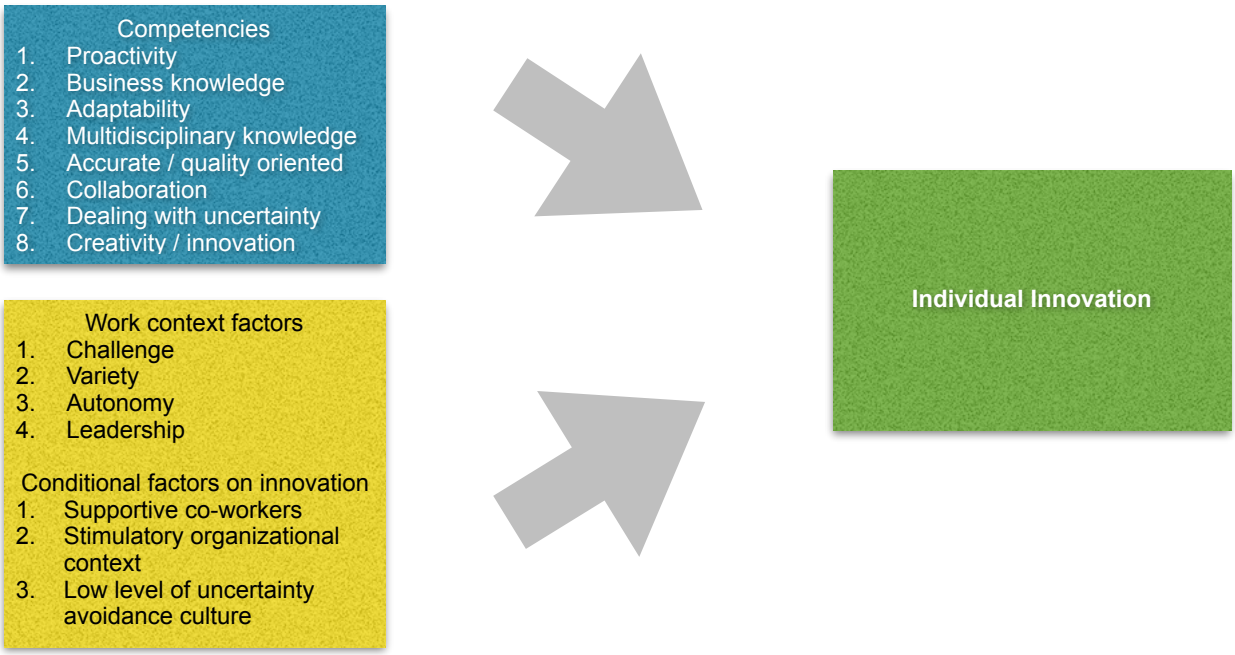

Figure 2.1 The conceptual model

3. Research methodology

This chapter elaborates on which methodology is used in the identification of the decisive competencies for the innovative technician. As described in chapter two, individual innovation is made possible through competencies and work context factors. The primary focus of this research is on which competencies are decisive to possess; however, the work context factors and the conditional factors are also taken into account as their influence on the outcome is of importance. This chapter includes the following items. The first section elaborates upon the research population. Secondly, the research method is discussed, followed by the interview protocol is elaborated upon. As last, the final section elaborates upon analysis method and a list of the reliability and validity aspects.

3.1 Research population

An obvious choice has been made to conduct the research within the technical sector, because of the explorative nature of the research. The object is to gain as much information as possible about individual innovation. The interviewed influential technicians, who are seen as innovative, were appointed by their immediate supervisors. Their innovativeness determines their suitability to participate in this research. The respondents for this research were contacted in various ways.

Firstly, contacts provided by the client supplemented with business contacts of the researcher himself were contacted. These contacts were informed about the purpose of the research and asked if their company could participate in the research. Next, the immediate supervisors were asked which of their employees would best be describe as the most innovative of all. In the case that the supervisor had difficulties to appoint someone, some questions were asked to help him make up his mind. An example of a question which was asked, is as follows, "*What was the most innovative initiative which has been executed in the last 12 months?*". This approach was crucial to determine which innovative technician was the most appropriate to interview. Eventually, the innovative technician was contacted to gauge their willingness to participate in the research and, if positive, a date for the interview was set. In addition to the innovative technician, also his direct supervisor was interviewed, providing the advantage that it creates an extra option to validate whether the competencies which are identified by the influential, innovative technician are also seen as important by their direct supervisor.

In this research a total of 21 participants were involved, who can be divided into two groups namely innovative technician (n=11) and supervisor of the innovative technician (n=10).

The first group, the innovation technician, consists of respondents of the following companies in the technical sector; Aqua Industrial Watertreatment B.V., ASML, Balance& Result Organisatieadviseurs BV, Eaton, Filtration Group, KLM, Norma, Rollepaal B.V., Solar Team Twente, Stork IMM, and TriMM. The above companies have been selected, because (1) they are part of the technical sector and (2) business contacts of the researcher himself or of the research group Smart Industry & Human Capital worked at one of the companies which increased the likelihood of the participation in this research.

The table below contains more accurate information about the first group, the innovation technician.

Table 1: Population innovative technician

Gender	Level of education	Function	Years of employment
Male	MBO	Aircraft Mechanic	9
Male	WO	Interaction Designer / Teamlead	5
Male	MBO	POB-ilemo technician	5
Female	HBO	R&D-coordinator	13
Male	MBO	CAD/CAM programmer	11
Male	WO	Electrical Engineer	1
Male	WO	Senior Separation Engineer / Innovation Manager	3
Male	HBO	Process Engineer	6
Male	HBO	Product Manager	9
Male	HBO	Software Engineer	32
Female	HBO	Junior Advisor	2

The second group, the supervisor of the innovation technician, consists of respondents of the following companies in the technical sector; Aqua Industrial Watertreatment B.V., ASML, Balance& Result Organisatieadviseurs BV, Eaton, Filtration Group, Norma, Rollepaal B.V., Solar Team Twente, Stork IMM, and TriMM. The above companies have been selected on the same criteria as the first group.

The table below contains more accurate information about the second group, the supervisor of the innovation technician.

Table 2: Population supervisor of the innovative technician

Gender	Level of education	Function	Years of employment
Male	HBO	Team lead Scanner, Mid-work	5
Male	WO	ESS EMEA Manager Program Management & Expertise	1
Male	WO	Factory Manager	4
Male	HBO	Technical Manager	1
Male	HBO	Product ownership	15
Male	HBO	Manager Process Technology & Development	3
Male	HBO	Manager Sales Engineering	8
Male	HBO	Head Engineering	3
Male	HBO	Technical Manager	18
Male	WO	Senior Advisor	11

3.2 Research method

To determine what innovative technicians need in order to create innovation so as to make a contribution to the Smart Industry, it is important to identify the decisive competencies and work context factors. Moreover, it is also important to identify which obstacles innovative technicians experience on their job, which influence his/her ability to create individual innovation. This is done on the basis of qualitative research, which has been established as the research method that best suits this type of research (Verhoeven, 2011).

Due to the fact that the research method is qualitative use has namely been made of semi-structured interviews. The benefit of making use of asking questions is that, different beliefs, experiences and opinions can be obtained. This way of research corresponds with the research approach of Boeije (2005), which is an approach that is best suited because the goal of the research is to gain as much information as possible about the factors that contribute to the creation of individual innovation. Furthermore, this research approach gives the interviews the possibility to ask in-depth questions when the respondents says something interesting or if it is unclear what the precise meaning is. This allows more detailed information to be shared between the interviewer and the interviewee.

Prior to conducting the interviews a test interview took place. This test interview was carried out with a mechanical engineer student who also participated in the Solar Team Twente. The purpose of the trial interview was to determine if the first draft of the interview protocol was of a high quality. Afterward, the test interview was analysed and the conclusion of this was that the structure of the interview did not meet the requirements to ensure valuable information.

Subsequently, to ensure high quality of the interviews, a brainstorm session was held. The purpose of the brainstorm was to think out-of-the-box to come up with a non-conventional structure. The idea behind this was that with a non-conventional interview protocol a higher quality can be achieved, because the respondents are being triggered throughout the interview and repetitions are avoided. This should ultimately ensure that the respondents think freely and thereby get better to the core with their answers.

Deriving from this brainstorm, the idea to split the interview into two parts was proposed up. Within these two parts, the initial part will concentrate on the story of the respondent while the second part will focus on identifying the decisive competencies and work context factors through an interactive card game.
The advantages of the storytelling phase are that (1) the respondent has the opportunity to share his story without any restrictions which can results in valuable information, (2) the interviewer has the possibility to ask specific in-depth questions related to the story of the respondent to get more specific information, and (3) the story could provide additional information which was not expected in advance and is beneficial for the research. The advantages of the interactive card game are that (1) in an interactive way it can be ascertained which competencies the innovative technician possess the most, while keeping hold of the attention span of the respondent, (2) the visual display of the ranking of the competencies is beneficial for the interview, and (3) the interviewer has the possibility to ask specific in-depth questions to identify why the competence is so decisive.

3.3 Description interview protocol

This paragraph elaborates on which steps are part of the process in the semi-structured interview. There is a distinction made between the description of the interview protocol for the innovative technician and his supervisor. Additionally a connection with the sub-questions of this research, see section 1.4, has been included.

1) Innovative technician

The complete interview protocol for the innovative technician sits in appendix A: interview protocol innovative technician. In the appendix the whole interview process is outlined.

Storytelling

The interview starts with the question whether the respondent wants to share a story about something special that he/she has done within their work, which they are most proud of. The respondent has the freedom, without limitation, to share their selected story.

After finishing their story, the interviewer can ask in-depth questions that relate to the story of the respondent. These in-depth questions focus on the 'how' aspect; thus they concentrate on identifying which actions the respondent has taken to reach the accomplishment they have just described. Additionally, in relation to their actions, it is also considered whether there were others who had a stake in this process. Hence, the focus will also be on the impediment factors; thus which obstacles the respondent experienced during the process and eventually which actions he has taken to deal with the resistance. This part of the interview is of importance for the collection of information which is necessary to answer the first, and the second sub-question "*Which obstacles does an innovative technician experience on the job, on his way to create individual innovation*?". Furthermore, it provides extra information for the other two sub-questions, but this additional information will be used to complete the whole picture in Chapter 5, the conclusion.

Competencies & work context factors card game

The second part of the interview uses a different method to keep the interview interesting. Use has been made of a card game in which the respondent is asked to perform some tasks. The card game consists of two topics, namely competencies and work context factors (see Appendix D: cards from the deck).

Overall, it is referred to as the eight competencies in the game. The competencies which are used were introduced in Chapter 2 (see section 2.2). The competencies are the eight highest scored competencies in the research of Ebenau (2016). Those 8 competencies are transformed into playing cards for the technician. The structure of all playing cards are identical; they consist of (1) the word of competence itself (2) a picture that visualises the competence and (3) a description of the operationalisation of the competence, which corresponds to the theoretical operationalisation (see section 2.2). The sometimes difficult to understand operationalisation of the competencies is therefore prevented as it is translated into more understandable definitions so that the respondent can recognise themselves with it. When playing the game, the correspondent is asked to rank the cards from which competence he believes to possess the most (1) to which the least (8). This gives the interviewer a good overview, and subsequently, based on the ranking, the interviewer can ask in-depth questions to gain more background information. The in-depth questions are focused on identifying why the competence is so important; how the competence was developed by the respondent; and what the employer of the respondent did to facilitate the development. After that, the respondent is provided with the opportunity to add a competence by himself. This is designed by means of a joker card. Through this, there is a chance to add a competence which is

crucial for the innovative technician of the future to possess but was not part of the theoretical framework in the first instance.

The other cards of the card game represent the work context factors. Similar to the competencies, the work context factors were also introduced earlier (see section 2.3). The work context cards are introduced in the same way to the respondent as the competencies. These, four work context factors were also transferred into playing cards. The respondent was asked to rank the work context factors on the basis of which one (1) was most beneficial and (4) to which least contributed towards him creating individual innovation. The structure and the goal of this card game corresponds to the section above. Therefore we will solely elaborate upon the deviating aspects within this paragraph.

On the contrary to the previous game the in-depth question are hereby focused on identifying the following aspects. Firstly, why and in which way the work context factor is important. Secondly, if the factor contributed in a positive or a negative way in the given example. Thirdly, what the consequence hereof was for the final result and fourthly how the factor should be modified according to the respondent in order to be beneficial for him. Once more, through this method the respondent has again the opportunity to use a joker card to add a work context factor by himself. Through this, there is a chance to add eventual work context factor that can be crucial for the technician to be innovative, which were not considered in the theoretical framework in the first instance.

This part of the interview allows for the collection of information which is necessary to answer the third sub-question *"Which specific competencies does an innovative technicians possess?"* and "*What does the innovative technician require from an organisation in order to show innovative behaviour?".*

2) Direct supervisor

The complete interview protocol for the innovative technician's direct supervisor stands in Appendix B: Interview protocol supervisor of the innovative technician.

Storytelling

Similarly to the innovative technician, during the interview with the direct supervisor, a story telling part is also present at the beginning. The interview starts with the question whether the respondent wants to share a story about what kind of person he/she believes the innovative technician is. The respondent receives the opportunity to elaborate on what he values in this person in their story. After finishing the story, the interviewer can ask in-depth questions related to the story of the respondent. These in-depth questions are focused on what makes this technician so unique and why they are so different from colleagues. To enforce this, one can ask for a concrete example of an achievement which displays that the innovative technician stands out.

Competencies & work context factors card game
The second part of the interview contains, like with the innovative technician, a card game. The same cards are used as in the interview with the innovative technician. The goal of also playing the card game with the direct supervisor is to identify which competencies recognises in the innovative technician. Eventually, the respondent has ranked the competencies, after which the interviewer can ask more in-depth question to gain additional background information. The in-depth questions are focused on why the competence is so important; how the competence is developed; and what the employer did to facilitate the development of the competence. Also, in the end, the respondent is provided with the opportunity to add a competence by himself through the joker card. By doing this, we can compare the perceived competencies of both individuals and subsequently check their validity.

After the supervisor played the first card game, he will also be asked to play the second card game, which represents the work context factors. Again, the same cards are used as for the innovative technician. The in-depth questions are hereby focused on identifying why and in which way the work context factor is important. As well as if the factor contributes in a positive or a negative way; and what the consequence hereof was for the final result. Moreover, how the element should be modified according to the respondent in order to be beneficial for the innovative technician. Ultimately, the respondent can add a work context factor which he finds to be crucial to in order be innovative.

