External factors affecting the adoption of IoT-Technology: A TAM and UTAUT approach

Author: Tobias Fretzen
University of Twente
P.O. Box 217, 7500AE Enschede
The Netherlands

ABSTRACT,

This research is conducted for analyzing the digitization process of a company, by investigating the role of IoT technology as a strategic tool. The core purpose is to identify factors influencing a company's motivation for implementing IoT into its strategic plans and to gain a better understanding of the technology's potential in general as a strategic option. This exploratory study strives for outlining the dynamics of a company's environment, potentially affecting the decision-making process with regard to IoT implementation. To do so, the 'Unified Theory of Acceptance and Use of Technology' (UTAUT) is applied and expanded, intending to conceptualize a model that merges the identified factors. Besides studying secondary sources, represented by existing literature about digitization and IoT technology, primary data is collected in form of three interviews, leading to an evaluation of the complex topic from three different perspectives. The findings highlight the complexity of the topic, by emphasizing the IoT technology dependence on the global motivation to create a digitized ecosystem. While factors such as costs, skills gap, technological infrastructure or stakeholder convergence are seen as critical towards the implementation, potential benefits such as process optimization, value chain expansion or higher profitability represent key factors in a company's motivation to make use of such a technology. The research points out, that motivating factors clearly outbalance the impeding ones, and that the overall trend towards digitization within a company's ecosystem is the main driving factor pushing a manager towards dealing with the implementation of IoT technology.

Graduation Committee members:
1st Supervisor: Dr. Efthymios Constantinides
2nd Supervisor: Dr. Kasia Zalewska-Kurek

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1. INTRODUCTION

1.1 IoT Technology

The term IoT is gaining enormous attention in the field of modern wireless telecommunications and refers to the connectivity among heterogeneous objects, devices, and other gadgets equipped with sensors, Radio-Frequency Identification (RFID) tags and other mobile transmitting devices which increasingly surround us (Bauer et al., 2014). Connected to the internet, such *things* interact through uniquely designed addressing schemes, striving for the common goal of exchanging data to create a more predictable, quantitative overview of one's interactive environment (Giusto et al., 2010). From a semantic position, the junction of the terms "things" and "internet" follows the idea of "a worldwide network of interconnected objects uniquely addressable, based on standard communication protocols" (Infso, 2008, p.6). The origin of the term IoT officially dates back to the year 1999 when Kevin Ashton, in his role as executive director of the Auto-ID center first coined the term in his presentation at Procter & Gamble. At that time, the upcoming trend of RFID in supply chain processes and its usage-link to the internet reinforced the focus on interconnectivity between devices. (*The Origin of the Internet of Things*, 2016) Nowadays, IoT is said to reflect the introduction of the third wave of IT-driven transformation of industries (Porter & Heppelmann, 2014). As a successor of computer-aided processes (*first wave*) and first connected networks due to the introduction of the internet (*second wave*), IoT shifts the focus to the product or *object* itself. As a result, new opportunities in data-collection have emerged, "triggering even more innovation, productivity gains, and economic growth than the previous two [waves]" (Porter & Heppelmann, 2014, p.5). In line with this observation, Gartner (2015) argues that IoT is not only a current trend but will gain increasing relevance and will redesign and restructure entire industry mechanisms. According to Porter & Heppelmann (2014), "the increasing capabilities of smart, connected products not only reshape competition within industries but expand industry boundaries" (p.12). Specifically, Gartner estimates the total global economic value added for the IoT market to reach around $3 trillion dollars until 2020 (Dijkman et al., 2015). This prediction roots back to Gartner Inc., which estimated the number of connected things to be 6.4 billion in 2016 (Gartner, 2015). Cisco, a leading international technology conglomerate, supports the aforementioned estimate in their 2017 report, expecting the number of connected objects to already exceed the total population of human beings (Evans, 2011). Due to IoT's increasing economic relevance, it is inevitable to understand the implications of IoT on its key drivers and users, namely the organizations. Besides the internal optimization of Big Data usage, "managing the data that flows from these devices often means connecting in new and more complex ways with a wide range of organizations" (Jernigan et al., 2016, p.4). These implications are far-reaching and can entail the restructuring of entire organizational units. The so-called "technology stack" represents the fundamental, technological infrastructure consisting of multiple layers (e.g. new product hardware, embedded software, security tools, and connecting gateways) which need to be integrated first, before being able to make use of all benefits provided by a new technology (Porter & Heppelmann, 2015). As depicted by Porter M.E. and Heppelmann J.E. (2015), the introduction of smart, connected products in a company can be summarized by four stages. Starting with (1) "*a radical shift*", requiring the company to redefine its industry and strategy followed by (2) "*new relationships*" with customers, opened up by new, vast amounts of data (p.5). Subsequently (3) "*new processes*" are established within the company's value chain due to the integration of new technology until ultimately (4) "*new structures*" enable cross-functional collaboration to support the data analysis and support (p.5). Considering these requirements and consequences the implementation of IoT brings to companies, one has to further examine companies' initiatives for implementing IoT in its current internal structure.

1.2 IoT and Strategy

Having realized the enormous potential of IoT, managers strive for effective strategic decision-making in the light of IoT business (Mytelka, 2000; Yokoi, 2010). When talking about 'strategic decision', a mechanism is meant which aligns a company's environment and competitive goal with the company's strategy (Ward & Duray, 2000). According to Rui & Yip (2008), this mechanism gets dictated by the preferences of the decision makers and constraining external conditions. By taking the strategic perspective, Li et al. (2012) state that "we regard IoT strategic decision as the positive response of firms to the changing IoT environment in order to gain competitive advantage by using advanced IoT technologies" (p.206).
Resulting from this, business processes have to be aligned with the new strategy setting, taking the technological component more into account. In doing so, such decisions can lead to a restructuring process within a company (Shen & Chou, 2010). Specific fields in which IoT is seen to play a fundamental role in the near future concern the optimization of 'Enterprise Data Management (EDM)' and 'Enterprise Information Systems (EIS)'. Referring to the research by Petrasch & Hentschke (2016), who lay the focus on cloud storage, IoT will support communication streams within the company and will lead to more flexible and innovative business models. Other researchers specify their research directly to the optimization of the logistic processes of a company. As Ferreira et al. (2010) investigate, IoT will not only increase the performance within the supply chain but also supports the integrity of it. Here, IoT can lead to more transparency and stability. By laying the focus on the domain digital marketing, Daj et al. (2012), show that marketing campaign and strategies can be elaborated with more detail to the target segments, giving companies new opportunities in identifying potential customers and their needs. Lu et al. (2010), instead, takes the overall business model into account, giving the example of the agriculture industry. They outline, that by gaining more data about processes and mechanisms within the company's environment, businesses can react more dynamically and flexible to changes and can expand operations into other areas of the industry.

1.3 Research Gap

Consolidating the research findings and the aforementioned future relevance of IoT, the importance of strategic IoT implementation becomes apparent. It is not enough to simply understand the complex, technological characteristics of IoT. A structure and encompassing transition approach appears to be a crucial factor for successfully addressing the IoT potential. In line with the previously established potential of digitization and disruptive technologies like IoT a central research question emerges:

What are critical factors driving a manager's motivation to implement IoT technology in business operations?

It is important to not only understand the technical components and the central technology behind IoT but also to examine the strategic deliberation of the IoT implementation process and its role in digitizing a company's ecosystem. Therefore, the

following sub-questions emerge from this central research question:

(1) *What is the level of engagement of the IoT as a strategic tool for today businesses?*
(2) *What are main motives and expectations of businesses implementing IoT?*
(3) *What are key factors influencing a company's motivation to adopt IoT?*

1.3.1 Academic Relevance

Internet of Things is a disruptive innovation, which has the potential to restructure and dictate future processes and market mechanisms of entire industries. From an academic perspective, it is, therefore, crucial to identify factors which influence a company's decision-making about implementing such an innovative technology into the internal processes and its overall strategy. Understanding the factors that drive a company's decisions towards implementing such a technology contributes insights into how manager's estimate the trend of digitization and what value they expect IoT to bring to the company's overall performance. However, the field of IoT cannot be recognized in isolation, since it considers the connectivity and communication between several devices at multiple levels. Consequently, it is of high academic relevance, to identify the scope of IoT and to create an inclusive knowledge domain about this field and its branches. Besides literature dealing with positive factors, creating opportunities to reduce costs and save time in production and business operations (Shrouf et al., 2014), trend-studies and market research highlight opportunities for manufacturers to increase productivity (Dijkman et al., 2015; O'Halloran & Kvochko, 2015) and outline the potential of IoT to optimize business processes, predominantly in departments such as marketing, production and research & development (Porter & Heppelmann, 2014; Dijkman et al., 2015; Porter & Heppelmann, 2015).

1.3.2 Business Relevance

The predominant reason for an urgent implementation of IoT is the constant competition within a market and any company's subsequent pursuit of a competitive advantage. Past technological evolutions and their adoption have taught us that early adopters can achieve significant time advantages, while laggards tend to lose market share and might even be forced out of business. As a result, a business' timely technological readiness is at the core of IoT adoption. Next, to the timely recognition and understanding of a new technology, the implementation process marks the decisive factor between success or failure. Without a well-structured and thought-out implementation, a company might be left with an inconsistent infrastructure, an issue which is extremely complicated to fix. As previously discussed, the majority of companies rely on consulting firms to structure their strategic implementation of IoT. From an industry standpoint, the overall IoT advancements are thus heavily dependent on the expertise of consulting firms. Information about the potential of IoT indicates, gaining knowledge about the technology, but also about its role in a company's strategic orientation will be necessary to benefit from the opportunities IoT implementation offers. Consequently, this research will provide a further step towards understanding the whole picture of the new technology, for businesses and their advisors. More specifically, the findings will outline relevant factors affecting a manager's decision-making for implementing a new technology. Managers should realize the importance of making a trade-off between motivating and restricting factors, and which areas in the external environment are driving these factors.