3.4 Analysis method
In this section the analysis method used to interpret the data gather from the interviews will be explained. The process of coding and encoding will be elaborated on and the produced followed by this research will also be made clear.

The data from the interviews were subjected to a coding system to answer the main question and the sub-questions. The interviews were recorded, processed and encoded using ATLAS.ti software. The chosen encoding theme which is used in the exploratory research involves two methods. On the one hand, the deductive method whereby in advance some items have been established based on the theories (see appendix C: codes competencies & work context factors). On the other hand, use has been made of the inductive method which created the opportunity to develop new codes and themes based on new insights within the exploratory research (e.g., recommendations).

The coding process is completed in three steps. In the first step, the open coding, codes were assigned to the pieces of text in the transcripts. These codes were designed from the theoretical framework (see appendix C: codes competencies & work context factors).
In the second step, the axial coding, the different assigned codes were compared with each other. During this step, the similarities, differences and inconsistencies were specifically looked at. These observations led to some changes. For example, the code category "*Story Telling*" which contained codes like "*ST*| *How was it accomplished*" and "*ST*| *Obstacles.*" Also, some codes changed. For example, in the coding scheme for the supervisor of the innovative technician, the code "*ST*| *Help from others*" transformed into "*ST*| *Different in comparison with colleagues.*" The reason was that the question was different in the interview protocol. After these changes were made, all transcripts were coded.
In the last step, the selective coding and the different codings were compared and analysed. The aim was to identify to subordinate relationships and how often certain answers occurred. The themes were integrated to respond to the questions in the end.

In order to support the identification of which competencies are possessed the most and which work context factors are experienced as the most beneficial, another additional analysis method is used. During the interviews the respondents were asked to rank the cards from which competence they believed to possess the most (1) to which the least (8). The same method was used for the work context factors, but then to rank the work context factors on the basis of which one was the most beneficial (1) to which the least (4) for the innovative technician to create individual innovation. Next, all the data points were added together and divided by the number of respondents. This resulted in an overview of a standard group which contained the average scores. This visualised which competencies were possessed the most and which work context factors were experienced as the most beneficial to create individual innovation (see Appendix E: Overview results ranking competencies & Appendix F: Overview results ranking work context factors).

Reliability and validity

Throughout this chapter several interventions have been described which guarantee the reliability of this research and the results. In this section, these interventions will be appointed again to show the reliability and validity of this research. (1) The research was done at various companies within the technical sector, because the research is exploratory, wherein the object is to gain as much information as possible about individual innovation. (2) Efforts have been made to generate a mixed population to ensure this variety. (3) An accurate selection of the respondents has been done to ensure which innovative technician was the best to interview. (4) A test interview has been conducted to verify the quality of the interview protocol. (5) The interviews were processed anonymously, and the recording material was discarded after use. (6) Also, to further increase the reliability of this research the researcher attended several interviews of his colleague graduate, and visa versa. (7) Subsequently, the transcripts and codings were peer reviewed. (8) The validity is ensured by keeping the research free from ‘systematic errors.' The validity is accomplished by using different data sources, theories, and methods to refine the results. (9) Lastly, the accuracy and completeness of all the documents has been ensured.

4. Results

This fourth chapter includes the results of this research. First, the results of which competencies the observed innovative technicians possess are presented, followed by the next section which elaborates upon which work context factors innovative technicians require from an organisation to show innovative behaviour. The final section elaborates upon the results of which obstacles technicians experience on their job, and on their way to create individual innovation.

4.1 Competencies

This section elaborates upon the results of which competencies the surveyed innovative technicians possess.

Table 3: overview results ranking competencies

	Innovative technicians	Supervisors of the innovative technicians
1	Proactivity (A)	Creativity / Innovation (A)
2	Creativity / Innovation (A)	Proactivity (A)
3	Accurate / Quality oriented (S)	Collaborate (S)
4	Collaborate (S)	Accurate / Quality oriented (S)
5	Multidisciplinary knowledge (S)	Multidisciplinary knowledge (S)
6	Adaptability (S)	Adaptability (S)
7	Dealing with uncertainty (A)	Dealing with uncertainty (A)
8	Business knowledge (K)	Business knowledge (K)

* A = Attitude K = Knowledge S = Skill

As can be seen from the table above is that the attitude competencies are the strongest possessed by the innovative technicians. Proactivity and creativity / innovation can therefore be seen as the most decisive competencies. This is demonstrated by the fact that a proactive attitude is vital to put everything in motion, as one interviewee said: '*You can have such good ideas, but if you do not do anything with it, then you will not progress as a company.*' But moreover after initiating the idea, it is vital that the technician copes with the resistance that occurs when wanting to realise the idea which he/she believes in. As one interviewee, described when asked how he dealt with opposition, he said: '*Moments when I am held against, I am looking for a detour to get it done anyway … rules are there to bend, but you can not break them*.' Moreover, this is also confirmed by their supervisor, as one of them said: '*You start from scratch, do something which only is possible if you are proactive or self-managing, showing self-initiative and come up with your ideas. Someone else can tell you to work out their idea, but then the innovation is not coming from you*'.

The table above also illustrated that the skill competencies form a strong diaphragm. They are, after the attitude competencies, the strongest possessed by the innovative technicians. These competencies are crucial for the innovative technicians to transform his/her idea into action, because innovation can only be achieved through collaboration. This is enhanced through a combination of youngsters and old hands who sees all kinds of pitfalls. As one interviewee put it: '*That a young fellow comes up with ideas, out-of-the-box and is not hampered by any restrictions like how I see them, because I have already made my mileage and thereby have discovered things, because that is a huge pitfall. That you no longer try things out, because you think it will not succeed anyway.*' But also other skills are required here for, such as adaptability, as one interviewee said: '*When something happened at an unexpected moment, then you have to be able to adapt, but then I am sick of it the next day, but okay, one sick day and then just again see new challenges and move on'.* Moreover, the importance of skill competencies is also confirmed by the

supervisor, as one of them said: '*If you have a diverse group of people, you don't know the outcome in advance, but if you have a group of individuals who are like-minded, then it is almost sure that you outcome will be in the traditional areas'.*

Hence, the attitude competencies are the strongest possessed, followed by the skills competencies and can, therefore, be regarded as the most decisive competencies to possess. If you are interested in more specific descriptions of all the questioned competencies, then I would refer you to Appendix E: overview results ranking competencies. This appendix contains an all descriptions of the questioned competencies of the interviews. All the outcomes of the interviews are analysed and merged into one concrete description of each competence.

Joker

The Joker was offered to the respondents in the interviews so that they had the opportunity to add a competency by themselves which they possessed and was crucial in their opinion. The respondents have expressed a wide variety of Joker competencies throughout the interviews. This broad range suggests that the respondents possess differing competencies which they believe that it is crucial. But, what is striking here is that the expressed competencies have much similarity with the other eight competencies. For example, perseverance can be related to adaptability, and curiosity is very similar to creativity/innovation. Thus, as a result, it's hard to determine the exact value of the Joker in comparison with the other competencies. Nevertheless, the provided input is valuable in the trace of which competencies are decisive for an innovative technician to possess, because in some cases it reaffirms the importance of a competence which one possess.

In addition, a more specific description of the joker competence can be found in Appendix E: overview results ranking competencies. Subsequently, if you are interested in an extensive overview of all descriptions of the Joker competence, then I would refer you to Appendix I: results of the Joker competencies.

4.2 Work context factors

This section elaborates on the results regarding what the innovative technician requires from an organisation to show innovative behaviour, this section expresses an overview below.

Table 4: overview ranking work context factors

	Innovative technicians	Supervisors of the innovative technicians
1	Autonomy	Challenge
2	Challenge	Autonomy
3	Variety	Leadership
4	Leadership	Variety

As can be seen from the table above, obtaining autonomy and being challenged in the work are experienced as the most beneficial factors which are required from an organisation to show innovative behaviour. This is demonstrated by the fact that one must have the feeling that they are free in their work, as evidenced by, for example, by having the opportunity to make autonomous decisions, as one interviewee described: '*I experienced that it is positive that I was not consistently checked on my work, but still I had the drive to create something of quality'*. Besides freedom, challenge is also highly valued in the form of complex tasks, as one interviewee put it: '*I need something where I need to crack my brains on, bite my teeth in, and combine things to make it work. That gives me real job satisfaction'*.

Nevertheless, it is not the case that variety and leadership do not have any influence, because they are experienced as less beneficial to show innovative behaviour. Both are valuable in their own way, such as variety is perceived as helpful, because it helps to avoid a routine rut in the work, as one interviewee said: '*I would be bored to death if every day would be the same*'. Leadership is experienced as the less beneficial factor by innovative technicians, but nevertheless the dependency of this is acknowledged, as one interviewee put it: '*If you do not get support then you can forget it. Then you are fighting a losing battle'.* On the other hand, also the supervisors themselves believe that leadership is not the most important, as one of them put it: '*Due to poor leadership, she might not be effective, motivate or whatsoever. Thus, it does have an effect, but if it is turned around and she has great leadership this does not mean that she is automatically a super good innovative engineer'*.

Hence, there is a difference between the work context factors on the basis of how beneficial they are being experienced to show innovative behaviour, but from the given descriptions of the respondents it can be concluded that it is all mutually linked with each other one way or another. Therefore, it is not the case that if you only provide autonomy that it will work, because if this is not supported by the supervisor then it does not work.

All in all, I would like to invite you personally to take a look, if you are interested, to one of the appendixes of this research, were there is further elaboration. Due to the wide availability of interesting information it is not possible to display everything in this chapter. That is why the decision has been made to shift a part of the information into an appendix, namely Appendix H: content descriptions of the work context factors. This appendix contains more specific descriptions of all the questioned competencies. All the outcomes of the interviews are analysed and merged into one concrete description of each competence. So please feel free to take a look and discover for yourself all kind of interesting insights.

Joker

The Joker as previously mentioned was offered to the respondents during the interviews allowing them the opportunity to add a work context factor which according to them is crucial. The respondents have expressed a wide variety of Joker work context factors throughout the interviews. This broad range suggests that that the respondents have differing assumptions about what kind of work context factors that are required from an organisation to show innovative behaviour. However, what stands out is that the illustrated jokers of the supervisors are mainly focused on areas within their circle of influence (leadership), such as involvement and appreciation, while the illustrated jokers of the innovative technicians focuses on a pleasant working environment which encourages innovation, for example through a good work-life balance. The provided input is valuable in the trace of which work context factor are beneficial to show innovative behaviour.

In addition, a more specific description of the joker work context factors can be found in Appendix H: Content descriptions of the work context factors. Subsequently, if you are interested in an extensive overview of all descriptions of the Joker work context factors, then I would refer you to Appendix I: Results of the joker work context factor .

4.3 Obstacles

This paragraph elaborates on the results of which obstacles technicians experience on their job, and on their way to create individual innovation. This section consists of two groups, namely the obstacles according to the innovative technician and the supervisor.

Innovative technician

To begin with, the **stubbornness of colleagues** has an impact on the successfulness of the cooperation to create innovation, as one interviewee experienced: '*Some colleagues necessarily wants to implement their ideas or do not want to cooperate with our requirements, which is a pity.*'
The stubbornness of the colleague who has no regard for the bigger picture but only for his work is the perpetrator. The stubbornness enhances by the fact that the research department has at the end of the day the last word, as one interviewee confirmed: '*You are powerless because the research department ultimately determines which tools were are going to use.*'
The ultimate consequence of this is that this incident has caused damage to the mutual relationship and has led to the production of an unusable tool, '*I do believe that it has cost around 10,000 euros which are a shame.*'

Moreover, the **opposition of colleagues** is perceived as an obstacle what arises from the fact that one will not adapt as quick as the innovator. The added difficulty then lies in the fact that, when it comes to people with a lot of experience, they refer to the past, '*I did this in 1960 or already experienced in 1970*'. The key here is to overcome this by a lot of talking, explaining and showing, as one interviewee said: '*In the end, it is about having the longest breath. Persevere and be persistent in your convictions*'.

Additionally, the time invested into **creating awareness among your colleagues**, as one interviewee said: '*This form of resistance is not so much that people do not want to change, but you must invest some time to sell your idea internally*.' In the end, you need all stakeholders to make it happen whereby as an innovator it is important to be aware of the fact that, as one interviewee put it: '*the best technical solution is not necessarily commercially the best option.*' In between is some tension for which discussion is necessary to come jointly to the most optimal choice. One interviewee put it: '*Especially in that corner you can suspect resistance, but resistance is not quite the right word. They do not go along blindly*'.

An ancient organisation goal, turning turnover, in which the organisational structure fostered is causing **conflict-provoking effects** for regarding innovation. The conflict-provoking reflects in the fact that it is easier for the salesman to sell 100 'old products' because it takes them less effort the meet their target than that they would sell the 'new automated products' which are still pilot projects and therefore require a higher investment of time investment. Thus, the long-term and short-term are in conflict with each other. Some who see the added value of the 'new automated products' manifest this, but others find it too much work, as one interviewee said: *'they focus on the low-hanging fruit which is short-term thinking.*'
This contradiction is addressed through a different approach namely, by looking at the total cost of ownership. It was important to make people aware of the fact what best choice was for the long term by considering all costs such as purchase, maintenance, durability, and (possible) extension.

Furthermore, **the way the organisation is structured** could mean that the turnaround time of goods is high. This hinders innovation as, "*Everything comes to lie on the bottom of the stack of products even whether it has priority or not.*" Putting this into perspective, some products are nearly two to three months in the job preparation or somewhere completely else in the process. The instigators are too many separations of business processes whereby delay quickly occurs, as

one interviewee illustrated: "*Everybody had to do something and then I had to wait for another week and so on.*" Reducing the number of separations and by making one person responsible for the product is a possible solution. As a result, the mutual dependence is reduced, and it promotes the self-sufficiency. The last one is beneficial to make innovation possible.

Lastly, the **cooperations with multiple countries** bring different cultures with it which **requires different approaches**, as one interviewee illustrated: "*English people have a lot of humor in the beginning, very informal. You think that you have an agreement, but you have not. They can revoke it out of the blue*". The most important are that both sides adapt and let each other in their value, such as within the Netherlands we are used to telling it as it is, but with other cultures, one must be more careful with that because others could be easily be offended by this. What can help is to have face to face contact for some time by visiting each other, as one interviewee said: '*Then you get to know each other and then you will succeed*.'

<u>Supervisor</u>
Firstly, supervisors described that **no proper communication** can be perceived as an obstacle because this can cause emerging conflicts among the innovator and his colleagues and ultimately influence the mutual relationship. As one interviewee illustrated: '*It is nice to have a fast guy to him, but he needs to learn to notify the measuring chamber in advance about a product what needs to be measured instead of handing in multiple products at the same time*.' A similar example emphasises how important it is to communicate well, as one interviewee illustrated: '*He lost at a sudden moment but kept saying that everything was going well, but if he did not communicate properly, I could not oversee the problems as his supervisor. The result was that we had faced some delay which had could be prevented by a better communication*'.

Additionally, the **composition of the organisation has a strong influence on the ability to innovate**, such as when the budgets are tightly fixed, as one interviewee elaborates: '*Every budget is predicted, everything that is not budgeted and which has no particular purpose's hard to get*.' In the end investments in the form of funds or time are necessary to establish innovation, as one interviewee said: '*Dare to give space for an experimental phase*.'

5. Conclusion and discussion

In the following chapter firstly a recapitulation of the goal of this research, as extensively described in chapter 3, will be provided. This will be followed by an answer to the main question as well as subquestions of this research, which is based on the results gathered in the previous chapter. Lastly, the restrictions and reliability of this research will be discussed.

5.1 Research goal and research questions

The goal of this study is to identify the decisive competencies that an innovative technician should possess in order to be able to contribute to the Smart Industry. The relevance for this study can be found in the fact that today's society is on the verge of a new era (Smart Industry) which is predicted to change the economy and labor market drastically. Therefor, it is to be expected that the disciplines, knowledge, and expertise of today will not be sufficient for the Smart Industry worker of tomorrow. To date, it is still unclear which competencies are decisive for the technician of tomorrow to possess and therefor this research has been conducted.

A specific context was chosen in which this research was executed, namely the technical sector. This is due to the exploratory nature of this study, wherein the object is to gain as much information as possible about individual innovation. Moreover, efforts have been made to generate a mixed population through conducting interviews at various companies.

On grounds of the above mentioned, the main question therefore reads: What do innovative technicians need, in terms of decisive competencies and work context factors, in order to create individual innovation so as to make a contribution to the Smart Industry?

The main question has been split up in three sub questions that support this research:

1. Which specific competencies does an innovative technicians possess?
2. What does the innovative technician require from an organisation in order to show innovative behaviour?
3. Which obstacles does an innovative technician experience on the job, on his way to create individual innovation?

Chapter 2 describes the theoretical framework which was focuses on individual innovation and was eventually translated into a conceptual model. The exact research methodology which was used to identify the decisive competencies for the innovative technician is described in chapter 3. This chapter uses the results of chapter 4 to answer the research question stated above and combine the answers to these questions to finally explain what innovative technicians need, in terms of decisive competencies and work context factors, in order to create individual innovation so as to make a contribution to the Smart Industry.

5.2 Conclusion main question

"What do innovative technicians need, in terms of decisive competencies and work context factors, in order to create individual innovation so as to make a contribution to the Smart Industry?"

With regard to the competencies that a technician needs in order to contribute to the Smart Industry, several critical competencies have been found. Firstly, in order to contribute to the Smart Industry; the innovative technician must possess a strong attitude. They need this in order to initiate their innovative ideas and convert them into action by taking the initiative. For the transformation of their idea, they must have the skills to collaborate with others, speak different languages of adjoining disciplines and be resilient for obstacles to ensure a high-quality end product. All this contributes to the realisation of innovation.

Besides the decisive competencies of the innovative technician, the adequate work context factors are also vital. The innovative technician must experience enough autonomy in their work, and they must experience a challenging environment which triggers their enthusiasm. Leadership is not widely acknowledged, however it still is a crucial element to establish a right environment for innovation. A supervisor must support the innovative technicians through his way of leadership by providing them with sufficient autonomy in their work that those technicians can provide themselves with variation and challenge in their work. The role of the supervisor of the innovative technician is a moderating factor of the work context.

On the way to the creation of innovation, obstacles will always occur in all shapes and sizes. It is ultimately about how the innovative technician deals with this kind of setbacks. Through a healthy dose of perseverance, the willingness to address it, and the skills to deal with resistance it is possible to overcome every hurdle on the way to the ultimate realisation of the innovation.

5.3 Conclusion sub-questions

This section describes the conclusion of the research results (chapter 4) for each sub-question, followed by the answer to the central question of this research.

"Which specific competencies does an innovative technicians possess?"

This research shows that the competence which the innovative technician possesses most, according to both the innovative technician themselves and the supervisors, are attitude competencies. These results contradict with the research of Ebenau (2016) which examined the desired competencies of the technician, according to employers. That study showed that the attitude competencies are less decisive for a technician to possess. Thus, there is a remarkable difference between employers who see attitude competencies as less decisive, while both the innovation technicians and their supervisors indicate that attitude competencies are the most possessed by innovative technicians.

The attitude competencies are the primary driver for the innovative technician to initiate their idea and to convert it into action by taking the initiative. The results are in line with the research of Unsworth and Parker (2003) which states that proactivity is acquired through one's initiative and is therefore a significant predictor of entrepreneurial behaviour (Rauch, Wiklund, Lumpkin and Frese, 2009).

This research also shows that after the attitude competencies, the skills competencies are often possessed by the innovative technician. These skills competencies contribute to the further transformation of the innovative idea into innovation. They cannot do this by themselves; they must collaborate with others and thereby it is crucial that they speak languages of multiple disciplines. All kind of obstacles occur during the process of the establishment. This research has shown that it is vital to be resilient in order to deal with this. Additionally, a key factor in the success of the transition from an innovative idea to the end-product is the skills of the technician to conduct a high-quality end product.
Earlier research of SEO (2013) stressed the growing importance for technicians to possess multidisciplinary knowledge, because the increasing versatility of their work. This transition also affects the labor market which is strongly changing (CPB, 2012). These changes confirm the importance for technicians to possess skills competencies in order to deal with this. The research of Van Est and Kool (2015) emphasised the importance for technicians to be adaptable to deal with, for example, ever-changing technologies that arise from the changing market. The way in which the importance of these skills competencies is described by both surveyed groups, the innovative technicians, and their supervisors, is in a large extent in line with these researches. Hence, the innovative technicians possesses the skill competencies to deal with the changes, but does not guarantee that all technicians are prepared for the future.

This research shows that business knowledge is the least strongly possessed competence by innovative technicians. The weak representation of knowledge competence is noteworthy because this is in contrast with the research of Ebenau (2016) which shows that employers see business knowledge as the most decisive competence to possess. Earlier research of Corporaal et al. (2015) and Nguyen (1998) stress the importance of business knowledge because according to them it is crucial for a technician to have an understanding of economic and financial issues which are related to their work. This research shows that this kind of knowledge provides no added value for the establishment of innovation because it creates restrictions rather than opportunities.

”What does the innovative technician require from an organisation in order to show innovative behaviour?”

One must have the feeling that they are free and not continuously monitored by others. If the innovative technician does not experience enough autonomy in their work, then it sets back their innovation which ultimately can lead to conservatism. From the expressed examples it has been noticed that innovation would flourish when the technician had the opportunity to be autonomous in their way of working and was given the opportunity to experiment. It is important that one is not punished for errors in the experimentation process because the innovative technicians see this as a valuable lesson. The outcomes of this research are broadly in line with the research of Parker et al. (2006), which proved that autonomy has a strong positive effect on innovative behaviour. It is of great importance that companies provide their innovative employees with sufficient and the right form of autonomy to enable the innovative technician to show innovative behaviour.

Supplementary the innovative technical must be challenged in their work environment to ensure their engagement is present, which is vital to make innovation succeed. With half-motivated technicians, you do not win the war. Enthusiasm among the technicians strongly depends on the degree of difficulty in their work. A challenging environment with a high bar standard must be present to ensures that the enthusiasm of technicians is triggered. By being provided with that, the technicians are capable of putting in that little bit of extra effort that is needed to succeed. This finding corresponds with the research Zald et al. (2008), which shows that challenge triggers the release of dopamine, which increases motivation. In addition to this Edwards et al. (2000) found that complexity is a definite factor, which is likely to have positive motivational outcomes. Organisations have the opportunity to encourage the innovative behaviour of the innovative technician when they ensure a challenging work environment in which they can flourish.

Furthermore, variety is essential for the innovative technician to avoid a routine rut in their work, which is eventually devastating for innovation. In a selection of the interviews with the respondents it was expressed that they needed variety in their activities to avoid routine, but also boredom. Both sides have a responsibility in this, namely the employer who must provide a degree of autonomy in this area to the technician, which, in turn, has a self-responsibility to provide themselves with the right amount of variety in their work. The outcomes of this research are in line with the research of Sims, Szilagyi, and Keljer, (1976) which proves that jobs, which involved the performance of several work activities are more likely to be enjoyable and exciting to perform for employees. Organisations can ensure the right form of variety for the innovative technician by providing them with autonomy in their work.

Leadership is not widely acknowledged, nonetheless, it as an important factor, because it has a strong influence on innovation. Great leadership does not make a technician better, but poor leadership can indeed harm. The interviews reflected that the technicians require reliance form their supervisor, which can be obtained by autonomy. Technicians prefer a supervisor who supports them in their doings. This in line with the research of (Manz & Sims, 1987), which stats that supervisors who help individuals to be self-managing and self-directed, are likely to enhance proactivity. The supervisors recognise that their influence is partly limited, but they can still be of added value. They see themselves that they play a supporting role to the technicians where possible. In fact, both parties agree on the fact that a supportive role of the supervisor is most beneficial which corresponds with the research of Axtell et al. (2000), which states that the effectiveness of the implementation of the innovative ideas depends on a supportive supervisory style. It is therefore important for organisations to ensure that innovative technicians have a supervisor, who offers a supportive form of leadership. This will then most likely have a beneficial influence on the innovative behaviour of the innovative technician.

”Which obstacles does an innovative technician experience on the job, on his way to create individual innovation?”

The struggles with which the innovative technician needs to deal consist of two factors, namely his colleagues and the organisational context. One of the biggest frustrations or perhaps even the greatest frustration for technicians is when their innovation is hampered by an internal process, with the consequence that it freezes. The delay is due to an internal conflict of interests, in which generating money in the short term leads to the upper bridle whereby the profitable, innovative way of the future stand no chance. The obstruction should not solely be a frustrating obstacles for technicians, but also for the organisation itself. There is no standard solution to prevent or to solve this kind of obstacles, but it is important to pay attention to these barriers. One has to actively search for the root of the problem and think of solutions to resolve them. If not, it may result in devastating consequences on the longer run. In fact, the worst case scenario could be that companies are not able to come on broad in time with regards to the step into the new technical era. These obstacles correspond with the research of Janssen, Van de Vliert, & West (2004), which states that the organisation structure could determine the success or failure of the innovative idea. Besides, the research of Vermeend (2014) stresses the importance for companies to innovate — because otherwise — they run the risk of not surviving the transition into the new Smart Industry era.

The other form of obstacles which technicians have to deal with is their colleagues. The stubbornness and opposition of colleagues against innovation forces the technician to gain skills to handle it. Colleagues often do not go blindly along with change, so the technician is forced to elaborate his idea better and develop it even further. In order to do so, perseverance is a good way to deal with the resistance of others, under the guise of the one with the longest breath succeeds. The resistance among colleagues corresponds with the research of Janssen (2003), which states that the tendency to avoid insecurity and stress, which comes as a result of the change, is a possible trigger. In the end, it is up to the technician to deal with the resistance of his colleagues to succeed in the innovation. This thought is also endorsed by the research of Janssen, Van de Vliert, & West (2004).

5.4 Discussion

This research has provided some new insights on which competencies are decisive for the innovative technician to possess in order to create individual innovation so as to make a contribution to the Smart Industry. As far as is known, there has not been a study conducted yet that examines what an innovative technician needs to create innovation in the width of this scope. The most comparable research is a study by Janssen, Van de Vliert, & West (2004). They investigated which moderating factors contribute to the benefits and costs individuals incur from pursuing innovative approaches.

This research, however, shows which kind of competencies are the most important ones to possess for an innovative technician. Furthermore, this paper draws attention to the substantive context of this. The results complement to the study of Corporaal et al. (2015), which study was focused on precisely identifying which competencies employers expect from the technician of the future. Furthermore, this research shows which work context factors are beneficial for innovation and in which way. Thus, these findings provide valuable insights for employers. Subsequently, this research provides insight into the obstacles which innovative technician experience on the job, on their way to create individual innovation. These moderating factors are in line with the research of Janssen, Van de Vliert, & West (2004).

Limitations and suggestions for follow-up research

Firstly, much information has been gathered sector-wide; however, the answers of the respondents varied significantly in certain areas which made it difficult to provide a concrete description of the content. For this research a total of 21 interviews were conducted, divided into two groups. The first group consisted of 11 innovative technicians and the second group consisted of 10 supervisors of those innovative technicians. The interviews were conducted at ten different companies which are all part of the technical sector. The limitation lies in the fact that the outcomes are not in all cases significant. That is why it is recommended for future research to extend the population even further to take care of a more reliable number of respondents in the technical sector.

Secondly, a good overview has been established of the ranking of the competencies. However, not all competencies were addressed in detail during the interview. It was up to the interviewer to make a choice for which competencies they asked in depth questions. These were mostly the higher-ranked competencies as well as the lowest-ranked ones. As a result, there is a skewed distribution of the amount of information that has generated through the interviews. The consequence of this was that the collected amount of information of some competencies was limited and this affects the relevance of that. The same applies to the other card game that has been used for the work context factors. It is recommended for future research to be aware of this and perhaps make the consideration to steer the conversation active to make sure that approximately the same amount of information is collected for all competencies.

Exploratory research

Exploratory research is research that focuses on the entire width of a subject. This research concentrated on the technical sector, wherein the object was to gain as much information as possible about individual innovation. For follow-up research it is desirable to, besides extending this research as suggested in the first limitation, also to facilitate the possibility of conducting this research on a company level. Thus, examine within one specific company what an innovative technician needs, instead of within the technical sector, a shift form a macro-level to meso-level. This approach may obtain a more accurate insight on which decisive competencies an innovative technician must possess to contribute to the Smart Industry. It will lead to new and exciting insights and perspectives for companies, but also for the research group Smart Industry & Human Capital. One of the recommendations (see Chapter 6) of this research is a more accurate plan for follow-up research in this area.