2. LITERATURE REVIEW

2.1 Research Model Justification

2.1.1 Technology Acceptance Model (TAM)

The underlying theory of the upcoming research will be the '*Technology-Adoption-Model* (*TAM*)' by Davis, who developed the model in 1989 to address the emerging need for technology in the 1970's in light of sustained problems in system adoption (Chuttur, 2009). More precisely, it was developed for understanding and investigating information technology adoption behavior (Davis, 1989). According to Marchewka et al. (2007), the model's primary purpose is to uncover how external variables could have an influence on internal factors, such as intention, beliefs, and attitudes. Davis based the conceptualization of his model on the socio-psychological 'Theory of Reasoned Action' (TRA), developed in 1967 by M. Fishbein and I. Ajzen. (Porter & Heppelmann, 2015). Central to the TAM is the *user motivation (UM)*, which, on the one hand, influences the actual system use and, on the other hand, is affected by external stimuli. According to Davis, UM is composed of three factors: (1) *Perceived usefulness* (U), (2) *Perceived Ease of Use* (E), and (3) *Attitude Towards Using (A)* (Chuttur, 2009). This is depicted in Figure 1., showing the conceptualized TAM.

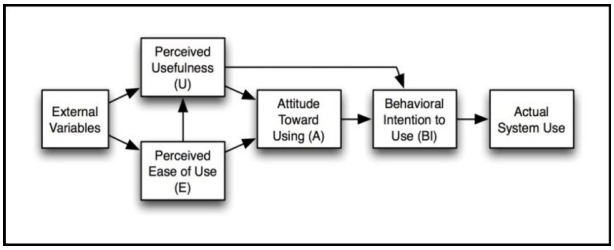

Fig 1: Technology Acceptance Model (Davis, 1989)

As can be seen, external variables have an influence on the user motivation for using the technology, which, in turn, affects the behavioral intention to use (BI), resulting in the actual system use. As stated by Kaushik & Rahman (2015), positively significant relationships were observed by investigating the individual construct's relations within the model.
For this research, the two key variables 'U' and 'E' are of high relevance, since they are essential factors concerning the adoption process of new technologies. In Table 1, the variables' definitions from Davis (1989) get presented:

Variable	Definition
Perceived Usefulness (U)	"The degree to which an individual believes that using a particular system would enhance his or her job performance" (p.320)
Perceived Ease of Use (E)	"The degree to which an individual believes that using a particular system would be free of effort" (p.320)

Tab.1: TAM core variables influencing attitude toward using (Davis, 1989)

Previous research already applied the TAM when striving for investigating technology acceptance in a B2B context. Such as the paper by Lee & Park (2008), in which the adoption of 'Mobile Information Technology' and its influence on the B2B market performance got highlighted. Furthermore, several studies analyzing technology acceptance digress from putting the consumer at the core of their study and, instead, focus on organizational factors influencing the technology implementation and use and their effect on a manager's decision-making process. Like Sebjan et al. (2014), who

examines the use of information solutions of CRM with focus on critical organizational factors, using the TAM. The importance of taking B2B and technology implementation and acceptance more seriously into account gets depicted by the work of Hughes & Perrott (2006). Their paper outlines the changes in the B2B market and its increasing dependence on technology and innovations, by using the TAM as one of their theories to conceptualize a suitable tool for understanding the company's role in the adoption process. By conducting a preliminary research, Bach et al. (2016) emphasize the need for applying the TAM to the B2B context, outlining a company's acceptance towards the use of business intelligence systems. Using the technology acceptance model as one theory of investigation for this research, therefore, appears to be suitable, since existing literature already attempts to take the B2B perspective when investigating technology acceptance. However, the amount of such literature is rather limited, representing a significant research gap concerning the research of technology acceptance in the B2B market.

2.1.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Over the past years, multiple researchers made use of or even expanded the Technology Acceptance Model, by adding, expanding and adapting variables, intending to increase the model's validity and generalization (Venkatesh et al., 2003). Based on these diverse studies Venkatesh et al. (2003) configured the Unified Theory of Acceptance and Use of Technology (UTAUT), conceptualized in Figure 2.

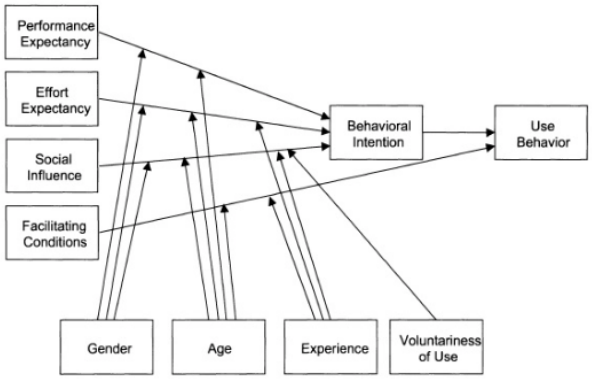

Fig 2: Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003)

The four core variables (performance expectancy, effect expectancy, social influence, facilitating conditions) depicted in the model combine similarities from the previously mentioned studies, which used TAM for conducting research. Table 2 offers the variables' definitions:

Variable	Definition
Performance Expectancy	"the degree to which individuals believe using the system will help attain gains in job performance" (p.447)
Effort Expectancy	"the degree of ease associated with the system" (p.450)
Social Influence	"the degree to which individuals perceive that important others believe he or she should use the system" (p.451)
Facilitating Conditions	"the extent to which an organization has put in place arrangements (for example training) to support those using a system" (p.453)

Tab. 2: UTAUT four core variables (Venkatesh et al. (2003))

In doing so, Venkatesh et al. (2003) states that "*UTAUT thus provides a useful tool for managers needing to assess the likelihood of success for new technology introductions and helps them understand the drivers of acceptance in order to proactively design interventions (including training, marketing, etc.) targeted at populations of users that may be less inclined to adopt and use new systems*" (p.426). As can be seen in Figure 2, the first three variables have an influence on the behavioral intention to use a new technology, while 'facilitating conditions' have a direct impact on the user behavior. Furthermore, the model shows that four mediating variables (gender, age, experience, voluntariness of use) may have an influence on these relations. For this research, however, these mediating variables will not be part of the investigation. This is due to the fact, that this paper strives for identifying factors influencing the decision-making process of managers that are in charge of deciding about the implementation of IoT-technology. For this analysis, the assumption, that these managers act in the best interest of the company and represent its values, is made. This is important to mention since the original UTAUT model aims for outlining relevant factors affecting an individual's attitude towards accepting new technology (Venkatesh et al., 2003). By making this assumption, this paper intends to identify the influence of relevant factors on a company's motivation, represented by a manager in charge, instead of highlighting the influence on an individual's motivation.

2.2 Critical Review

Analyzing the IoT-integration into a current company structure by using the TAM or the UTAUT as observation tools is not a widespread approach. Recent studies predominantly focused on the individuals' usage or consumer level when analyzing IoT. Even though not many of such a research approach exist, researchers support the usage of TAM and/or UTAUT when investigating technology acceptance and usage (Oshlyansky et al., 2007). Such as the paper by Al-Momani et al., in which TAM and UTAUT are complementarily used for conceptualizing a model to understand the usage of IoT services by individuals. In addition, explorative research by Bernsdorf et al. (2016) lays the focus on the company perspective, highlighting companies' need for successfully identifying the consumers' acceptance of IoT-devices. A more strategic view on a company's IoT-usage within the company itself is taken by Patil (2016), focusing on the acceptance-level of retail employees and important variables influencing the degree of acceptance. Each of these papers highlights the need for discussing IoT implementation on a strategic level. Li et al. (2012) attempt to consolidate this need with earlier studies by discussing the process of strategic decision making with regard to IoT (Li et al., 2012). They focus on external factors such as technology pushes and investigate the connection of such pressures with internal capabilities of handling the technology shift and the underlying decision-making process.

2.3 Factor Identification

In this section, the external factors with possible effects on one of the four core variables are presented. For each factor, a definition and short description are given in the Tables A.1. (*Appendix A*).

Taking the literature into account, two of the main factors related to the Performance Expectancy are new opportunities for process optimization and value chain expansion given by the use of IoT technology. Collecting more data about processes enables a business to allocate resources more efficiently and to align various steps more effectively (Porter & Heppelmann, 2015; Evans, 2011). Having collected Big Data, businesses gain a better understanding of its industry and can expand their value chain due to the possibility of adding more value to

personalized products or services (Jernigan et al., 2016; Leminem et al., 2012).
Concerning the variable 'Effort Expectancy', one relevant factor to mention is the required technology infrastructure, which is required to receive the full potential of the IoT technology implementation (Low et al., 2011; Fleisch et al., 2009). Additionally, literature deals also with the importance of security and data privacy, which is a complex component of IoT technology. Especially for globally operating businesses (Low et al., 2011; Mahmoud et al., 2015).
The variable 'Industry Influence' clearly entails the pressure put on a business by its competitors that already invest in digitization (Porter & Heppelmann, 2014; Evans, 2011). Moreover, a crucial trend is also the redesigning of industry structures, since digitization enables companies to create new business models and to reposition themselves in the market (Bauer et al., 2014; Infso, D. G., 2008).
'Facilitating Conditions' can be seen as one of the most important variables, since IoT technology cannot be treated in isolation and, therefore, its compatibility is of high relevance. Besides human factors such as the creation of skills and the training of the workforces (Jernigan et al., 2016), also organizational factors such as stakeholder convergence, necessary for a facilitated implementation (Low et al., 2011), need to be taken into account. Here, the underlying factor is the company's culture, which is fundamental for making IoT technology compatible with other technology devices and the employees' willingness to integrate it into their everyday work (Mytelka, 2000).