6. Recommendations

This sixth chapter is comprised of the recommendations which are drawn up from the basis of the conclusions of this research. The first paragraph contains several recommendations directed at organisations, precisely at what they, as an organisations, can do, in terms of work context factors, so that an innovative technician can show innovative behaviour. Secondly, a specific recommendation is provided on how organisations can excite the innovative technicians to initiate innovative ideas and moreover to support them to develop this further. Next, a manifest is proposed which is directed to innovative technicians and challenges them to take control through answering the call for a rebellion. As last, a recommendation is described for two clients the research group Smart Industry & Human Capital and TechYourFuture.

6.1 Recommendations for organisations

The recommendations within this section focuses on what organisations can do, in terms of work context factors, so that an innovative technician can show innovative behaviour. These recommendations will be focused on HR, because they have an important role to prepare their organisation for the Smart Industry era. For notification: there are no recommendations formulated in the area of the decisive competencies for the innovative technicians, because the aim of this research was to identify them and not how they can be recruited.

Create challenging / inspirational work environment

As the research showed innovative technicians must be challenged in their work to ensure his /her engagement is present which is vital to make innovation succeed. In addition it is essential to have variety, because otherwise it is easy for workers to get bored and fall back into a routine rut. The research of Zald et al. (2008) shows that novel behaviour, such as trying something tricky or new, triggers the release of dopamine, a chemical that helps keep us motivated and, even more important, eager to innovate. It is interesting to stimulate this novel behaviour among innovative technicians, for instance through purchasing a drone. The innovative technicians then get the opportunity to experiment with the drone in their spare time to explore the technique and gain new ideas by doing. This ensures that the technicians are continually triggered and therefor experience challenge and avoid a routine rot.

The aspects that employers use must aim to challenge the innovative technicians in their work. Continually inject novelty into the work of the technicians can be beneficial, because novelty is a powerful force. This obviously depends on the type of work, but since the research was conducted at the sector level, some varying suggestions are proposed.

(1) The purchasing of some random technology, as previously described in the form of a drone, or something else that can help, for example within R&D the ability come up with a new application through combining new technologies.
(2) The introduction of new technologies, for example Virtual Reality, can stimulate innovative technicians to come up with new methods to visualise their ideas to others by using this form of technology.
(3) The purchase of new software (e.g., Sollidworks) offers the opportunity to the innovative technician to find better and more efficient ways to design the products and eventually produce them which may even lead to cost reduction.
(4) The purchase of the most advanced Smart Industry machines can stimulate innovative technicians to come up with more efficient ideas how to produce products with full automation.

Role of HR

The role of HR herein is to ensure that the work environment within the company is challenging and inspirational for the employees. HR has a key role, because HR must engage in dialog with the management board about the importance of a challenging work environment by acting as a sparring partner for the management, but with a clear purpose, namely creating awareness of the importance hereof. They can ratify this by showing their expertise in this area, but above all by asking good questions. An example of showing expertise is that HR pitch their ideas about, for example, providing a budget to purchase new technology with the goal to inject novelty in the workplace. This initiate is one of the ways to establish a challenging work environment. Ultimately, the management board decides what happens and what does not, but HR must take the role of providing guidance in this process. They need to steer towards the right direction which in this case is ensuring a challenging / inspirational work environment for innovative technicians.

My advice would be to look around in your company, whether you are a technician, HR, or a supervisor, or anyone else, and to think what would be a trigger to add to the environment with the aim to spark novel behaviour among others, as well as yourself. Your action should inspire others to do the same. In the end it must create an atmosphere wherein this can of actions are not perceived as weird, but as normal. Of course you do not know in advance what the effect or outcome is going to be, but you do not have to, because everything starts with useless knowledge in my opinion.

Provide autonomy

As the research showed innovative technicians must have the feeling that they are free and not being monitored continuously by others. The supervisor has a key role to provide herein, but leadership is not broadly acknowledged as important. Nevertheless, the importance of the leadership is present, because great leadership does not make a technician better, but poor leadership can indeed harm them. This is supported by the research of Parker et al. (2006) which proved that autonomy has a strong positive effect on innovative behaviour. Other companies, for example British Airways in 1990 got rid of their thick customer-service handbook and gave employees the autonomy to figure out themselves how to deal with customer problems when they arose (HBR, 1995). As well as, Southwest Airlines encouraged employees to deliver the safety procedure announcement in their own style and humor (Gino, 2016). The results of this research and the provided examples stresses the importance of autonomy.

How autonomy can be provided differs, but the direct supervisors has an important role heron. This obviously depends on the type of work, but since the research was conducted at the sector level this is not of concern. Some varying suggestions are proposed hereunder.

(1) The innovative technician must be autonomous in his/her way of working by placing them responsible for the result, so he/she has the freedom in order to experiment with approaches to come to the desired result.
(2) A budget must be available for the innovative technician to purchase various things which he/she needs to work. The technician should not have to constantly answer for purchases he/she makes.
(3) The job of the innovative technician must be Tailored in such a way that there is room within his/her work to allow for experimentation.

Role of HR

The work environments within companies in the technical sector vary widely. Through this distribution it is in some cases beneficial to provide innovative technicians with autonomy (R&D-environment), while in other cases this is less beneficial (in the production of standardised products). Nonetheless, the role of HR is the same in both scenarios, namely they must be very sharp in constantly observing where and in which way employees can be provided with a form of autonomy. This must be done through good contact with the workforce, because they can best indicate the areas for improvement in this area. It is then the turn of HR to make it possible in consultation with the management board. HR has a connecting role herein.

Providing an adequate leadership style

As the research showed, and as previously mentioned, innovative technicians do not acknowledge leadership broadly. Nevertheless, leadership has a great influence on what corresponds to the research of Axtell et al. (2000) which proved that the effectiveness of the implementation of innovative ideas depends on a supportive supervisory style. Thus, the right leadership style is necessary to have a successful outcome. It is interesting to provide innovative technicians with a supportive leadership style in various manners. The innovative technicians then receives the experience of different angles which could be beneficial for their innovative idea.

How a supportive leadership style can be designed varies. It obviously depends on the type of work of the innovative technician, but since the research was conducted at the sector level, some alternating suggestions are proposed.

(1) The supervisor can stand up for the innovative technician by guaranteeing for his/her idea within the organisation.
(2) The supervisor can facilitate through keeping general business tasks away from the innovative technician, so he/she can focus entirely on their work.
(3) The supervisor can help the innovative technician by sparring with him/her to hone in on their idea.
(4) The supervisor can motivate the innovative technician when he/she shows his/her appreciation for the work.
(5) The supervisor can support the innovative technician by providing a listening ear if necessary to share frustrations.

Role of HR

Firstly, HR must have a vision on what kind of leadership is desired within their company, and what is in line with what they want to achieve. For example, when innovation is one of the drivers of the company, then a supportive leadership style is beneficial in most cases. HR must then advocate this form of leadership within the company. When appointing new supervisors, this can be included in the recruitment process as a decisive factor. In the case that supervisors are already appointed, but have a different leadership style, then HR must take actions. A standard leadership training is not the answer in such cases, but what HR can do is actively engage the conversation with the supervisor to emphasise the importance of providing support. HR must stimulate that the supervisors have conversations with their employees to talk about the leadership style, because the right leadership form is different for everyone.

My advice to the innovative technicians themselves would be not to be passive in this situation. Just sit down with your supervisor, or vice versa, with your employee to have an open and honest conversations. The purpose of the conversation should be about what you expect from each other, what kind of guidance you need, and what you want to do differently. In this way the both of you can determine which kind of leadership style is the most suitable for this situation. I do not belief that there is one best way or a best fit. What I do believe is that honest and sincere conversations

with each other are valuable to determine what is best for both. HR should not be in the situation that they have to take a role in this process in my opinion.

6.2 Innovation Stimulation Box (ISB)

This recommendation included within this section is a detailed example of what companies can do to stimulate innovation behaviour among innovative technicians. For notification: this recommendation serves as an inspiring example, it is not a standardised format which can be used right away. Further content development is required. The goal of this recommendation is to inspire companies, and to trigger them to think about what they can provide their innovative technicians with.

Why?

In order to stimulate innovation within companies the innovation kit has been conceived. Employees within companies can access this innovation kit help them develop their innovative idea to the next level.

What is the ISB?

The ISB is a toolbox for individual innovators and at the same time a system to foster innovation within an organisation. It is designed to support the individual innovator in their process to translate their idea into action. It helps to become more effective which is beneficial towards the rate of the process and as last it improves the outcomes of the innovation process.

Who is ISB for?

The ISB is for employees within companies who have an idea, but who could use some assistance in making it more than just an idea. The indicated also benefits also the company where they work, because they need such initiatives to innovate as a company. This research, but also many others, stress the importance of innovation for companies regarding the transition into the new Smart Industry era. Thus, this ISB can contribute to this urge.

What does the ISB do?

The ISB helps individual innovators to become more effective in their process to translate their ideas into action and thereby have more impact through it. Further, it helps the innovator to build valuable life skills and experiences during the process. It may even help him/her to (re)discover their passion in work which is beneficial for their job satisfaction and engagement with the company.

The ISB is also beneficial for organisations, because it can help to increase the number of innovations within the company. The ISB also helps to increase the quality of the innovations through the offered supplies. Another advantage is that it can identify potential innovators who otherwise would not have stood up.

What is in the ISB?

The ISB contains the following items which help the individual innovator to transform their idea into action.

- A pre-paid credit card with a value of €500. This card can be used to buy the necessary equipment to validate their idea.
- Instructions of the process which must be passed through to establish the innovative end-product.
- A permit which allows them to work 4 hours every week on their idea for a period of 10 weeks.
- Other helpful materials which can help the innovator with his idea.

What are the costs and the benefits?
The calculated cost of this investment can be found in Appendix L: Cost-benefit analysis.

How does the process look like?
Three weeks prior to the opening of the contest employees receive a notification about the ISB-pilot. Employees will be informed through various ways, such as an e-mail from one of the members of the management board, updates on tv-screens, updates in team-meeting and by ambassadors. All these actions will stimulate employees to already think about an innovative idea for the contest.

The employees can submit their ideas through an online portal. There is no-standard form provided which needs to be filled in. The submission must be creative which will challenge the employees from the first moment.

All the submissions will be reviewed by the project-team. They will decide which ideas are the best and get the opportunity to pitch in front of the jury.

Eventually the selected ideas will be pitched by the employees whereafter the project-team decides which presentations are the best and are eligible for the ISB.

The chosen employees from whom the ideas are chosen receive the ISB which includes the pre-paid credit card to purchase the necessary products, a permit which provides them to work on their idea while being on the job, instructions to develop their idea further and other helpful materials.

During the process they have full autonomy regarding their procedure. They decide themselves what they do and how they do it.

After 10 weeks they must again present their now developed idea to the project team. The project team will assess the presentations of ideas. In the end, the project team will announce which idea was the best and will be developed further. The winner will receive a bonus of 1000 euros, an honorary naming of his innovative idea and he will become one of the project leaders to develop the idea further.

What needs to be done to implement this?
The implementation scheme of this recommendation can be found in Appendix K: Implementation plan.

6.3 Call for Rebellion

MANIFEST:
I AM A REBEL, SO I CALL FOR A REBELLION

Yes, Hello.

In this manifest I want, among other things, wake you up to let you realise why deviating from the status quo is actually beneficial for you, but also for your boss. Ask yourself why you choose to conform in situations? Stress the importance to **REBEL** against the status quo and encourage you to do the same! But before I start, I want to take a little trip with you. I do this because I think it is important that you become aware of the particular circumstances, and then, in particular conformity.

So, why do you conform actually? That is not an easy question, is it? Well, from a young-age you have learned that tangible benefits arise from following social rules about how to act, what to say, how to behave, and so on. Conforming makes you feel accepted and part of the majority.

> An old classic research which was conducted in the 1950s showed that conformity to peer pressure is so powerful it occurs even when we know it will lead us to make bad decisions (McLeod, 2008).

Conformity also occurs within your work. How? Well, through expressing appropriate emotions, agreeing with other opinions from supervisors, acquiescing to a team's poor decision and so on. This all is understandable, you are not the only one, everyone does it. BUT there is a downside because if you bow to peer pressure, then it reduces your engagement with your job, maybe even without you noticing this.

> Conforming often conflicts with your real preferences and beliefs and therefore makes you feel inauthentic (Gino, Kouchaki,& Galinsky, 2015).

The danger of you becoming too comfortable with the status quo at your work is that it affects your performance. It could work impeded, decrease your engagement, and constrain your ability to innovate or to perform at a high level. Maybe you are already in this stage? Do you feel validated and reassured when you stick with your usual way of thinking and doing? If yes is your answer than I have some bad news. You are part of the feared status quo.

> We weigh the potential losses of deviating from the status quo much more massively than we make the potential gains (Gino, 2016).

But what is now the actual danger of the status quo? Well, conformity does not only refers to you, but also to the companies where you work. The ultimate consequence of a too comfortable status quo environment within companies can be devastating.

> Blackberry, MySpace, Polaroid and countless more experienced a doomsday scenario. One day they all had a champion method, but they stuck with the status quo which ultimately lead to stagnation in the form of not updating their strategies until it was too late for them.

Thus, your employer needs your help to avoid this doom scenario. It is more relevant than you might think. Your crazy, unconventional, out-of-the-box ideas matter more than ever!

> Companies need to innovate to survive the transition into the new Smart Industry era. Companies which don't respond to this development on time run the risk of not surviving (Vermeend, 2014).

You can make the difference, you can change it. And that is why I call for rebel against the status quo. How difficult it may seem, you can make the difference!

Hence, use your power. Let us hear from you.
Let's hear what you want.
Let's hear why you want it.
Let's hear what you need.
Let's hear if you need help.

Let your boss hear from you next time when you see him. From that moment you take your first step into the rebellion. Hurray!
That day is the day that you determine the direction of your company. And damn you must take that opportunity.

It is simple.

Normally others decide what you do or they tell you what needs to be done. With a bit of luck you have a say in how you do this. And that is nice. But it can be more fun.