2.4 The Conceptual Framework

Based on the previous literature review about the topics IoT and digitization, and the understanding of the TAM and UTAUT, figure 3 depicts this paper's conceptual framework of the investigation.
As can be seen, the variable 'Social Influence' does not play a crucial role in this research. Referring back to its definition shown in Table 2, it considers an individual's social environment that has an impact on one's formation of opinion about the technology use. However, this research focuses on a company's strategic IoT-implementation, wherefore the original model's variables need to be redefined.
To keep or reach competitive advantage in today's world, managers need to consider more intensively upcoming technological trends and strive for including the technology component into a company's strategy setting. As identified by Low et al. (2011), industry and competitive pressure play a significant role in a manager's decision-making process and motivation to adopt. In their study, the adoption of the at this time manifesting technology around cloud-computing was investigated, offering insights into industry factors, influencing a company's adoption process of the technology. Focusing on IoT technology, Li et al. (2012) emphasizes that there exist multiple industrial factors influencing a company's need for IoT adoption (Li et al., 2012). In their paper, the central external drivers are categorized as 'technology push' (new technology evolving from the developing process of related technologies) and 'market pull' (force created by new emerging market needs, requiring the company to innovate) (Tidd et al., 2005). Therefore, the external business environment including competitors' performance and technology development gets represented by the variable 'Industry Influence' with direct influence on 'Behavioral Intention'. Oriented on this model, the previously mentioned research question for investigating strategic issues of IoT implementation gets answered.

3. RESEARCH METHOD

To investigate the role and importance of Internet of Things for companies and industry structures, an explorative research based on a qualitative methodology will be conducted. Since IoT is a new technology for which currently only limited reliable data exists, a quantitative assessment of correlations in this field is beyond the scope of this paper. By executing a qualitative research, connections within this topic can be further analyzed, conducting to the overall understanding of the big picture 'Internet of Things'. Based on literature review, external factors impacting the four core variables get identified. The main sources that provide reliable information and that are used for this research are academic papers, providing insights into the topics of IoT and Digitization. Additionally, papers analyzing the implementation of emerging technologies, such as Cloud Computing, are used as a benchmark. Furthermore, research findings by research institutes such as Gartner are used for gaining an understanding of the current usage situation of IoT technology in different industries. They are also used to realize the future potential of IoT and to get an overview of future trends and statistics concerning the development of IoT. Moreover, attention is additionally spent on research findings by consulting companies, like Roland Berger or McKinsey, to collect information about first company experiences using IoT technology. Based on this knowledge creation, the search for factors gets specified by searching more explicitly for the factors' relevance in the implementation process. Since Roland Berger is one of the cooperating companies in this research, the excess of data and information about IoT and digitization conducted by this consulting company supported the

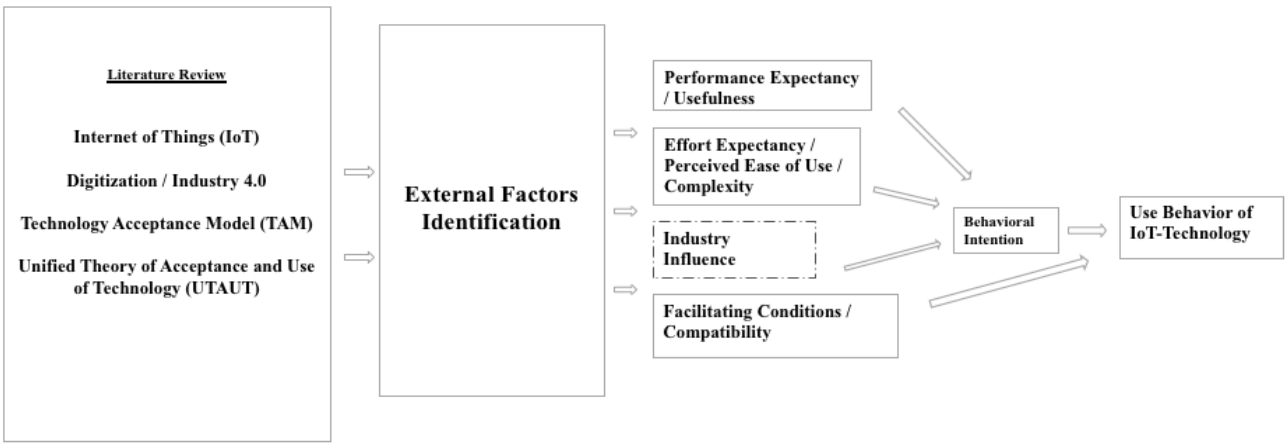

Fig.3: Conceptual framework of investigation

specification of the literature search. Besides the search for academic research papers, additional information is collected from official homepages of leading companies in the field of digital transformation, such as Bosch GmbH, and leading research institutes, like Gartner. The findings then represent the section 'External Factor Identification', given in the proposed conceptual framework in Figure 3. To strengthen the relevance of identified factors, an expert interview is conducted in which significant components and linkages within the framework are discussed. After having adopted the expert's opinions and critics, a follow-up interview, held with a manufacturing company, is conducted to test the reconceptualized framework from a company perspective. The interview as research approach is chosen since it supports the explorative nature of the study by conducting research in a natural setting. It focuses on the creation of a shared understanding of a relatively new topic, by answering the questions about 'how?' and 'why?' (Yin, 2017). Finally, the discussed and applied framework will be further investigated by taking the consultant perspective into account. Interviews represent an adequate technique when having a small sample size to work with an interest in the respondents' perspectives on an understanding of specific situations and ideas. Furthermore, it allows gaining knowledge about a person's or a group's thoughts and the particular behaviors following from these (Boyce & Neale, 2006). Therefore, the three participants chosen for this research represent three various perspectives on the topic of IoT. To gain more knowledge about the technology's infrastructure and its technological components, the sales manager at SIGFOX is the participant in the first interview. Collecting his opinion about the pre-defined factors gives more detailed insights into the importance and difficulties of implementing such a technology. Additionally, since SIGFOX cooperates with multiple companies from various industries in different countries and consults them in the field of IoT implementation, his experience adds value to the discussion of the pre-defined factors. To understand the factors' impact on a company's motivation for IoT implementation, a German construction materials and solutions company is chosen for the second interview. Gaining insights into the company's opinion about IoT technology offers the opportunity to directly apply the prior identified factors to its implementation plans and to have a representation of the German manufacturing industry, in which digitization starts playing a crucial role. For the third interview, the perspective from the consultant point of view is taken. Interviewing the Senior Advisor for Digital Transformation at the consulting company 'Roland Berger', further insights into various industries and their motivation to implement IoT technologies are gained. This perspective is chosen since consultants accompany a company during its transformation process towards digitization and, therefore, have knowledge about critical factors affecting a company's motivation towards IoT during the process of the decision-making until the final implementation.

The chosen interview style for all interviews is the semi-structured one, due to the pre-defined intention to discuss the prior identified factors and to get answers directed to these topics. However, after first meetings with the interviewees, it became obvious, that there are central differences in the IoT definition between the theoretical understanding gained from literature and the working experience with that technology. Due to that, the semi-structured style supports the intention to offer a wide scope to the interviewees to bring in own experiences with the technology and to give insights into the industry understanding of that technology.

3.1 Interview Structure

3.1.1 Interview 1 With SIGFOX

The first interview strives for clearly discussing the previously identified factors based on the literature review in form of an open discussion. Making use of the participant's experience from real-life cases in which he supported companies' IoT implementation processes, this interview outlines the factors' relevance for various companies and industries. Additionally, questions are asked about his own assessment of the topics digitization and the role of IoT technology in the near future. Based on this, follow-up questions ask for the participant's own opinion about crucial factors and whether he would add additional factors, which were not identified by the literature review.

3.1.2 Interview 2 With Example Company

This interview consists of two rounds, each getting briefly described in the upcoming sub-sections. The questions for each round can be found in Appendix B, List B.1.

The first interview round deals with the company's current state of IoT usage, intending to answer the sub-question "*What is the level of engagement of the IoT as a strategic tool for today businesses?"*. Important aspects of consideration are the company's motivation for using IoT and its experience with the technology. Questions about the industry structure and the relevance of IoT for the current business, as well as for the current industrial processes, are additional components of the interview for understanding connections between the company's internal motivation for and the external pressure on using IoT. The idea behind the audit-interview is to create a baseline on which one can categorize the company in terms of its level of knowledge about the topic of IoT and its importance.

In the second interview round, questions are focusing on the company's future state, by taking a look at the company's plans for implementing or further developing IoT in its company structure and strategy. Together with the findings from the first interview round, answering the question "*What are main motives and expectations of businesses implementing IoT?"* gives insights into a company's understanding of what IoT will bring in the near future and how the company will benefit from it.

Based on this, the last part of the interview deals with answering the question "*What are key factors influencing a company's motivation to adopt IoT?"*. Besides introducing the prior identified factors, this interview is used to disclose further factors with which the company has dealt with or currently deals with when strategically considering the IoT implementation.

3.1.3 Interview 3 With Consulting Company

The third interview intends to discuss the identified factors and to evaluate the findings from the first two interviews in form of an open discussion. Here, the relevance of each factor is discussed and complemented with the consultant's own experience from different IoT implementation projects. Questions asked to the participant do not only focus on the individual factors, but also address the participant's estimation of the overall emerging trend of digitization and the use of IoT, and which future outlooks may motivate or impede a company's motivation to implement technologies such as IoT.

4. RESEARCH

4.1 Findings: Interview 1

The expert chosen for the interview is the current sales manager at SIGFOX and former employee at Telefónica Germany. SIGFOX is a global IoT services provider, following the vision 'Make things come alive'. The company strives for building a global network, in which objects are enabled to share collected data, by taking constraints such as energy into account. In his function as sales manager, the interviewee deals with companies intending to implement or expand their current use of IoT technology, giving him the necessary background knowledge for participating as an expert in this study. Concerning the role of IoT technology in today's businesses, he emphasizes that digitization has taken a priority role in a company's strategy development, containing IoT as a fundamental component. Instead of focusing solely on IoT technology in isolation, the interviewee highlights, that one has to recognize the trend of digitizing a company's whole ecosystem including parallel technologies such as 'Artificial Intelligence' for understanding the potential of such a technology. He points out that, nowadays, it is inevitable for middle-class companies or industry leaders to develop an understanding of the IoT's potential and to develop future business cases, in which the IoT implementation gets addressed. However, he adds that for some businesses, the topic IoT is still difficult to address since the technology is not elaborated enough to add value for all types of businesses. From his point of view, the central motivation for a company to deal with this topic should be Big Data, allowing a company to reach new levels of value creation by not only collecting more data but also higher quality data. Three benefits explicitly mentioned by the interviewee are *(1) process optimization* of internal manufacturing processes and communication streams, *(2) saving of costs* due to more transparent processes, and *(3) reduction of waste* as a consequence of more predictable forecasting procedure in the planning process. He states, that even though some companies do not see potential benefits for their businesses to this point in time, IoT will be a driving force for a company's success in the future. Here, he points out that the optimization of processes and the collection of more and higher quality data to improve the company's overall performance is only the first step in the process of digitization. Based on trend studies and own experience, he sees the potential in IoT to reshape a company's business model as a second step. Since Big Data allows companies to collect more data about own processes, clients' needs, and supply offerings, IoT technology can lead to the expansion of a company's value chain by adopting new product and service offerings or by acquiring external processes within the supply chain. However, besides all the benefits, he depicts that there are multiple hurdles for a company, concerning the IoT implementation process. One of the most critical ones is initial investments for a company. Besides investments for hardware components, software programs, and connectivity, companies operating on an international level have to take factors such as costs for data roaming into account. On the Sigfox global IoT Network, therefore, no roaming costs incur. However, the interviewee states that with today's mobile technology available, companies still have to include such factors in its strategic considerations. Furthermore, he points out that the human aspect needs to be taking into consideration when planning the implementation of IoT technology. One problem here is the risk of an occurring skills gap. While employees are familiar with work processes and the company's everyday course of action, companies should be aware of the risk that IoT technology can disrupt such structures. It is of high importance to offer training and workshops to employees, securing an effective and efficient exposure with data collection and data analysis. Another important aspect is the overall culture within a company. Here, he refers to companies with a lot of tradition and well-rehearsed processes, in which it is often difficult to redesign structures. He adds that a central factor for successfully implementing IoT technology is the inclusion of all stakeholders affected by the change. On the one hand, the board and management need to be involved in spreading an overall understanding of the technology's strategic benefits and for successfully laying out the visions for the future. On the other hand, the focus has to be laid on the acceptance and engagement of the workforce. Here, he emphasizes that especially concerning data privacy and security shouldn't be underestimated, since making work processes more transparent consequently means that also the workers' behavior and actions become more transparent. This topic is also relevant to a company's interactions with other stakeholders, such as other companies in the B2B market or end consumers in the B2C market. Implementing IoT technology also requires to be aware of privacy issues of suppliers and clients, as well as the individual as a consumer.

However, the interviewee emphasizes that the motivation to implement a new technology should not only be measured by the benefits and disadvantages of the technology, but that also external pressures play a critical role. Strengthening the prior developed variable 'Industry Influence', shown in Figure 3, he indicates that companies are aware of the fact that competitors in the industry are already dealing with IoT technology. From own experience, he points out that companies benchmark their own state of the IoT technology use with the one of competitors, increasing the willingness to expand own investments into the technology.

Occurring from the IoT technology's potential to optimize processes and add value to services and products, and the felt pressure from the external environment, the interviewee constitutes the *time* aspect of the decision-making process of implementing the technology as a key driver of motivation. Managers need to be aware of the fact that it will require at least 2-3 years for successfully setting up the infrastructure supporting a successful implementation of the technology. Furthermore, profitable outcomes should not be expected directly after the implementation and that this time-span should be considered when deciding to use IoT technology strategically.

In conclusion, the interview emphasizes that dealing with the implementation of IoT technology should be a core topic for the strategy setting of every business. However, there exists a trade-off with all the predicted potential and benefits on the one side, and the crudity of the technology, risking a lock-in into available technology with a short maturity time, on the other side. Additionally, since multiple technologies need to interact with each other for creating the full potential of data collection, a company has to understand the broad picture of its digitized ecosystem. The findings and statements for each factor are summarized in Table C.1 (*Appendix C*), depicting the interviewee's opinion about the factor's relevance to the research framework.

4.2 Findings: Interview 2

The company participating in the second interview for this research is a leading global construction materials, and solutions company, operating in the building materials industry. Their main business is oriented towards the manufacturing of cement and other building materials and its global client portfolio contains masons, builders, architects, and engineers. Since the company evaluates itself as 'advanced' concerning digitalization with the potential to further expand the use of IoT

technology, it represents a suitable case company for investigation. To successfully address this potential, the company currently founded a digitization initiative, for which the job ‘Chief Digital Officer' was created. The position got created to define a digital transformation and implementation strategy, for basically digitalize the company inside processes and outside products and services. IoT is a part of it and considered as a means to reach that goal of digital transformation. Therefore, the input provided by the employee reflects the current state of the market and his personal opinion on the matter. Considering the production of cement and its derivatives, the company already takes advantage of sensor solutions to track the production process and to screen the performance of the production plants. The motivation behind using sensor technology at this stage of the supply chain is to collect data about the production and to use such data for further optimizing the process. Currently, the company considers also the use of IoT solutions in the interaction with clients, by striving to satisfy their needs and optimize their working processes. Here, the company points out the critical factors ‘time' and ‘cost'. Since in the construction industry multiple suppliers, constructors and planners are involved in creating the final outcome, the company critically investigates how IoT technology can enable customers to become more efficient or at best transform the business model of the construction industry. From a strategic point of view, the company is looking not only for solutions which would create value for the customers, but also solutions that will improve the sustainability of the overall construction ecosystem, like waste management or Co2 reduction. The underlying vision of the company is to create a digital ecosystem for the company and its stakeholders, in which not only the internal production processes should be optimized, but also the interaction and cooperation with clients should become more efficient and effective. However, to this point in time, the company emphasizes that it is still difficult to have a conforming definition of ‘IoT' within industries and among experts and to clearly identify which technologies are included into this topic. More specifically, a central topic of concern is the innovation adoption rate of those IoT solutions by customers like builders and masons, and the need for raising awareness and offering training to help those parties to get familiar with the technology. The potential of IoT is immense, ranging from process optimization to creation of new products and services. The underlying motivation is to increase the value for the customer, leading to a more profitable and differentiated business model in the long-run. Currently, the company is approaching IoT technology stepwise according to the customer demand and technological opportunities. One opportunity that motivates the company to invest further in IoT technology is the chance to differentiate the company from its competitors in the industry. While the main business currently deals with the production and marketing of cement and aggregates. The company already develops a business model as a service provider. Here, the company strives for becoming an IoT technology expert for its industry, by offering IoT technology as extra service for a premium price to its clients, increasing the product's value due to optimized and more cost-efficient processes for the client's labor force. However, due to high costs and required expertise in the field of sensor technology, the company will not include the production of such sensor-technology in its value chain. Instead, the company aims for developing a network of suppliers, such as IT specialists, to reach the position as IoT expert in its industry. This, however, is concerned as a difficult challenge, since the right partners have to be identified, which represent the company's values and add value to the company's value chain, without acting self-seeking. Over the long run, the company intends to become a solution provider, supporting clients to create their own digitized ecosystem, in which IoT technology takes a key part. However, this proposition will be concretized when industries and experts have more certainty about IoT technology and its right way to use for developing its full potential. Concerning the company's industry, the interviewee states that only a few competitors can be considered more innovative and more digitalized than the company. The company constantly benchmarks itself to the competition in various topics, including also technology. While the product cement is rather seen as a standardized product, the variety of offerings and its quality and services are still differentiators, which build up the brand. IoT is considered as one of the means to further build the brand by providing outstanding products and services to the customers. Nonetheless, taking the previously mentioned plans for the business models into account, one has to be aware of being a first-mover concerning differentiation towards becoming a service or solution provider for the industry. The main problem for developing such business plans and for repositioning the company in the industry is the risk of creating a skills gap between the workforce of the company but also of their clients and the IoT technology. In the specific example of the company, construction and building processes are still labor intensive, having created an own culture in which routine and personalized cycles are internalized. Here, motivating clients to digitize its ecosystem and giving technology more responsibility will create disagreements and impede the implementation process. In sum, the company has recognized the potential of using IoT implementation, specifically concerning the optimization of processes and the cost-reduction within its manufacturing. The linkages towards other technologies like AI and its role within the broad topic ‘Digitization’ is the current task of the company. Over the last years, IoT’s potential has become apparent, so that the company now breaks it down into various areas to focus more strategically yon actionable initiatives. Moreover, besides motivational factors such as increased revenue and data collection, downsides such as reshaping internal cultures, high investment costs and creating the required knowledge base need to be given proper attention and requires clear communication. Digitalization is happening everywhere in the company’s ecosystem and the company cannot afford to not take part in this trend. The findings and statements for each factor are summarized in Table C.2 (*Appendix C*), depicting the interviewee's opinion about the factor's relevance to the research framework.