Through this rebellion I want to achieve that rebels take the lead again. Literally!
From tomorrow you do not continue your work, no mail, no spreadsheets, no it must be done.
From tomorrow you. take. the. lead.
Now it is on you to determine what is best.

Are you in?

By sharing this manifest, you actually are saying:
I REBEL AGAINST THE STATUS QUO.
I REBEL AGAINST OTHERS WHO TRY TO DECIDE WHAT IS RIGHT AND WHAT IS NOT.
I REBEL AGAINST THE IDEA THAT MY IDEAS ARE STRANGE AND WILL NOT MAKE THE DIFFERENCE.

YES.
I AM A REBEL.
I ANSWER THE CALL FOR A REBELLION.

Good luck!

Sjoerd Peters
On behalf of your subconscious who secretly wants to rebel

6.4 Follow-up research

This section elaborates upon the recommendation to conduct a follow-up research after following this thesis. The recommendation is addressed to one of the clients of this thesis, namely TechYourFuture.

This research shows that attitude competencies are the strongest possessed among innovative technicians which is recognised by themselves, but also by their supervisors. Therefor attitude competencies can be seen as the primary driver for innovation. Nevertheless, today's educational programs are mainly focused on the development of knowledge competencies. That is why it is relevant for TechYourFuture, along with educational programs, to investigate redefine technical educational courses, so that attitude competencies are better developed. This is necessary to provide in a better alignment between educational institutes and employers.

Redefining technical educational courses contributes to the goal of TechYourFuture that more students choose for a technical educational program and will work in the technical sector, because the development of competencies among future students is fostered. Hence, the technical educational courses are than fit for the jobs of the future.

6.5 Follow-up research by the research group Smart Industry & Human Capital

This section elaborates upon the recommendation to conduct a follow-up research after following this thesis. The recommendation addresses to the main client of this thesis, the research group Smart Industry & Human Capital.

Goal of the follow-up research

The purpose of the follow-up research contains two flavours, namely (1) expanding the current research in the technical sector, and (2) facilitate the possibility of conducting this research on a company level.

Benefits

(1) Enlarging the research population in the technical sector enhances the reliability of which competencies are decisive for the average sketch of the technician of the future. Besides, the reliability of the content descriptions will also increase, because more content can be collected.
(2) Specific knowledge of which competencies are decisive for technicians on the company level is still missing but can be obtained by facilitating organisations and students herein.

Design / Plan

This part is split up into the two follow-up research recommendations, namely (1) expanding the current research in the technical sector, and (2) facilitate the possibility of conducting this research on a company level.

<u>Expanding the current research in the technical sector</u>

The enlargement of the population in the technical sector can be achieved by a mix of approaches.
(1) By offering students a graduation place at the research-group Smart Industry & Human Capital.
(2) Through offering students the opportunity to take part in the research in the context of their honours program or excellence track where they have to contribute to their profession in the form of research.
(3) By researchers of the research group itself.

The final mix of contributors, each of which has its own importance, contribute to the overall research. All conducted interviews of the contributors can be merged together which enhances the reliability of which competencies are decisive for the average sketch of the technician of the future.

Facilitate the possibility of conducting this research on a company level

The extension of the research at the business level can be achieved by offering students the opportunity to use the research group as co-principal for their research. The ways in which can be-be facilitated are:

(1) Providing literature about Smart Industry
(2) Acting as a sparring partner in the process
(3) Providing interview supplies (e.g. interview protocols)
(4) Providing benchmark data (data of the technical sector-level)

In exchange for all offered help is the consideration that research group get access to the generated data (anonymous). This is a win-win-win situation whereby the company gains useful insights into their problem, the students gets access to extra possibilities for their thesis, and the research group Smart Industry & Human Capital gain additional data to extend their research.

Scientific value

The scientific value lies in the fact that the angle of this research provides additional knowledge to the existing theories in the field of Smart Industry. Much attention is paid to theories such as, socio-technical systems thinking, network theory, design theory and new service concepts related to customer intimacy. This research angle contributes to the human factor altogether.

Practical relevance

Insight in the field of how companies can stimulate innovation among their employees is crucial for companies, researchers and students. For companies to know how they could stimulate this, for researchers to understand which factors are important, and students to know what skills are required for innovation.

Knowledge / implementation / distribution

Active knowledge sharing is very important in order to create engagement. All of the theses will be publicly accessible to spread awareness and knowledge. Moreover, the results and examples of innovation will be published in a book as food for thought for interested readers. In addition, to reach a wider audience, all results will be translated into a scientific article which will be presented at a scientific conference.

My personal advice

My personal advice is to actively work on a follow-up research after the occasion of my explorative graduation research. I have described my thoughts on how this follow-up research must be shared above. My personal opinion on this is based on my view regarding this subject.

From my experience, I know from myself that at I am willing to give the 100 precent if I am intrinsically motivated. This occurs when I have the opportunity to do what I like without being hampered by others. At such a time I sit in a flow which I have no sense of time, but all arise in what I'm doing. That is in my opinion the ultimate level that you want to accomplish as a human in the work you do.

From practice I have learned that this is rarely the case. I believe that each of us is looking for this but everyone in their own way. What could be of added value in my opinion is that an employer could have a major role in this process. He has the opportunity to offer the employee what he needs in order to come into a flow. But what? How? That's the fundamental question!

That question, that is what fascinates me personally. I have no idea if there is a simple answer for it, but what I do know is that it needs to be examined in order to find out. This follow-up research I am proposing is one step in the direction to find this out.

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Overview appendices

Appendix A: Interview protocol innovative technician

Introduction

My name is Sjoerd Peters, student International Human Resource Management at Saxion University of Applied Sciences in Enschede, the Netherlands. At the moment I am in my last phase of my study which consists of doing research and write my thesis. That is the reason why we are having the interview today. Before we start with the interview I want to walk you through the process by giving an introduction of the subject of the research and some other important things you need to know before we start.

Goal of the interview

The goal of this research is to identify the decisive competencies for an innovative technician in order to be able to contribute to the Smart Industry. By identifying which competencies influential technicians, which are seen as innovative, possess, we can determine which competencies are decisive to possess. In addition, the work context influences is also important. Through measuring what the innovative technician requires from his employer regarding his work context, but also which obstacles he experiences, we can determine what is beneficial for his innovative behaviour and what is not.

Structure of the interview

The interview consist of two parts. The first part of the interview is focused on a example from you wherein you share something special what you have done within your work where you are most proud of. On the basis of your story I will ask some in depth questions, so that it become clear why your example is innovative. Next, in the second part of the interview, we are going to play a card game. Not a standard card game, but a specially formulated card game which helps to identify which competencies and work context factors have played a role in your earlier given example in the first part of the interview. Also here I will ask some more in depth questions.

Approximate duration

The approximate duration of the interview is 45-60 minutes. Thank you again for participating in my research. The valuable information what do I get through this interview helps me a lot to identify which competencies are decisive for an innovative technician to possess and also which work context factors are beneficial for innovative behaviour and which are not.

Part one
Story telling

First of all, could you share something special what you have done within your work where you are most proud of?

Optional (if the respondent doesn't elaborate on this)
- How did you accomplish this?
- Which actions did you took to accomplish this?

Deepening topics
Help from others
- From who did you have help?
- What kind of help did this person provide you with?
- What made this kind of help so valuable?
- What did you achieve with this help, you could not have achieved without this help?

Impediment factors
- Which obstacles did you experience?
- Which actions did you take to deal with this resistance?

Part two
competencies & work context card game

Competencies
All of the eight competencies are represented by a playing card with an symbol which represents the competence itself. The respondent is asked to order the cards on the basis of which competence he possess the most (1) to which the least (8).

Proactivity	Adaptability	Accurate / Quality oriented	Dealing with uncertainty
Business knowledge	Multidisciplinary knowledge	Collaborate	Creativity / Innovation

You give the respondent approximately five minutes to order the cards. When the respondent is finished, you are going to ask some in depth questions about the competencies, starting at the top. You will discuss the top five of the cards (if necessary you could do more).

Deepening topics
- Have you used this competence in the example you shared earlier? If yes, how was it emerged than? How is it that this competence is so important in this particular situation?

- How did you develop this competence which you described in the example you shared earlier? How can you develop this competence even further?

- What does your employer do to facilitate you in order to develop this competence? Does this have a stimulating or a prohibitive effect? In the case of a prohibitive effect, what kind of obstacles do you experience?

Extra option:
Joker card (blanco) can be offered to the respondent, so that he has the opportunity to add a competencies by himself which he possess and is crucial in his opinion.

Work context
After this part you are going to do the same with the work context factors. All of the four work context factors are represented by a playing card with an symbol which represents the work context factor itself. The respondent is asked to order the cards on the basis of which work context factor is the most important (1) to which is the least important (4). You will discuss the top two of the cards (if necessary, you could do more).

Autonomy	Variety	Challenge	Leadership

Deepening topics
- Could you describe the importance of this work context factor in the example you shared earlier?
- Could you elaborate further in which way work context factor was important?
- Did this factor ultimately contributed in a positive or a negative way?
- What was final the consequence from this result ?
- In which way should this work context factor be used to create a beneficial effect for you?

Extra option:
Joker card (blanco) can be offered to the respondent, so that he has the opportunity to add a work context factor by himself which is according to him crucial in his opinion.

Appendix B: Interview protocol supervisor of the innovative technician

Introduction

My name is Sjoerd Peters, student International Human Resource Management at Saxion University of Applied Sciences in Enschede, the Netherlands. At the moment I am in my last phase of my study which consists of doing research and write my thesis. That is the reason why we are having the interview today. Before we start with the interview I want to walk you through the process by giving an introduction of the subject of the research and some other important things you need to know before we start.

Goal of the interview

The goal of this research is to identify the decisive competencies for an innovative technician in order to be able to contribute to the Smart Industry. By identifying which competencies influential technicians, which are seen as innovative, possess, we can determine which competencies are decisive to possess. In addition, the work context influences is also important. Through measuring what the innovative technician requires from his employer regarding his work context, but also which obstacles he experiences, we can determine what is beneficial for his innovative behavior and what is not.

Structure of the interview

The interview consist of two parts. The first part of the interview is focused on a example from you wherein you share something special what you have done within your work where you are most proud of. On the basis of your story I will ask some in depth questions, so that it become clear why your example is innovative. Next, in the second part of the interview, we are going to play a card game. Not a standard card game, but a specially formulated card game which helps to identify which competencies and work context factors have played a role in your earlier given example in the first part of the interview. Also here I will ask some more in depth questions.

Approximate duration

The approximate duration of the interview is 45-60 minutes. Thank you again for participating in my research. The valuable information what do I get through this interview helps me a lot to identify which competencies are decisive for an innovative technician to possess and also which work context factors are beneficial for innovative behavior and which are not.

Part one
Story telling

First of all, could you share with me what kind of person he is (the innovative technician)?

The following in depth questions can be asked:
- What makes him so special?
- How is he different in comparison with his colleagues?
- Could you give an example of an achievement of the innovative technician which had great value for you?
- What made that this achievement is so special?

Part two
Competencies & Work context card game

competencies
All of the eight competencies are represented by a playing card with an symbol which represents the competence itself. The respondent is asked to order the cards on the basis of which he sees that the innovative technician possess these competencies from most (1) to least (8).

Proactivity	Adaptability	Accurate / Quality oriented	Dealing with uncertainty
Business knowledge	Multidisciplinary knowledge	Collaborate	Creativity / Innovation

You give the respondent approximately five minutes to order the cards. When the respondent is finished, you are going to ask some in depth questions about the competencies, starting at the top. You will discuss the top five of the cards (if necessary you could do more).

The following in depth questions can be asked:
- Could you relate this competence to the earlier given example wherein you described an achievement of the innovative technician? Why is this competence so important in this particular situation?

- How did he develop this competence? How can he develop this competence even further?

- What do you do to facilitate him in order to develop this competence? Does this have a stimulating or a prohibitive effect? In the case of a prohibitive effect, what kind of obstacles does he experience?

Final question of the competence part
To what extent does he show behavior / competence which you perceive as difficult? How is it that you experience it as difficult?

Work context

After this part you are going to do the same with the work context factors. All of the four work context factors are represented by a playing card with an symbol which represents the work context factor itself. The respondent is asked to order the cards on the basis of which work context factor is the most important (1) to which is the least important (4). You will discuss the top two of the cards (if necessary, you could do more).

Autonomy	Variety	Challenge	Leadership

In depth questions:

- Could you describe the importance of this work context factor in the example you shared earlier?
- Could you elaborate further in which way work context factor was important?
- Did this factor ultimately contributed in a positive or a negative way?
- What was final the consequence from this result ?
- In which way should this work context factor be used to create a beneficial effect for him?

Extra option:

Joker card (blanco) can be offered to the respondent, so that he has the opportunity to add a work context factor by himself which is according to him crucial in his opinion.