4.3 Findings: Interview 3

To further examine factors influencing the IoT technology implementation and the technology’s strategic role within the trending topic of digitization, the discussion was held with the Senior Advisor for Digital Transformation at the consulting company ‘Roland Berger’. Having gained insights into varies industries and business models, he points out that IoT technology cannot be treated in isolation and has to be considered as one key driver in the creation of a digitized ecosystem for the Industry 4.0. A company has to strive for developing an underlying infrastructure addressing the implementation of IoT technology and facilitating its compatibility with other technologies within the company. However, he points out that companies often face the problem of high costs for arranging such an infrastructure. Moreover, restructuring internal processes and internalizing the spirit to innovate processes often gets constricted by the company's deepened culture and the managers' lack in realizing the need for digitizing the business for staying competitive. This goes along with the problem of existing skill gaps, occurring due to

employees' limited experience with innovative technologies. However, the participant emphasizes that it is inevitable for managers to include IoT technologies into their strategic decision-making process when intending to reach the full potential of digitizing their businesses. From his point of view, industry structures will get reshaped due to technologies such as IoT, since companies will discover new scopes of opportunities for expanding their product and service portfolios. And this should also be the central motivation for a company to place digitization and technologies such as IoT as a key pillar in its future strategy plans, according to the interviewee. Besides benefits such as increased revenues, cost savings, optimized processes or improved client identification due to BigData, the key motivation should be the chance to reinvent one's business model to reach new markets and to broaden the client portfolio. The need and motivation for addressing the use of IoT technology and the overall digital transformation get also influenced by the increasing industry pressure. On the one hand, competitors investing in digitization will increase the value of their products and services and will gain an advantage in marketing this value to potential clients, due to vast amounts of collected data and, consequently, a better identification of the clients' needs. On the other hand, companies within a company's supply chain digitizing its business models can become a danger. By expanding its capabilities and business processes, such companies can adopt new tasks within the industry, making the role of companies, sticking to their usual business model, obsolete. Referring to the UTAUT model, the interviewee clearly states, that industry pressures and the vast potential of IoT technology and other correlated digital trends should outbalance a company's concerns about high costs, cultural changes, and data privacy issues.

The findings and statements for each factor are summarized in Table C.3 (*Appendix C*), depicting the interviewee's opinion about the factor's relevance to the research framework.

5. CONCLUSION AND DISCUSSION

5.1 Key Findings

Based on the conducted research, one can state that factors motivating a manager to implement IoT technology clearly surpass the impeding factors, that appear to be critical concerning the implementation. The analysis, however, emphasizes that besides these two categories, factors need to be categorized in total into the three groups '*Motivating*', '*Driving*' and '*Impeding*'.

5.1.1 Motivating Factors

For this research, motivating factors are defined as factors that contain clear benefits for the company and positively support a manager when deciding about the implementation of IoT technology. The most relevant motivating factors include the process optimization, resulting in cost savings, due to reductions in production waste and process timing. Improved forecasting and planning due to Big Data collection are additional factors supporting the motivation to implement. Furthermore, new opportunities in the company's value chain expansion are crucial to a manager's motivation. Since the use of IoT technology enables a company to add more value to its products and services, and to adopt new roles within the industry. Business operations can be expanded, increasing the likelihood of strengthening the brand awareness and gaining additional market share. The redefinition and possible expansion of its own business model and possible benefits like higher profits that go along with that change are key factors motivating a manager to support the implementation of IoT technology.

5.1.2 Driving Factors

When talking about driving factors, external pressure from outside the company or global trends on which the company does not have direct influence is meant. Concerning the relevant factors that drive a company to the implementing IoT technology, one has to mention the overall trend towards digitization. As a consequence of an overall digitized ecosystem surrounding a company, managers have to be aware of shifting boundaries within the company's industry. Not only can competitors outperform a company that does not participate in the digitization trend by benefiting from motivating factors such as process optimization or cost saving, but also can the number of competitors increase, due to companies adding new products or services to their portfolio as a result of IoT use. Therefore, competitive pressure is a key driver. However, also the pressure within a company's supply chain drives a manager towards taking IoT technology into consideration. Suppliers making use of IoT will experience the opportunities to integrate forward and to adopt services to their business model. The company would then be outperformed by these suppliers, letting their own business to appear irrelevant.

5.1.3 Impeding Factors

Impeding factors are those that contain a lot of risk or drawbacks for a company and, consequently, are expected to negatively influence a manager's decision-making process for implementing IoT technology. Especially small- or medium-size companies often face the problem of high costs when planning to implement IoT technology. Investing in IoT does not only mean to acquire the required sensor-technology but also to invest in the technology infrastructure of the whole company to secure the most efficient way of using IoT technology. Additionally, implementing a disruptive technology like IoT bears the risk of creating dissonance between the workforce, negatively affecting the company's underlying culture. As the research outlines, cultures within companies that operate in labor-intensive industries, such as the construction materials one, arose over many decades, having formed well-rehearsed processes and conceptions of how the work has to be done. Interaction with machinery and especially the right interpretation of real-time collected data can, therefore, lead to irritations and misapprehensions in the overall work process. Based on that, an additional impeding factor is, therefore, the created skills gap. Offering training, workshops and continuing education to the employees needs to be taken into account by a manager when intending to implement IoT technology. As a consequence, higher investments in the employees' apprenticeships are necessary and sufficient time needs to be given to the workforce for getting familiar with the new operational procedures.

5.2 Research Conceptualization

In addition to the factors that are core to the research, the findings from the interviews depict that these factors cannot determine the UTAUT's final variable 'Use Behavior of IoT-Technology' completely. A central finding of this research is that the motivation towards using IoT technology cannot be treated in isolation and gets affected by other dynamics inside and outside the company while affecting other strategic decision processes within the company. Therefore, based on the research's findings, the model shown in Figure 4 got developed, converging the identified factors influencing a company's motivation to implement IoT technology as a strategic tool into the company's strategy towards digitization. As can be seen, besides the initial UTAUT model and its identified factors, additional significant sources of influence surrounding a company complete the developed model, which got added

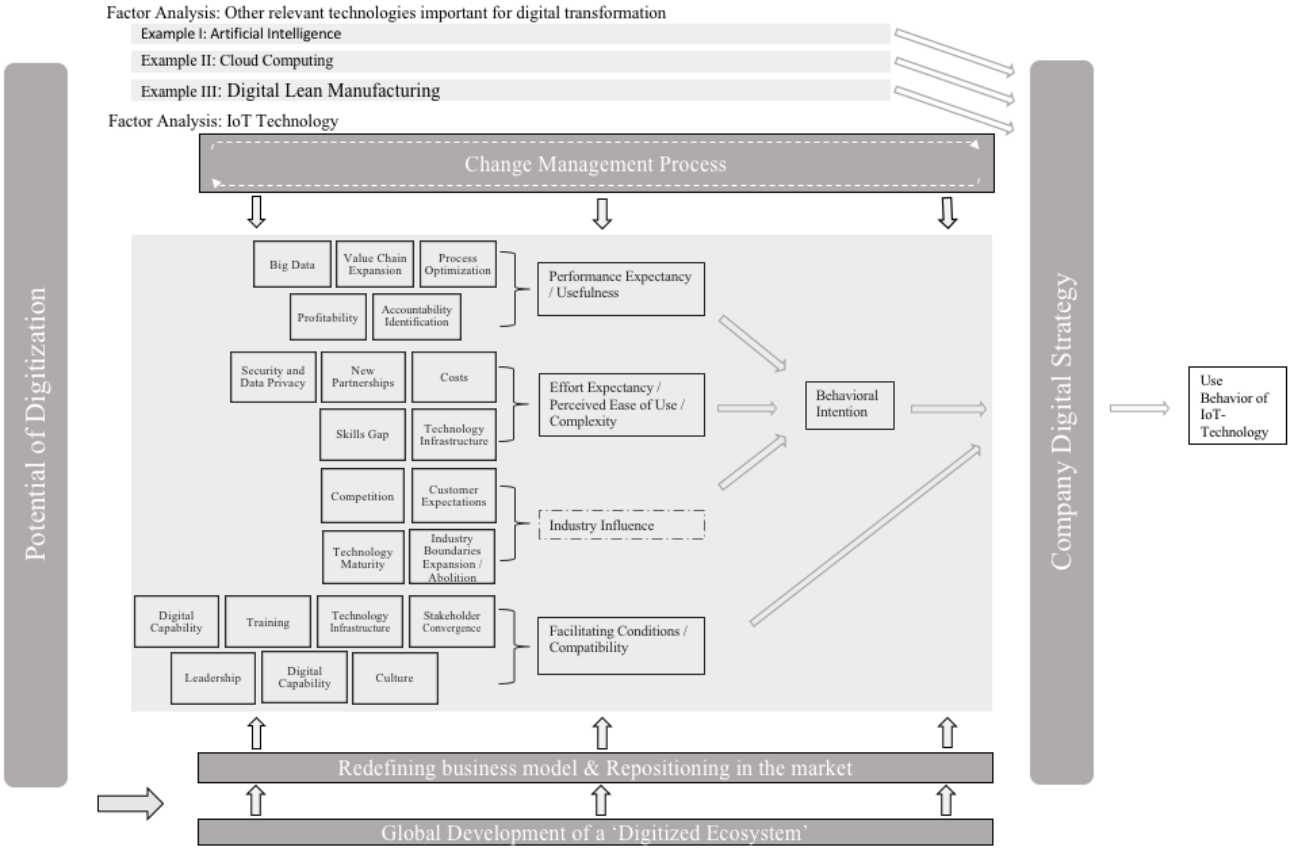

Fig.4: Conceptualized IoT-UTAUT Model

based on the research participants' assessment concerning the implementation of IoT technology.

The main driver towards implementing IoT technology is the overall potential of digitization. Over the last decades, Cloud Computing and Applications have optimized and facilitated internal processes and Data Analysis Software has enabled companies to track their actions and to improve forecasting and market analysis. Due to that and the ongoing development of new technological devices such as IoT, companies strive for reaching the full potential of the digital transformation to increase the business performance. In addition to that, leading companies and governmental institutions strive for creating a digitized ecosystem for industries and the society. Companies feel the pressure of taking part in this alteration.

The research points out, that this change motivates companies to include innovative technologies such as IoT, due to new opportunities for expanding business operations with new partnerships within the industry and creating new sources of revenue. As a result of this overall digitization trend, companies strive for a transformation of their business models. This motivation gets not only pushed by new opportunities of expanding the business, but also by the fear of losing market share or even its existence, since industry boundaries will be redefined, and new competitors will enter the market. Implementing a technology like IoT creates new possibilities for gaining market share since new products or services can be added to the company's portfolio, or existing ones can get optimized and personalized in the interest of potential clients or customers. When concerning the decision-making process for implementing IoT technology, Figure 4 depicts the previously identified factors of the UTAUT model crucial to the process. It shows that IoT is a key pillar in a company's strategic digitization plan and is promised to have the potential to make a company's operations more efficient and profitable over the long-run. However, to unfold the full potential of the company's digital strategy, additional coexisting and compatible technologies such as AI needs to be involved into the implementation plans, since the use of IoT technology cannot be treated in isolation. Another finding shown in the model is the importance of the change management process. During the three interviews, the importance to lead the change and to transform the theory about IoT to practical use was stated to highly influence the motivation of further implementing the technology. The constantly ongoing process of making decisions about change can also influence the weighting of factors since the success of the change management process affects the ease of technology use and its complexity and compatibility with other technologies.

Based on the evaluation of all these relevant factors, the company's digital strategy gets developed. It includes trade-offs between important factors and considers not only the relevance of one specific technology but contains the interactions of the overall technology infrastructure and other technologies besides IoT, supporting the digitization process.

The final use behavior, therefore, can only be evaluated when all influencing factors of all technologies relevant to the overall digital strategy got identified and their importance evaluated. As mentioned before, IoT is not a stand-alone technology, and the final use behavior gets affected by the scope and possibilities ofusing complementing technologies.

5.3 Academic & Business Relevance

For academic purposes, this research presents a foundation to further explore the relevant factors influencing the IoT implementation. It gives an overview of crucial factors, discussed and evaluated from three different perspectives and highlights the technology's relevance for each them. Based on

the developed model, researcher learn more about the interconnectivity of various factors and the dynamics surrounding a manager during his or her decision-making process, when acting in the best interest of the company. It depicts a guideline for further researcher and supports the goal of understanding the final use behavior of IoT-technology.
Even though the analysis was conducted by qualitative research methods, businesses gain insights into the complexity of the IoT implementation. It emphasizes that not only the technological requirements have to be fulfilled, but that also underlying structures such as the company's culture need to be investigated when developing the implementation plan. More specifically, this research points out that the overall implementation process is time consuming and that benefits for the company cannot be expected directly. The developed model serves managers as a map for constantly reevaluating the relevant factors and dynamics to optimize the implementation process.

5.4 Research Limitations

The conducted research is qualitative and based on a literature review about potential factors motivation or impeding a company to implement IoT-technology. Following such a research design contains the downside, that no correlation between the findings can be proven. By choosing interviews as sources of primary data collection, the subjective opinions and attitudes of the respondents towards the topic get integrated into the creation of the findings. Due to that, one has to be aware of the fact, that these findings cannot be generalized. Furthermore, the conducted research investigates the IoT implementation of only one example company. Having such a limited sample size leads to further problems in generalizing the findings. In addition to that, the research solely analysis a small fragment of the Germany manufacturing industry in the B2B market. Benchmark cases and interviews with other companies from varies industries could have brought a more complete picture of the topic of IoT and its relevance for a company's strategy.

5.5 Future Outlook

Future research investigating digital transformation will benefit from first experiences made by companies in this field. The current uncertainty about IoT and the need for finding a central definition for this technology makes it still difficult for managers and experts to create an opinion about this topic and to discuss the full potential of it. When enough data about IoT technology use in different industries is collected, the future researcher can expand this research and create a quantitative approach for understanding the strength of and the correlations between the identified factors. It is of high importance to create quantitative results, showing how these factors are affecting the strategic development in different business models and industries, to further understand the broad picture of IoT. When more certainty about the technology and its consequences are collected, the conducted research can be expanded by including quotative research approaches, such as surveys, for depicting the correlation between the various factors. Moreover, a wider sample size should be selected. On the one hand, this will be necessary for understanding the factors' importance for different business models and industries. Here, additional knowledge would be gained about the suitability of IoT for various company forms and its importance in different industries in the near future. On the other hand, the company sample should include more companies from different nations. Since digitization is already a central topic in a few countries, while other nations still evaluate its potential, the importance of the analyzed factors can be further oriented towards the IoT readiness of a company and its ecosystem.

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Appendix

Appendix A

Table A.1 – External Factor Description

External Factor	*Definition*	*Description*	*Sources*
Big Data	IoT-devices constantly collect and send out data, creating many databanks for further analysis.	Data offers the company an overview about processes and performances within the company. Big amounts of such data need to be handled adequately, to receive the full potential out of it.	Bauer et al., 2014, Infso, D. G., 2008, Jernigan et al., 2016
Process Optimization	Within a company, multiple departments and layers of authority are involved in the process of everyday work and production.	IoT-Technology, characterized by the connection of objects via internet can lead to a faster communication and optimization of processes due to constant data exchange.	Porter & Heppelmann, 2015, Evans, 2011, Leminem et al., 2012
Value Chain Expansion	Integrating a new technology can add value to products and/or services.	IoT-devices can optimize a product's features and enable new possibility of adding value to it.	Jernigan et al., 2016, Evans, 2011, Leminem et al., 2012
Profitability	Companies search for new ways of creating profit and making the company performance more profitable.	IoT-Technology contains a huge potential for future operations, from which new opportunities for increasing revenue or cutting costs result.	Bauer et al., 2014, Infso, D. G., 2008, Jernigan et al., 2016, Jia et al., 2011

A.1.1. Performance Expectancy / Usefulness

External Factor	*Definition*	*Description*	*Sources*
Security and Data Privacy	The required security framework, the company needs to create for keeping organizational operations safe from cyber-attacks.	Digitizing a company always bears the danger of making the company too transparent, offering hackers the chance to gain access to private data.	Low et al., 2011, Mahmoud et al., 2015
Skills Gap	Skill Gap occurring due to fast changing technology setups and untrained workforce.	Implementing Technology and specifically IoT requires workforce to constantly gain new knowledge and an understanding of the right use.	Berger & Frey, 2016
New Partnerships	New partnerships necessary for successfully using the full scope of IoT-Technology.	Implementing a new technology requires to expand the value chain of the company, including i.e. new suppliers of components or maintenance services.	Low et al., 2011, Leminem et al., 2012
Technology Infrastructure	To implement a new technology, the readiness to integrate it needs to be identified on multiple levels, including hardware, middleware and software appliances within the company.	Without compatible technologies and surrounding systems for using the implemented technology, the full potential of that technology cannot be recieved by the company.	Low et al., 2011, Fleisch et al., 2009

A.1.2. Effort Expectancy / Perceived Ease of Use / Complexity

External Factor	*Definition*	*Description*	*Sources*
Competition	Market competitors in the industry making use of IoT-Technology.	Competition is an ongoing process, in which it is essential to have the necessary resources and strategy for being successful.	Porter & Heppelmann, 2014, Evans, 2011
Customer Expectations	Pressure from customers, expecting service or product quality to improve parallelly to the increasing technology opportunities for companies.	Customers always want to receive the best product or service available. IoT-Technology offers companies to optimize processes and products/services. Being aware of new opportunities in optimization due to IoT is essential for serving customers with the best solution.	Jernigan et al., 2016
Technology Maturity	The predicted timespan in which a technology operates most efficiently, giving a point in time, at which the technology may be outdated.	Technology gets updated and optimized constantly and rapidly. Understanding the timespan for a technology is essential for a company to stay efficient.	Schuh et al., 2017
Industry Boundaries Expansion/ Abolition	IoT-Technology offers companies the chance to redefine their role in the industry and supply chain structures. As a result, forward and backward integration in the supply chain can occur.	By using IoT-Technology, a company can gain more information about the environment in which it operates. Getting a better understanding and more relevant data enables the company to expand its operations, i.e. manufacturers getting direct information from consumers to optimize production, making the role of retailers with direct contact to consumers dispensable.	Bauer et al., 2014, Infso, D. G., 2008, Jernigan et al., 2016 Porter & Heppelmann, 2015