Appendix C: Codes competencies & work context factors

Variable	Definition
Competencies	Competencies
Proactivity	
Voicing your own opinion	The ability to give expression to your desires, interests and opinions in a clear and respectful manner
Take initiative	Motivating themselves to develop professional competencies and demonstrating eagerness to keep learning
Attitude to constant improve themselves and their own development	Through refining their performance, analyze and evaluate in order to gain insight into which aspects they could improve themselves
Business knowledge	
Knowledge about other disciplines	Knowledge about other disciplines which is necessary to work together colleagues from other disciplines.
Knowledge about finances	The ability to understand which impact operations have on for example the profitability of a company and understanding of economic issues for understanding how to compete in the market
Knowledge about processes	Has understanding of the whole production process and is role heron
Adaptability	
Adapt to varied roles, jobs responsibilities, contexts and schedules	I am able to adapt to varied roles, jobs responsibilities, contexts and schedules.
Work effectively in a climate of constant changing priorities & ambiguity	I am able to adapt to work effectively in a climate of constant changing priorities in combination with ambiguity
Takeover the work of colleagues	I am able to takeover the work of colleagues if necessary
Multidisciplinary knowledge	
Communicate with multiple other disciplines	The ability to communicate with other disciplines in order to collaborate
Knowledge about the customer	The ability to advice, communicate and negotiate with customers
Accurate / quality oriented	
The ability to conduct the job precisely and accurately	I am able to conduct my job precisely and accurately through taking responsibility of the quality my own work by asking for feedback from others

Awareness about the importance of precision engineering	The awareness of the importance of precision engineering and the ability to meticulously proceed in every action
Collaborate	
Open mindedly	The ability to respond open-mindedly to different ideas and values through a respectable, professional manner
Take responsibility for collective results	The ability to take responsibility for collective results
Make a contribution to the joint solution	When a problem arise while working on a common goal he must be able to make a contribution to the joint solution
Offer (constructive) feedback to colleagues	The ability to offer constructive feedback to colleagues, so they can learn form each other
Dealing with uncertainty	
Deal with conflicting interesest and tight deadlines	The ability to deal with conflicting interest and tight deadlines
Switch quickly between changing expectations	The ability to adapt to different roles, job responsibilities, and work environments
Creativity / innovation	
Think out-of-the-box to create innovative products	Show curiosity and entrepreneurial attitude in order to create innovative products by takings risks
Create new ideas through existing knowledge	The ability to apply exciting knowledge to create new ideas for improving products or processes
Generate unconventional solutions through think along wishes of customers	Possessing knowledge about creative techniques and the ability to think on detail level
Work context	Work context
Challenge	
Solving and dealing with new or difficult problems	Necessary knowledge is lacking about how to execute the procedure and thus own ideas and creativity are of importance
Job Complexity	Executing tasks on the job which are complex and difficult to perform
Problem Solving	Devising unique ideas or solutions
Variety	
Variety in the range of tasks	The degree to which a job requires employees to perform a wide range of tasks on the job
Variety in the skills and talents which the job appeals	The extent to which a job appeals to the different skills and talents of an employee
Autonomy	
Freedom for setting own goals	Freedom in setting goals

Freedom in choosing own work methods	Freedom in choosing ways to achieve these goals
Freedom to make mistakes	Freedom to make mistakes and learn from them
Leadership	
Leadership style	Transactional or charismatic /transformational
Support	The support the employee receives from his supervisor regarding his innovative behavior

Appendix D: Cards from the deck

Accurate / Quality oriented

This competence consists of the following components:
- *I can conduct my job precisely and accurately*
- *I am aware of the importance of precision engineering*

Collaborate

This competence consists of the following components:
- *I am able to respond open-mindedly to different ideas from others and values in a respectable, professional manner*
- *I am able to take responsibility for collective results*
- *I am able to make a contribution to a joint solution*
- *I am able to offer (constructive) feedback to colleagues*

Dealing with uncertainty

This competence consists of the following components:
- *I am able to deal with conflicting interests and tight deadlines*
- *I am able to switch quickly between changing expectations*

Creativity / Innovation

This competence consists of the following components:
- *I am able to think out-of-the-box to create innovative products*
- *I am able to generate new ideas through existing knowledge*
- *I am able to generate unconventional solutions through think along wishes of customers*

Proactivity

This competence consists of the following components:
- *I am able to voice my own opinion*
- *I am able to take initiative*
- *I have the attitude that I constant improve myself and take care of my own development*

Business knowledge

This competence consists of the following components:
- *I have knowledge about other disciplines*
- *I am able to understand which impact operations have, on for example, the profitability of the company*
- *I understand the whole production process and therein I am aware of the influence of my own contribution*

Adaptability

This competence consists of the following components:
- *I am able to adapt to varied roles, jobs responsibilities, contexts, and schedules.*
- *I am able to adapt to work effectively in a climate of constant changing priorities in combination with ambiguity*
- *I am able to take over the work of colleagues if necessary*

Multidisciplinary knowledge

This competence consists of the following components:
- *I am able to communicate with multiple disciplines*
- *I am able to advise, communicate and negotiate with customers*

Joker

This card gives you the opportunity to add a competence which you possess that you think is crucial for the innovative technician of the future to possess.

Challenge

This work context factor consists of the following components:

- *I have to solve and deal with new or difficult problems*
- *I have to execute tasks on the job which are complex and difficult to perform*
- *I have to think of unique ideas or solutions*

Variety

This work context factor consists of the following components:

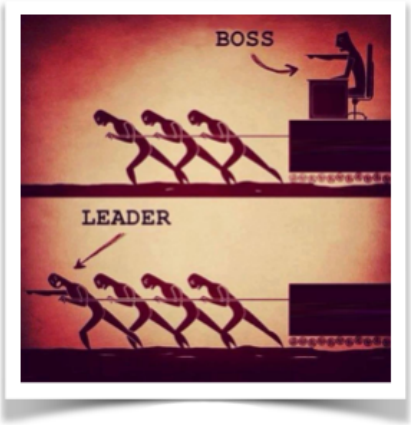
- *I have variety in the range of tasks*
- *I experience variety in the skills and talents which my job appeals*

Autonomy

This work context factor consists of the following components:

- *I experience freedom in setting my own goals*
- *I experience freedom in choosing my own work methods*
- *I experience freedom to make mistakes*

Leadership



This work context factor consists of the following components:

- *I experience a supportive leadership style from my supervisor*
- *I experience support from my supervisor regarding my innovative behavior*

Joker

This card gives you the opportunity to add a work context factor that you think is crucial

Appendix E: Overview results ranking competencies

The calculation of the average was as followed. The first competence has a value of 1, the next competence has a value of 2 and so on. In the end, all the data points for each competency are added together and divided by the number of respondents. The calculation resulted in a mean score by which has determined the ranking.

Ranking competencies innovative technician								
Position	1	2	3	4	5	6	7	8
Competence	Proactivity	Creativity / Innovation	Accurate / Quality oriented	Collaborate	Multidisciplinary knowledge	Adaptability	Dealing with uncertainty	Business knowledge
Mean	2,55	3,00	4,64	4,64	4,73	4,82	5,36	6,27

Ranking competencies innovative technician (with joker)									
Position	1	2	3	4	5	6	7	8	9
Competence	Proactivity	Joker	Creativity / Innovation	Accurate / Quality oriented	Collaborate	Multidisciplinary knowledge	Adaptability	Dealing with uncertainty	Business knowledge
Mean	2,91	3,30	3,55	5,36	5,36	5,36	5,55	5,82	7,09

Ranking competencies supervisor								
Position	1	2	3	4	5	6	7	8
Competence	Creativity / Innovation	Proactivity	Collaborate	Accurate / Quality oriented	Multidisciplinary knowledge	Adaptability	Dealing with uncertainty	Business knowledge
Mean	2,45	2,73	3,00	4,00	4,55	4,55	4,73	6,18

Ranking competencies supervisor (with joker)									
Position	1	2	3	4	5	6	7	8	9
Competence	Creativity / Innovation	Joker	Proactivity	Collaborate	Accurate / Quality oriented	Multidisciplinary knowledge	Dealing with uncertainty	Adaptability	Business knowledge
Mean	2,64	3,00	3,36	3,45	4,36	5,09	5,27	5,45	6,91

Appendix F: Overview results ranking work context factors

The calculation of the average was as followed. The first work context factor has a value of 1, the next work context factor has a value of 2 and so on. In the end, all the data points for each work context factor are added together and divided by the number of work context factors. The calculation resulted in a mean score by which has determined the ranking.

Ranking work context factor innovative technician				
Position	1	2	3	4
Work context factor	Autonomy	Challenge	Variety	Leadership
Mean	1,55	2,18	3,00	3,00

Ranking work context factor innovative technician (with joker)					
Position	1	2	3	4	5
Work context factor	Autonomy	Challenge	Joker	Leadership	Variety
Mean	1,64	2,36	2,40	3,27	3,36

Ranking work context factor supervisor				
Position	1	2	3	4
Work context factor	Challenge	Autonomy	Leadership	Variety
Mean	1,89	2,33	2,56	3,22

Ranking work context factor supervisor (with joker)					
Position	1	2	3	4	5
Work context factor	Challenge	Autonomy	Leadership	Variety	Joker
Mean	2,11	2,56	3,11	3,78	3,44

Appendix G: Content descriptions of the competencies

Proactivity

Innovative technician

Proactivity is apparent from **taking initiative** by taking action, within the framework of your job or out of your comfort zone. This is characterised by taking action through, as one interviewee put it: '*You can have such good ideas, but if you do not do anything with it, then you will not progress as a company.*'

Through **voicing a (strong) own opinion** ideas can be accomplished, but more importantly, the initiator must cope with the resistance that occurs when he wants to realise his idea where he believes in. One interviewee, when asked how he dealt with opposition, said: '*Moments when I am held against, I am looking for a detour to get it done anyway … rules are there to bend, but you can not break them.*' Initiators must have the capacity to put their ideas into action; otherwise, it won't make any difference.

Supervisor

Taking the initiative is driven by himself and not by others. As one interviewee put it: '*You start from scratch, do something which only is possible if you are proactive or self-managing, showing self-initiative and come up with your ideas. Someone else can tell you to work out their idea, but then the innovation is not coming from you*'. As their supervisor, you do not have to tell them what to. They observe what needs to be done and take action thereupon, as one interviewee illustrated: '*At the beginning of the project… all networks and computers were present but were not performing optimally. He prefers to work efficiently … so he edited the entire network even before the year had begun*'. They do not hold back by barriers, they are willing to make the extra mile, as one interviewee said: '*He will not be stopped by fences if something needs to be done, he will walk through them and say: Hello, here am I, this is what I am doing, and I need help here*'.

The process of taking the initiative is not always conducted by **voicing their opinion**; this is person dependent. On the one hand there are the 'extravert' ones who give their views solicited or unsolicited, '*If there are discussion about processes than he is always gladly to jump in, regardless of the subject, whether it concerns solutions or The Great British Bake Off, he is present*' and on the other hand are the 'introvert' ones who just to take initiative and express their opinion to a lesser extent.

Creativity / Innovation

Innovative technician

Only a small number of respondents indicated that innovation is established through **out-of-the-box thinking**. The establishment was through accomplished through various ways, such as by coincidence (an error in the production process) and through complex problems, where no standard solution was applicable but solved through spontaneous inspiration while waiting in traffic.

Other respondents alluded to the notion of achieving innovation **thinking through with customers**. This form of innovation arises from the exposure to new technologies, customer inquiries which call for unique solutions, and in consultation with the client figure out where the 'real need' for innovation is.

The remaining respondents suggest that innovation is established through **combining existing knowledge**. They at this moment appoint that a lot of innovation is accomplished by copying and do it in a slightly different way. As one interviewee put it '*It is just like evolution*.' But also, existing knowledge is taken as the starting point and through reading and discussion, you gain more expertise which eventually leads to a basis wherefrom innovation can occur. Hence, creativity/innovation consists of numerous ways. That is why the principle of multiple roads leads to Rome is highly applicable here.

Supervisor

The way in which supervisors describe the creativity/innovation of their innovative technician in their team range from out-of-the-box thinking to creating new ideas through existing knowledge.

The **out-of-the-box thinking** is characterised by thinking in possibilities which others deem impossible, as one interviewee said: '*First he considers what is possible and only then what is not*.' Through learning on the job, the ideas are put into practice, as one interviewee illustrated: '*He works with the newest equipment and software, and he adapts quickly. He learns very quickly by making use of the resources*'. The next challenge is to develop to such an extent that it can be processed can be executed unmanned, as one interviewee elaborated: '*Producing is one thing, but I prefer that an operator is not always necessary because it increases the cost of the product unnecessarily. My desire is that the machine can run at night, especially in significant amounts*'.

The other way how creativity/innovation is characterised is by **creating new ideas through existing knowledge**. Processes are executed in the same way for years, it has become the mainstream way, but it is forgotten why again, as one interviewee illustrated: '*Always evaluating our existing processes, some we have been doing the same way for the past twenty years, and then taking a step back and look: why do we do it this way, how can it be smarter?*'. The supervisors expose the innovative technician consciously on situations which give the environment to experiment, '*We encourage this by involving especially him*', but the do not offer them specific time to think about ideas, as one interviewee put it: '*It is not that he has an hour every day to sit down, put his legs on the desk, and quietly think about what could be done differently*'.

Accurate / Quality oriented

Innovative technician

An innovative initiative succeeds or fails with the final quality of the end product. Talking about a virtual reality initiative, the interviewee said: '*If I showed you something that makes you sick, then you would turn it down with the next offer … thus, the height of the camera has to be perfect to make sure you do not get sick.*' Finally, it has to be perfect entirely correct in every little detail.

Awareness about the importance of precision engineering is vital which occur in several capacities, such as (1) discipline in dealing with tools, '*In the air force, this is instilled in your mind from the moment you start*', (2) the consequences of pollution in the production process, '*once you get used to it is a part of your quality*', (3) awareness of the potential dangers, '*It is crucial to examine what can go wrong … in which way it can occur and most importantly how to avoid this from happening.'*, and (4) the financial impact '*It can entail a significant cost.*'

Awareness only is not sufficient; **the ability to act upon it** is also critical. For example, the careless handling of tools has tremendous consequences for safety and does not fit with quality; thus there is strict monitoring heron, '*if you lost the tool, you had to search as long until you found the tool again*.'

Supervisor

Awareness about the importance of precision engineering occurs in several capacities, such as (1) the observation of polluted parts, '*they sometimes say he has hawk eyes*', and (2) know that there is no room for room for manoeuvre, '*We always say the measurement report must be written with black ink*'.

The transition between being aware of the importance of precision engineering and the real consistency of the **conducting** still leaves room for improvement, as one of the interviewee elaborated: '*In the short term, he knows what is expected of him, and he is doing good, but for the long run he is lax.*' The lax attitude concerns mainly the peripheral issues of the work, such as clocking hours, '*I want to know what a product costs to make and for that, I need to know how long someone is working on it … if he does not note the hours, then I can not do the calculation. According to him, it is not his fault because he was not in possession of a map to note the hours*'. The administrative side is important, but as one interviewee mentioned: '*The innovative and precision engineering is more important.*'

Collaboration

Innovative technician

Innovation can only be achieved through collaboration what consists of **open mindsets**. This is enhanced through a combination of youngsters and old hands who sees all kinds of pitfalls. As one interviewee put it: '*That a young fellow comes up with ideas, out-of-the-box and is not hampered by any restrictions like how I see them, because I have already made my mileage and thereby have discovered things, because that is a huge pitfall. That you no longer try things out, because you think it will not succeed anyway.*'

A crucial point to reinforce the cooperation is **constructive feedback** to each other in the phase of the first innovative ideas, '*I always emphasize a lot on the fact that it is my first stage of my design … so please share your thoughts*', but cultural differences have to be taken into account, *'In the Netherlands, we are used to be direct, but you have to be more discrete with other cultures because they can conceive it as offensive.*' Also, one can also find it valuable sparring with others outside of the organization. One individual stated that '*The moment when you can not get to other options … you miss some steps*'.