A.1.3. Industrial Influence

External Factor	*Definition*	*Description*	*Sources*
Costs	Costs associated with setting up or expanding the IoT-infrastructure.	Besides hardware (e.g. sensors, devices), also soft- and middleware are costly requirements to arrange.	Tedeschi et al., 2018
Company Culture	Internal commitment and willingness for change.	The adoption of a new technology needs an underlying culture, showing openness to innovate and change.	Mytelka, 2000
Digital Capability	Existing technology such as information systems need to be checked for capability to secure a smooth implementation.	To make sufficient use of IoT, technological setups within the whole company need to be compatible to benefit from the data creation and analysis.	Schuh et al., 2017, Jia et al., 2011
Leadership	The required leadership style, to prepare the company for and guide the company through the technology integration.	Changes in company processes and structure requires managers to adapt their managing style to these changes. Concerning technology, this requires the creation of a fundamental knowledge basis within the company, to successfully use it, and to efficiently use its outputs (in case of IoT, data).	Porter & Heppelmann, 2014, Evans, 2011, Porter & Heppelmann, 2015
Training	Employees need to receive training to gain new knowledge about the introduced technology and how to integrate it into work processes.	Introducing a new technology bears the risk of creating a gap between the new opportunities offers by the technology and the employees' skills	Jernigan et al., 2016, Porter & Heppelmann, 2015

		and knowledge about the right handling.	
Stakeholder Convergence	A company's need to be aware of all stakeholders affected by the IoT-Technology implementation or development.	IoT-Technology can, for example, lead to changes in work flows, data analytics and communication streams. Therefore, it is of high importance to identify all stakeholders and significant consequences for them.	Low et al., 2011

A.1.4. Facilitating Conditions / Compatibility

Appendix B

B.1 – Interview Questions – Interview 2

Introduction

- What is the company's central business model and what is the specific task of your department?
- How familiar are you with the topic ‚Internet of Things'? What is your definition of that technology?
- Do you recognize a trend towards digitization within your industry or especially towards IoT-technology?

Round 1: What is the level of engagement of the IoT as strategic tool for today's businesses?

- How much are you discussing that technology within the company?
- In which business departments do you already see the use of IoT-technology?
- In what ways is the company making use of the technology?
- What are complementing technologies you are already using? As an example of the literature, cloud-computing for processing data. Or are there any other technologies, you are already using for machine-2-machine communication and data processing?
- What role does IoT-technology play when developing short- to medium-term strategies for reaching the company's goal?
- What role does the technology-infrastructure play in general when developing a strategy?
- Does the use of IoT or IoT related technology play a central role for reaching the determined goals?
- What problems have you had dealt with when implementing IoT technology or IoT related technology?
- How much influence does the topic IoT has on developing a strategy? Does it constrain the usual considerations?
- What changes do you expect to happen within the company as consequence of further implementing IoT-technology?
- What trends to you recognize within your industry, that could have an influence on your motivation towards implementing IoT?

Round 2: What do businesses expect from IoT to bring in the near future?

What are key factors influencing a company's motivation to adopt IoT?

- What was the company's initial motivation to implement IoT technology into the business processes of the company?
- What potential do you realize in IoT or generally in the trend towards digitization?
- What are business domains, in which you would say, IoT will revolutionize the work processes?
- Does IoT has the potential, to optimize entire processes that positively influence the overall performance in the long-run?

(**Followed by open discussion about the identified factors of 'Performance Expectancy'**)

- How does the company handle the technology's complexity? Are there any impeding factors that already hindered the company to further implement IoT?

(Followed by open discussion about the identified factors of 'Effort Expectancy')

- Are there any driving factors in the industry, which motivates or forces you to deal with the topic IoT**?**
- Does IoT has the potential, to reshape this industry**?**

(Followed by open discussion about the identified factors of 'Industrial Influence').

- What are other relevant technologies that support the use of IoT?
- What has to be changed within the company to successfully implement and use IoT technology?

(Followed by open discussion about the identified factors of 'Facilitating Conditions/Compatibility')

Appendix C

Table C.1 – Findings Interview 1

Variables	*Factors*	*Statement*	*Interviewee's Opinion About Relevance for Framework*
Performance Expectancy			
	Big Data	Collecting new and specific data about processes and the work flow enables a company to learn more about the interconnectivity between departments and steps within these processes. It enables a more efficient resource allocation and forecasting methods. This factor was mentioned as the most important one, since Big Data offers new opportunities in increasing the company's overall performance to understand internal processes and the importance of single variables influencing the performance in more detail.	***Motivating Factor*** Positively influencing the manager's decision-making process. Key factor affecting the variable 'Performance Expectancy' in the framework.
	Process Optimization	Companies constantly search for ways to optimize their processes. This includes improvements in the efficiency of the resource allocation, but also considers the saving of costs by cutting the amount of wasted materials. Processes can be designed more flexible and the company can react more dynamically to changes of clients' demands, when using IoT for better understanding their needs.	***Motivating Factor*** Positively influencing the manager's decision-making process. Key factor affecting the variable 'Performance Expectancy' in the framework.

	Value Chain Expansion	By collecting more data about the product's or service's features and the customers' demands, IoT clearly adds value to those products or services. They can be personalized and, in advance, can be oriented specifically towards clients' needs and expectations. Moreover, failures in the development process can be identified due to more intensive tracking, so that less misunderstandings occur and new ways of adding value become apparent. It is an important factor to take into account, because new value can differentiate a company's products or services from its competitors, which could lead to a competitive advantage.	***Motivating Factor*** Positively influencing the manager's decision-making process. Key factor affecting the variable 'Performance Expectancy' in the framework.
	Profitability	Gaining a competitive advantage by increasing the products' or services' value and by identifying new ways of cutting costs, an increase a company's profitability can be expected. New revenues can be generated, and new clients can be attracted.	***Motivating Factor*** Positively influencing the manager's decision-making process. An underlying motivation that is relevant for most of the manager's decisions / not specifically only for this research about IoT implementation.
Effort Expectancy			
	Security & Data Privacy	Increasing the use of tracking technology also contains the risk of violating privacy rights. This includes not only the awareness of clients' rights, but also the workforce rights because processes and therefore the workers' performance are tracked. Especially since current laws about privacy issues got intensified in the last years, companies often try to avoid the conflict with these rights. Additionally, collecting more data and storing them in clouds makes the company more transparent and bears the risk of losing private data when getting cyberattacked.	***Impeding Factor*** Gained awareness in the past years due to several data scandals. A central factor in the framework affecting the variable 'Effort Expectancy'.
	Skills Gap	Implementing IoT technology is not done in only one section of the company but gets implemented throughout the whole company to receive the most value out of its use. This entails also the workforce level, on which the use of high-tech devices is not common in most companies. Therefore, a skills gap can occur when untrained workers are in charge of handling these devices. Time has to be spend to train everyone within the company of how to work with this technology and how to most effectively deal with the collected data.	***Impeding Factor*** Difficult to predict and therefore a factor in the framework linked to uncertainty. A key factor to consider when dealing with the variable 'Effort Expectancy'. Has the potential to affect other variables in the framework significantly when poorly treated.
	New Partnerships	Because medium-size companies do not always have the financial resources and the knowledge for implementing the technology by their own, new partnerships with IT specialists or IoT-service specialists get created.	***Driving Factor*** A central factor in the framework representing the wide scope of effects the implementation can has.
	Technology Infrastructure	IoT is not a stand-alone technology. Therefore, compatible technologies need to be identified and arranged. Throughout the whole company, an infrastructure needs to be developed in which the use of IoT is facilitated and the full potential of this technology can be reached. This includes time-consuming research and also costly restructuring plans in the whole company.	***Impeding Factor*** An important factor for the framework because it highlights the effort needed to be spend to create a suitable environment for the technology.
Industrial Influence			

	Competition	Competitors apply pressure when implementing disruptive technologies such as IoT. A company has to be aware of competitors' actions because of the positive effects of such a technology. Value creation or process optimization can lead to a competitive advantage, wherefore a company needs to evaluate whether the implementation of such a technology is also useful for its own processes and for avoiding the case of falling behind the competition.	***Driving Factor*** A constant driver pushing the company towards dealing with IoT. Strong factor for the variable 'Industrial Influence' due to increase global competition.
	Customer Expectations	Personalized products or services became usual over the last decades, due to more data tracked by devices or by improved forecasting methods. Customers, therefore, expect to receive products or services adapted to their specific demands. Using IoT technology offers a company the tools to better understand these demands and to identify specific needs.	***Driving Factor*** Less important factor since most company's address a broad customer base with their products/services. Still crucial for the framework because customers are important stakeholders.
	Technology Maturity	Nowadays, technologies get improved and updated on a regular basis. On the one hand, this drives a company to constantly update its technologies within the company, to create the most effective and efficient workflow. On the other hand, this bears the risk of high costs when trying to keep up with the technological trends and of getting locked-in when becoming too dependent on one technology.	***Driving/Impeding Factor*** Can be driving or impeding, depending on a company's flexibility to change. Crucial to the framework due to increasing relevance of technology and its fast-changing environment.
	Industry Boundaries Expansion / Abolition	IoT technology offers a company the opportunity of expanding its product or service portfolio. Collecting more data about its ecosystem, a company can take over the role of competitors or clients. However, this also means that competitors or even suppliers in the supply chain have the same possibilities when implementing IoT technology. Therefore, these dynamics drive a company to use IoT for reaching new markets share by expanding its business, and to avoid forward and backward integration within its own supply chain.	***Driving Factor*** Emphasized as the most important driving factor with influence on the variable 'Industrial Influence'. Seen as the underlying driver for a company to create a sustainable business model.
Facilitating Conditions			
	Costs	High costs on many domains often demotivate a manager to implement IoT technology. Costs do not only occur when investing in IoT, but also when expanding the technology infrastructure, arranging compatible technologies or offering workshops for the workforce to avoid the skills gap.	***Impeding Factor*** Factor of high relevance since financial resources are not always given. Highly relevant factor for the framework because project financing is a central element of every strategy.
	Company Culture	A company's culture evolves over many decades and work flows and routines got strengthened over these years. Introducing a disruptive technology can lead to discrepancies between workers and management and impedes the successful implementation of a technology.	***Impeding Factor*** Often underestimated factor, but highly relevant. Important factor in the framework because a culture is difficult to change but can determine the success of the implementation.
	Digital Capability	To receive the full potential of IoT and the collected amount of data, a company has to be capable of storing, analyzing and processing such data. This requires investments in	***Impeding Factor*** Important factor of the variable 'Facilitating Conditions',