In innovative cooperations, the most important are that **everyone does contribute** to the best overall solution. As one interviewee put it: '*So it may be the case that you have to sacrifice some an electronic part, because you thereby ensure that more benefits are gained with the aerodynamics.*'

Supervisor

Diversity is beneficial for the outcome of the collaboration, as one interviewee illustrated: '*If you have a diverse group of people, you don't know the outcome in advance, but if you have a group of individuals who are like-minded, then it is almost sure that you outcome will be in the traditional areas*'.

For an effective collaboration, it is important to be **open minded**, as one interviewee put it: '*Respect people who they are and what they value and actively involve others into discussions. Have an eye for everyone on the table, give people the opportunity to do good things, but also sometimes bad things*'.

It is important that one can **offer constructive feedback to each other**, but technicians find this difficult at times, as one interviewee illustrated: '*The constructive feedback is often based on assumptions and less on facts.*' It is equally important that one can offer constructive feedback to others as this could encourage the cooperation even further, as one interviewee said: '*He is always very open if he did something wrong … he takes responsibility for his actions*'. In the end, it is important that **everyone contributes**, in their way, to the overall solution.

Multidisciplinary knowledge

Innovative technician

The versatile of technical functions is high which results from the fact that technicians are more busy with managing different interests and stakeholders. As one interviewee put it: '*This is also referred to as system architect, but mainly it is often described as application knowledge.*'

For this purpose, it is necessary that the technician **can communicate with multiple different disciplines.** One individual stated that '*You see very often that people can develop systems, and other people use these systems, but they do not speak the same language.*' This miscommunication can lead to errors. For example, one interviewee elaborated: '*An example of how natural confusion can occur between two disciplines is as followed. The streams in an electrical transformer house consist of three phases. A socket consists of two pins, a 0 and one phase. The goal of the company was to investigate if it was possible to lower the costs of current measurement. The electrical department was asked to take a look at the design of the streams and to think about how possible savings can be created through a new redesign. Their simple answer was to remove two of the three pins, because, in their view, they were all three identical. In other words, proper designers who recognize immediately that there are three streams, but had not any clue that all three streams were necessary'*.

To proper communicate with other disciplines, there is a need **to have substantive knowledge** which can be obtained through experience, as one interviewee said: '*For years I have as an industrial designer designed a lot graphically which fostered my substantive knowledge about this. This experience ensures me that I can speak properly with both developers and designers'*. The first step is to put yourself committed, as one interviewee put it: '*It is crucial to develop yourself into something where you not (yet) very good in like electronic or hardware because that will give you insight into your work.*' As one interviewee complemented: '*You need to have the courage to look beyond your profession.*'

Also, the technician must also be **able to communicate with the customer** to discover what the need is for the customer. As one interviewee put it: '*Look at what the common denominator is.*' It is important that the client feels heard, As one respondent said: '*I'm pretty good at understanding the customer and give them the impression that I understood them.*'

Supervisor

The **communication with other disciplines** is sometimes disturbed by the stubbornness of one as one interviewee mentioned: '*In the case that other disciplines are similar in terms of mindset it goes well, but in the case that they think differently in terms of business than he is tough in communication and sometimes even impossible to deal with*'. This miscommunication could be prevented through force the different disciplines subtle to communicate and collaborate with each other as one interviewee put it: '*If you do not initiate them to sit down together then they will not come up with solutions. They are like male chickens with tunnel-vision, but did not bother to look in each others tunnel*'. Also, substantive knowledge of others disciplines is also valuable, as one interviewee said: '*He has a basic knowledge of adjacent disciplines which helps him to work in a multidisciplinary team.*'

Adaptability

Innovative technician

Resilience is a key factor for technicians to survive in dynamic climates of constant change and ambiguity. One interviewee stated that '*You must be able to cope with changes. I have seen a lot of people come and go … because it was a too dynamic company. What is decided an hour ago can be different in the next hour and you have to deal with that*'. The ways of how adaptability is applied diverge such as one individual stated that '*I always make sure that I have my things in order so in the case that somethings changes I can find it again*' and someone else commented '*When something happened at an unexpected moment, then you have to be able to adapt, but then I am sick of it the next day, but okay, one sick day and then just again see new challenges and move on*'.

That is how people experience adaptability, the other denominator in this story is how it fostered within companies. The fostering of resilience is done, for example, by **cross functionality** which has advantages such as '*I affirm that, because … you were not specialised in everything, but had a little bit knowledge of everything. That is much better because you do not feel stupid*'.

Supervisor

The resilience from the innovative technicians is apparent from their ability to a**dapt to unpredictable changes in their work schedule**, as one interviewee put it: '*this is not a daily issue, but it happens quite often.*'

Companies have the possibility to foster the adaptability of their workforce through stimulating cross functionality. As a result, one is better able to **take over the work of colleagues**, as one interviewee confirmed: '*If someone is ill or whatsoever than he can take over very easy.*' In order to be able to take over each other's work, it is necessary that the required information is available for everyone, as one interviewee emphasised by way of example: '*He had all the information stored in his head … if he would become sick or even worse, than we had a major problem. Then we had to start all over again.*'

Dealing with uncertainty

Innovative technician

The ability to deal with uncertainty is **strengthened through experience** with such situations. As one interviewee said: '*The fist time when you experience it then you are like 'oh what happens now, ' and you have a little bit of panic and doubt if everything is going to work out. Nowadays, it is a pity, but we have to go through, quickly adapt and not dwelling too long, it will be all right. More thinking solutions*'. Another interviewee said: '*It was indeed building up a bit of experience I think, to handle the uncertainty,*' while someone else considered that: '*We have had so many management changes over the years and in addition to that different priorities … I try only just to ignore it*'.

Tight deadlines are not scary, **not meeting a deadline is part of the job**. As one interviewee put it: '*You deliver, or you do not deliver … so many factors change constantly … as long as I can justify anything, I am not afraid of a deadline*'. It is even better is to raise the alarm in the case for example when the safety is compromised due to a too tight deadline. As one interviewee illustrated in this scenario: '*Then you have to switch quickly and consult with the right people that you're not going to make it.*'

In the case that a tight deadline leads to errors than it is essential to **acknowledging your mistake** than coming up with excuses, '*It is better that you admit that you have done something inconvenient.*'

Supervisor

One interviewee summarised the **essence** on what to do with uncertainty as followed: '*With every new development or innovative idea is accompanied by uncertainty, so you should not be inhibited by that.*'

The good news is that **one can learn how to deal with uncertainty through exposure** over the years, as one interviewee said: '*If we have a tight deadline … there is always some pressure, but you learn how to deal with that*'. It is important to be close to the top so one can act quickly if necessary, as one interviewee illustrated: '*If she noticed certain problem or uncertainties … she always acted very strong through good communication which eliminated the risk in that area*'.

This has similarities with scenarios wherein the uncertainty is caused by changing expectations. To deal well with it is important to **go with the flow and do not resist too much**, as one interviewee illustrated: '*With this customer, we had to deal with a lot of uncertainty because there were many changes. He showed a cooperative attitude and did what was asked*'.

Business knowledge

Innovative technician

Business knowledge is strongly characterised by the **substantive knowledge** of other disciplines. In a variety of ways this is gathered such as (1) personal interest / discover in leisure, '*I have a lot of knowledge about servers, because I have experimented a lot with it as a child*', (2) Learn from colleagues, understand what they do and why, '*I have learned it through watch my colleagues work and showing interest in what they were doing*', and (3) looking beyond just your profession, '*If you have blinders on, you keep making the same circle over and over again*'.

Supervisor

Business knowledge is described as important but less in comparison with others, due to several reasons as one interviewee said: '*We are aware of our impact on the production process but we it is outside of our circle of influence*', and another commented '*It is not that he does not possess it, but other competencies have priority, he is a real technician*'. In the initial phase of innovation business knowledge could have a prohibitive influence, '*it could hinder or block the creative process*', but at a later stage, it could have a positive impact, as one interviewee said: '*it could be very relevant when the product is going to the market, and everything must be perfect*'.

Joker

Innovative technician

According to the respondents is having the **right attitude** vital to make innovation work. Enthusiasm can characterize this, "*Enthusiasm is a driver that you are excited yourself to renew things*," fun, "*you must see the fun in it, it must give you energy, especially to make it happen*," but also curiosity in how things work, the newest developments etcetera., "*You must be broad curios*". Especially thinking about opportunities and not in problems, as one interviewee put it: "*Trough approaching everything as a challenge I keep it positive for myself and fun to challenge it*".

Basic knowledge is a prerequisite herein, and it is vital that one knows what is necessary, but also what is important for the stakeholders (customer), other professions and in the process (supply chain), "*You need to look far in the future because that has an influence on everything*." Basic knowledge enables one to make the necessary connections wherefrom innovative ideas can arise.

The basic knowledge can then be further strengthened by **sparring the idea with others** with a substantive knowledge to make it sharper, "*I like to spar with others about particular problems, someone with substantive knowledge in an area*."

Finally, the **laziness** of one can even push the idea further, "*You must ensure that the machine does most of the work, everything should be automated*." Thus, the human factor is even unnecessary in the realization, "*Actually it should be so easy that the product can be made with one press on the button*," but the urge to accomplish this is dependent on the person, "*laziness is something that is in you as a person*."

Supervisor

A healthy dose of **entrepreneurship** one must possess in order to be innovative, "*Not only theory, but also be able to make the transition to the practice and reality*," which is characterized by courage "*You must not be afraid to fail" and the perseverance to push through, because 'an idea never succeeded without a fight.*'

The ability to overview the process from a **helicopter perspective** and involving people into the process is vital, "*This is crucial when you want to be seen as credible by not only other disciplines but the whole organization*."

The interrelationship with others is essential and can be strengthened even further through a set of **social skills** whereby one has not the only eye for his work, but also for the people around him. "*Through this competence of him, others preferred to approach him if they had something on their chest.*" The interrelationship with others arises from attending social events, such as Friday afternoon drinks, the relationship with colleagues can be fostered.

The ultimate success of one's innovative idea stands or falls by the quality of the **communication** which occurs in meetings, e-mail traffic, and conversations, "*You need to gather information, but ultimately also share it. If you want a project to succeed, then this is essential.*"

Appendix H: Content descriptions of the work context factors

Autonomy

Innovative technician

Autonomy is crucial to **creating an environment wherein innovation can arise**, as one interviewee put it: '*If there is no room for autonomy then … one will become a lot more conservative*'. One must have the feeling that he is free, 'the space to look around' and not being monitored continuously as one interviewee illustrated: '*I experienced that it is positive that I was not consistently checked on my work, but still I had the drive to create something of quality*', and another commented '*the freedom that you do not need to justify if something was useful or not immediately.'*

The important feeling of liberty for one can be supplemented through **choosing their work methods.** The freedom in work methods can be provided through for example by creating space within procedures to allow experimentation, '*Sometimes you want to follow a particular path, but you have now idea where you end up, but therefore you need to the necessary space to do so*.'

Another way is to provide one of freedom is through creating a **budget** which one can use for purposes which are beneficial for innovation, such as ordering tools or visiting conferences. One interviewee stated that: '*Every year, we have a budget to to attempt this type of activities which ensure that we look with a different perspective on the world around us*.'

With all the freedom that one receives, it is important that one **may make mistakes** in the process. One should not be punished for mistakes, but let one reflect on the process and learn from mistakes, as one interviewee illustrated: '*If you learn something from it then it is more valuable*.' Even when the mistake cost a lot of money, try to see it as an investment in practical education, '*It is always important to invest in people*.'

Supervisor

It is crucial to provide one with **the ability to be autonomously in his work** as one interviewee illustrated: '*He gets cadres and targets from the organisation … , but for the rest he is autonomous*'. On the other hand, if one is limited in his autonomy through being told what and how to do it, '*this will limit his creativity and innovation capacity and in addition to that the result*.'

Freedom in the **way of working** for example by (1) not standardise the tools, but let one work with preferred ones, (2) the ability to work from home, and (3) being responsible for their planning.

Autonomy is accompanied by the **risk of mistakes**, as one interviewee said: '*It is part of the job. This must be possible'*.

In the end, **autonomy must come from both sides**, as one interviewee put it: '*You must give employees to space to be autonomous, but these same employees should also take the space the be autonomous*.'

Challenge

Innovative technician

One must be **exposed to problems and complex tasks** in his work because otherwise, the enthusiasm will descend, as one interviewee put it: '*I will do less than which will affect my achievements.*' If one has plenty of challenge in his work, then you have more motivation to put that little bit of extra effort in to succeed, as one interviewee illustrated: '*I need something where I need to crack my brains on, bite my teeth in, and combine things to make it work. That gives me real job satisfaction*'.

Challenge is mainly characterised by **making the impossible possible**, such as (1) building something that has never been built before, '*That gives me a euphoric feeling, makes me excited*', or (2) work under an enormous time pressure together with the uncertainty if it actually will work, '*That gave me an extra boost of energy to putting in even more work in it just in order to finish it on time*'.

Supervisor

An environment must be present wherein one is optimally **challenged by setting the bar high**, because challenge has a positive influence on the motivation, as one interviewee put it: '*Challenge must always be present because it is necessary for an organization to grow*.'

The supervisor has an important role herein, concerning the employee by defining the agenda priorities so that he is not swallowed the routine side of the work, as one interviewee said: '*If he did the same job all day long he would leave within six months.*' Besides, the supervisor must challenge one by testing if the idea is unique or if it has not been done already somewhere else, one interviewee elaborated on how he does that: '*By having open dialogs, offer opportunities to express ideas, and alway take them serious.*'

Variety

Innovative technician

One needs variety **to avoid a routine rut** in his work which is devastating for innovation, as one interviewee said: '*I would be bored to death if every day would be the same,' and another respondent put it: 'you need variety in your work to avoid routine.*'

One has a **self-responsibility** to take care of variety in his work if he has autonomy in his work, as one interviewee put it: '*If you have a large degree of freedom then you must you use it.*'
The way how variety is ensured diverge, such as (1) contact with the customer or suppliers, (2) broadening your function, as one interviewee put it: '*Anyone can click on a square and say it is green, but making it with the machine is a different story.*' Thus you learn more by combining them.

Supervisor

Variety is beneficial for one, because it **influence their motivation**, as one interviewee said: '*Variety is crucial for him, because it keeps him motivated*', because in a scenario with no variety the opposite occur, '*if he has to the same thing over and over again, then he would get bored pretty quick*'.

It is important that an employer **gives space** to the employee to create variety in their work, for example, to visit some customers, as one interviewee said: '*He is visiting a client on a regular basis to optimize a machine. I could choose to be very strict by saying that the customer should pay for this, but on the other side I know that he is talking to the client and while doing that he comes up with new ideas, which can make our machines better*'.

Leadership

Innovative technician

A matching leadership approach makes one willing to do more than is expected to form him.

The basis of this is **reliance**, as one interviewee said: '*If you do not get support then you can forget it. Then you are fighting a losing battle*'.

One must experience autonomy to be able to innovate, '*I want to work in my way.*' The opposite way has the opposite effect, as one interviewee put it: '*If you always being told what to do and there is no room for discussion your pro-activity is lost*.'

The preferred role for the supervisor is **supportive** which can be used in various ways such as (1) **facilitation** of the employees through sticking up for them, '*having an innovative idea is one, get the blessing within the organisation is a second*', (2) **show appreciation** to one in the form of compliments, and (3) **sparring** to reinforce ideas, '*To shake the entire structure in order to see what keeps standing. Purely to get the quality up*'.

Supervisor

The purpose of leadership is to enable the employee in the best way a possible to lead to innovation, as one interviewee said: '*If I purely focus on innovation which arises from himself then it must derive from himself.*' **The role of the supervisor is partly limited**, because, as one interviewee formulated: '*Due to poor leadership, she might not be effective, motivate or whatsoever. Thus, it does have an effect, but if it is turned around and she has great leadership this does not mean that she is automatically a super good innovative engineer*'.

Nevertheless, the **added value of leadership is indeed recognized,** as one interviewee put it: '*Leadership is necessary to draw up the frameworks which ensure that the ones who are going to provide the innovation within the company can be accompanied.'*

The way in which a supervisor can **make a contribution** is by for example (1) by providing support, '*Someone has to justify the time which is invested … it is my role to support him here in*', (2) facilitating in the way that one can focus entirely on his project, '*We divided all inbound phones calls which could distract him. We have discussed in advance with all colleagues*', or (3) offering support to one, such as lend an ear, '*It is often the case that he wants to share his story because it is not going that smoothly.*'

Joker

Innovative technician

One needs to have **control** over his agenda so that he can find the adequate **work-life balance** which fits best for his situation at that moment, "*The company is very compliant with the employees' work-life balance to fit the work in the employee's life*."

One must have the opportunity **to be themselves** at their job, so they can use all of their energy for their work which weather vice versa also produces energy, "*If you cannot be yourself at your job or you walk on your toes then you won't last long.*"

The supervisor has a significant role in the **enthusiasm of others**, especially in the field of innovation, "*It will lead to a greater effect.*"

Besides, **the work environment must be ergonomic** so one has the opportunity focus fully on his work, "*It is important to have a work environment where you can work in peace and think without interruption.*"

Supervisor

A company needs to have the **capability to innovate**, "*I believe that it is important for a company to have a long-term strategy wherein innovative is one of the central focus points.*"

A **social environment** wherein one can flourish can be facilitated in various ways, such as a cafeteria to meet others, a gym to blow off steam, or team building activities, "*If people have the opportunity to relax then they have more energy for the business work.*"

The investment in the **team building process** is a two-way traffic, "*The meal we pay ourselves, but we get time to time paid off by the company.*" This kind of investments has beneficial influence, "*The whole social aspect is highly valued, and I have the feeling that the group engages with each other.*"

Financial stimulants can be used to trigger one to make overtime hours to finish an order for the customer, "*Normally I am not a big fan of economic stimulation, but sometimes it works with certain people. The financial stimulants had a motivating influence on him*".

Appendix I: Results of the joker competencies

Innovative technician

Name of the joker competence	Description of the quotation from the interview
Perseverance	“Along the way, you will face a lot of obstacles leaving many people to say they have a problem, but they have a challenge. By approaching it as a challenge, you develop perseverance. You may see it as a problem, but then you have a negative attitude which encourages you to give up because you allow to downgrade yourself. A trough approaching everything as a challenge I keep it positive for myself and fun to challenge it”.
Visual communication	“A picture says more than 1000 words. I can translate a customer which into a picture. This ability is something that I can do and others not. I think that explain something through visualisation is precious. This gift is particularly helpful in the case with customers because it gives them the feeling that you understand their problem. It makes their problem visual readable”.
Coaching	“This is something which arises from my personal background. In my previous job, I had a managerial position wherein I have learned to coach. I would not say that I was a real supervisor, but more a coach for other people. This coaching is also what I do know in my current job. I coach dual pupils. Now I have almost coached them for a year, and I have received some positive experiences from them”.
Substantive knowledge	“I think that it is critical that if you want to come up with something new or innovative that you have a broad knowledge. You have to know what is important for the customer, what is vital for manufacturing, but also for the longer term. You need to look far in the future because that has an influence on everything. I think it is part of who you are, but also part of being innovative. Those two things are intimately related. You have it, or you do not have it”.
Laziness	“You just need to be a little bit lazy, that is it. You must ensure that the machine does most of the work, everything should be automated. There should not be even any human interference. It should be as simple as possible, that is important. Yes, it is tough to make it so simple that you never have to do anything anymore. Actually, it should be soo comfortable that the product can be done with one press of the button. The laziness is something that is in you as a person”.

Substantive knowledge	“It means to me that I know what I am doing and have skills in my profession. It is good that people can collaborate with other disinclines and come up with new ideas, but at the end of the ride it is important that you know what you are doing and therefore you need substantive knowledge. You develop this through a combination of education and experience. Learn a lot of things and try to master certain things”.
Business network	"This one is important because is a value that I can contact other people in the work field. It could be a whole other company, but I like to spar with others about particular problems, someone with substantive knowledge in an area. These people could be form Universities or suppliers”.
Enthousiasme	“Enthusiasm is a driver that you are excited yourself to renew things. You must see the fun in it; it must give you energy, especially to make it happen. From the ten things you initiate, maybe only two will succeed. In the case it does not succeed, then you should not give up, you must stay enthusiastic. Take the positive points out of it and look critical why it failed. Keep looking for improvements, and therein you need you stay passionate. Enthusiasm is a major factor”.
Curiosity	“Naturally you need to be curious about how things work, but also about new developments and new techniques. It is typical technicians that they also want to know everything that is not part of their profession. This form of curiosity happens unconsciously. You must have an open mindset; this also correlates with substantive knowledge about other professions. You must be broad curios”.
Flexibility	“The willingness to also work after the standard office hours.”

Supervisor

Name of the joker competence	Description of the quotation from the interview
Multicultural background	“One of the nice things about him is his multicultural background and the way how he is living his life. That fits well with the company because we have 87 nationalities here. It says nothing about his work but more about him as a person, but it is a very nice quality”.

Entrepreneurship	“It is not one particular thing, but what I do think is important is a piece of entrepreneurship. It is a combination of the competencies which are part of the research. I believe that you a certain amount of entrepreneurship to be innovative. Not only theory but also be able to make the transition to the practice and reality. Maybe also a bit of courage and perseverance. You must not be afraid to fail because you are working on something new where nothing is sure, there is uncertainty. Thus, sometimes you have to show a little bit of courage and just do it. Sometimes you also have to go further where other people stop by believing in your concept.”
Helicopter view	“He has shown that he has a helicopter view and involve people into the process what he is doing is crucial. Also, some empathy. Not only in other disciplines, but also for someone's opinion and respect that. This attitude is essential when you want to be seen as credible by not only other disciplines but the whole organisation. In every company, you have to deal with different cultures and movements, but if you are not willing to talk to other people and you can not adjust if this is necessary to work together then you will not get along with other people.”
Social skills	“Despite the fact that he had difficulties with expressing his opinion, he was always present at social events, such as the Friday-afternoon drinks. That was something he enjoyed a lot and where he always stayed until the end. Despite that he is, on the one hand, a typical engineer and thereby highly values his work and don’ t want to be too distracted, he found it important also to establish a good relationship with his colleagues”. Through this competence of him, others preferred to approach him if they had something on their chest.”
Sharing knowledge	“He had the gift to share knowledge and especially his determinism to do so was very strong.”
Communication	“You need to gather information, but ultimately also share it. If you want a project to succeed, then this is essential. This kind of behavior is shown in meetings, in the correspondence of e-mail, and in conversations with others. These examples relates in particular to communication skills, such as the structure, summaries, and listing skills.”
Perseverance	“An idea that you have never succeeded without a fight, so you need to possess perseverance to make it happen. If you get the feeling that someone is doing everything he can do to make it work, then you must rely on the abilities of him. You must have faith in him.”

Appendix J: Results of the joker work context factor

Innovative technician

Name of the joker work context factor	Description of the quotation from the interview
Work-life balance	“We have the possibility always to leave whenever it is necessary. You can, for example, go out for a long lunch with your wife, or you decided to start later in the morning because you want to drop off your kids at school. This form of freedom is all possible in a consultation which also gives much support. The company is very compliant with the employee's work-life balance to fit the work in the employee's life. For example here you get a month paternity leave as a father which is with according to the law only one day. The company believes that you need that time to adapt to the new situation before you can start working again”.
Good team	“The work environment is to the utmost extent the people who work there. If you can not be yourself at your job or you walk on your toes, then you won't last long. If I would be in that situation, then it would cost me soo much energy to pretend that I am someone who I am not actually, that I could not use that energy for my work. The other way around, a good team gives me energy. If I can do something together with others, then I have fun at my job which gives me energy and what I can reinvest again in my work”.
Resources	“You need resources such as time to invest. Trying out things cost money, but if you do not have it, then it will not work. You need to keep spending, even when the economy is in recession”.
Support	"The supervisor has in important role share enthusiasm because it will lead to a greater effect. People notice that it is fun to come up with new ideas, think out-of-the-box, and thereby making the link to their daily lives”.
Ergonomic work environment	“It is important to have a work environment where you can work in peace and think without interruption.”

Supervisor

Name of the joker work context factor	Description of the quotation from the interview
Involvement	“Something what is the yearly tradition of our team, and which is always highly appreciated, is our Christmas activity. We always go out for dinner at a restaurant in one of our breaks. The meal we pay for ourselves, but we get time to time paid off by the company. The whole social aspect is highly valued, and I have the feeling that the group is engaged with each other”.
Offer opportunities to innovate	“A company needs to have the capability to innovate. I believe that it is important for a company to have a long-term strategy wherein innovative is one of the central focus points”.
Financial stimulans	“It is probably not the best one, but a financial stimulant is helpful from my experience. I used it for example with an employee. There was an order of a client which had to be completed in a couple of weeks. I offered him a thousand euros if he could do the job and he took it and succeeded. Normally I am not a big fan of financial stimulation, but sometimes it works with certain people. The financial stimulants had a motivating influence on him”.
Social environment	“It would add the social environment here because the other four work context factors focus on the employee to become better in their profession and the company to perform well which is all very business oriented. I think that the informal part of the company is also crucial. For example a cafeteria as a place to meet, the possibility to exercise or a business trip with colleagues. Here a company must facilitate. If people have the opportunity to relax, then they have more energy for the business work”.
Humor / Customer	“You must have fun with each other through laughing, the jokers and whatsoever, and on the other side also what is the wish of the customer. It is about the balance between those two”.
Resources	“Resources are critical for engineers to conduct their job in an efficient way which prevents frustrations, such as tools, fast computers, two monitors screens. With a small investment in such resources, a lot of frustrations about ancillary matters could be prevented”.
Appreciation	“It is vital to receive appreciation from direct colleagues, your supervisor, or even customers because this enhances the motivation. The way how appreciation is expressed varies such as from attention to flowers”.

Appendix K: Implementation plan

Innovation Stimulator Box (ISB)			
What	**What**	**How**	**By who**
First quarter	The composition of the pilot	1. Brainstorm about how innovation could be fostered and what (possible) obstacles could be within the company 2. Outline what the goal of the pilot 3. Create a structure for the pilot 4. Compounding a project team	1. Member of the Management board 2. HR 3. R&D 4. Marketing 5. Employees
Second quater	Preparing the pilot	1. Compiling the review-board 2. Notify employees about the ISB-pilot 3. The content composing of the IBS	1. The project team 2. Member of the Management board
The pilot process			
Week 1 -4	Notifying employees through information campaign	By e-mail, updates on tv-screens, team-meetings, and ambassadors	1. The project team 2. Member of the Management board
Week 5-6	Start of the pilot	Employees can submit their ideas through the portal	1. Employees
Week 7	Picking the best ideas	The jury picks the best ideas. The employee gets the opportunity to present his idea for the jury.	1. The project team
Week 8	Presentations for the jury	The innovators present their idea The jury determines which ideas receive the IBS.	1. The project team 2. Employees
Week 9-18	Developing the idea	The innovators work with the IBS to work on their idea	1. Employees
Week 19	Presentations final ideas	The innovators present their final ideas The jury determines which ideas are the best and will be executed further	1. The project team 2. Employees
Week 30	Evaluation of the pilot	The pilot is evaluated based on his effectiveness The determination is made if the pilot will be continued the next year	1. The project team 2. Member of the Management board 3. HR 4. Marketing 5. Employees

Appendix L: Cost-benefits analysis

Recommendation: Innovation Stimulator Box (ISB)

Action	Time investment (indication)	Costs (indication)	Benefits
Developing pilot	120 hours		1. Individual innovators becomes more effective in their process to translate their idea into action 2. Their idea has more impact. 3. The innovator develops valuable life skills 4. The innovator (re)discover his passion in his work which is beneficial for his job satisfaction and engagement with the company. 5. It increases the quality of the innovation 6. It helps to identify latent innovators within the company.
Review-board	(4 members X 19 weeks X 4 hours weekly) = 304 hours		
Providing the IBS (10 pieces)		Pre-paid creditcard 10 X 500 = €5000 Materials Printing of materials (10 X 20 = €200)	
Labor hours for developing ideas	10 innovates X (10 weeks X 4 hours) = 400 hours		
Evaluation of the pilot	8 members X 8 hours = 64 hours		
First prize		€1000	