		processing and ERP software.	because IoT is not a stand-alone technology. Key factor in the framework that determines how much use the company can get from the implementation.
	Leadership	To enable a smooth implementation, managers need to be trained for communicating the technology's relevance to the workforce and to keep up the motivation for handling it. Failures in the right leadership result in unmotivated employees and prodigality of the technology's potential.	***Impeding Factor*** Often underestimated factor, but highly relevant. Can affect other factors in the framework when wrong leadership style is chosen or the right one is poorly performed.
	Training	Time and money needs to be spent for creating a shared knowledge about the technology. Especially the time needed for offering trainings or workshops and required by workers to implement the handling of the technology is a factor that is often underestimated by managers.	***Impeding Factor*** Often underestimated factor, but highly relevant. Can affect other factors in the framework when wrong training is chosen or the right one is poorly performed.
	Stakeholder Convergence	Implementing IoT technology requires to involve everyone affected by this change into the decision-making process. Managers not supporting the implementation or employees refusing the use of it in their everyday work can create problems, which costs time and slow down the company's business. It is mentioned of being an important impeding factor, often creating confusion and disaccords between the involved parties.	***Impeding Factor*** Gets evaluated as one of the most important factors in the framework. Without the support of the involved stakeholders, the implementation cannot be executed.
***Additional Findings**:* Important to highlight the fact that IoT is not a stand-alone technology. Instead of solely focusing on that technology and its features, a manager should try to identify the company's environment that transforms towards a digital ecosystem and that interacts with the technology. Based on that, complementary technologies need to be arranged, interacting with IoT and addressing the external overall trend towards digitization.			

Table C.2 – Findings Interview 2

Variables	*Factors*	*Statement*	*Interviewee's Opinion About Relevance for Framework*
Performance Expectancy			
	Big Data	New data enables the company to know more about its own performance and, more importantly, to identify changes in its ecosystem more rapidly and to realize demands more quickly.	***Motivating Factor*** Positively influencing the manager's decision-making process Key factor affecting the variable 'Performance Expectancy'
	Process Optimization	The company already makes use of sensor-	***Motivating Factor***

		technology in its production. By expanding the use of IoT technology towards its clients' actions, collected data can be linked to the production processes, making interconnected processes more efficient and complementary. Due to a better evaluation of processes and resource allocations, costs are reduced, and time is saved.	Positively influencing the manager's decision-making process. Key factor affecting the variable 'Performance Expectancy' in the framework.
	Value Chain Expansion	The company sees the potential of exploring new ways of adding value to its products and services on the basis of collected data. Processes can be oriented more personalized towards its clients' needs, creating individual value for each one.	***Motivating Factor*** Positively influencing the manager's decision-making process. Key factor affecting the variable 'Performance Expectancy' in the framework.
	Profitability	The participant's states that profitability is the underlying motivation of the IoT implementation. Over the long run, the business model should be oriented towards the use of the technology, enabling new sources of revenue by becoming more attractive to potential clients and by cutting costs.	***Motivating Factor*** Positively influencing the manager's decision-making process. An underlying motivation that is relevant for most of the manager's decisions / not specifically only for this research about IoT implementation.
Effort Expectancy			
	Security & Data Privacy	Even though the company mentioned multiple motivating factors, it also highlights that security & data privacy are very time-consuming topics. A lot of research has to be done for avoiding the fraud of violating privacy regulations. The cooperation with existing and new suppliers or clients became difficult and requires a lot of effort when creating contracts.	***Impeding Factor*** Gained awareness in the past years due to several data scandals. A central factor in the framework affecting the variable 'Effort Expectancy'.
	Skills Gap	As a manufacturing company, the problem of a potential skills gap is high. Many processes within the company and of their clients require mechanical skills and the current dependence on technology on the workforce level is low. A lot of effort needs to be spent on making workers familiar with the technology and problems may occur when dealing with the right interpretation of the collected data.	***Impeding Factor*** Difficult to predict and therefore a factor in the framework linked to uncertainty. A key factor to consider when dealing with the variable 'Effort Expectancy'. Has the potential to affect other variables in the framework significantly when poorly treated.
	New Partnerships	The company states that the collaboration with new partners like IT specialists contains many impeding factors. The dependence on such services is often a crucial topic and it is problematic to evaluate how much influence on and insights the partner gets into internal data.	***Driving Factor*** A central factor in the framework representing the wide scope of effects the implementation can has.
	Technology Infrastructure	While sensor-technology is already used in the manufacturing departments, the connectivity to other technologies is not given. Implementing IoT, therefore, is seen as a complicated topic, since various layers within the company but also from the client side first need to develop a foundation for the implementation.	***Impeding Factor*** An important factor for the framework because it highlights the effort needed to be spend to create a suitable environment for the technology.
Industrial Influence			

	Competition	The company does not experience any pressure by its competition. That's due to the fact, that the production of cement does not really differ among the production companies. However, concerning the competitive advantage over the long-run, the company can imagine that companies using IoT technology can cut costs and optimize processes, leading to the outperformance of less innovative companies within the industry.	***Driving Factor*** A constant driver pushing the company towards dealing with IoT. Strong factor for the variable 'Industrial Influence' due to increase global competition.
	Customer Expectations	Customer expectations do not differ over the years since cement is a commodity product and its composition does not vary significantly. However, customers expect to receive the best product and service and a perfect cooperation. IoT technology can therefore support the personal treatment of each client and the company can identify way of standing out of the competition.	***Driving Factor*** Less important factor since most company's address a broad customer base with their products/services. Still crucial for the framework because customers are important stakeholders.
	Technology Maturity	The company does not experience the risk of getting locked in when concerning the maturity of a technology. This is due to the fact that the overall production will not depend on IoT technology.	***Driving/Impeding Factor*** Can be driving or impeding, depending on a company's flexibility to change. Crucial to the framework due to increasing relevance of technology and its fast-changing environment.
	Industry Boundaries Expansion / Abolition	This factor is the most motivating one for the company. While being a product and service provider in the manufacturing industry, the company clearly sees the opportunity for becoming a solution provider for their clients. This includes offering products and services entailing IoT technology, like faster tracking of cement drying and, consequently, making processes of clients more efficient and effective. The company strives for redefining its business model, becoming an expert for IoT in its industry, taking over the job of IoT consultants focusing on building lots.	***Driving Factor*** Emphasized as the most important driving factor with influence on the variable 'Industrial Influence'. Seen as the underlying driver for a company to create a sustainable business model.
Facilitating Conditions			
	Costs	Being one of the leading companies in its industry, the company does not face the problem of lacking in financial resources for supporting the implementation. However, the company states that high costs are expected and a separate project budget for IoT will be required.	***Impeding Factor*** Factor of high relevance since financial resources are not always given. Highly relevant factor for the framework because project financing is a central element of every strategy.
	Company Culture	A high risk is identified when dealing with the company's culture and the overall use of technology within the industry. Close cooperation with smaller construction companies bear the risk that the use of technology can be declined in some cases, since the construction industry characterized by highly skilled manual jobs.	***Impeding Factor*** Often underestimated factor, but highly relevant. Important factor in the framework because a culture is difficult to change but can determine the success of the implementation.
	Digital Capability	To effectively use IoT technology, the company sees still a need for expanding supporting software throughout the company. To store and process the created data, compatible technology needs to be	***Impeding Factor*** Important factor of the variable 'Facilitating Conditions', because

		implemented in various layers within the company. Here, time consuming evaluations and analysis are expected.	IoT is not a stand-alone technology. Key factor in the framework that determines how much use the company can get from the implementation.
	Leadership	The company is aware of the need for the right leadership. As a consequence, the position as 'Chief Digital Officer' got created for developing an overall digitization plan, consisting also of requirements of the right leadership style.	***Impeding Factor*** Often underestimated factor, but highly relevant. Can affect other factors in the framework when wrong leadership style is chosen or the right one is poorly performed
	Training	Training and workshops need to be offered to the workforce, but also to management levels. It is seen as time consuming and it is expected that by gaining experience in the use of IoT technology, the right training methods will evolve over time and cannot be perfectly offered directly at the beginning.	***Impeding Factor*** Often underestimated factor, but highly relevant. Can affect other factors in the framework when wrong training is chosen or the right one is poorly performed.
	Stakeholder Convergence	This factor is seen as one of the most critical ones. It is of high importance to convince everyone involved in and affected by the IoT implementation in the planning process. Furthermore, the company has to be aware of the workforce's opinion and potential disaffirmation of some departments.	***Impeding Factor*** Gets evaluated as one of the most important factors in the framework. Without the support of the involved stakeholders, the implementation cannot be executed.

***Additional Findings**:*

An important process that need to be taken into account when striving for the implementation of IoT technology, is the change management process. Closely connected to the factor 'Leadership', this process needs to be elaborated in detail to address every change in the company sufficiently and to constantly evaluate the importance and feasibility of each factor.

Table C.3 – Findings Interview 3

Variables	*Factors*	*Statement*	*Interviewee's Opinion About Relevance for Framework*
Performance Expectancy			
	Big Data	Big Data will be the key for a company's success in the future. Having collected a big amount of data banks enables a company to analyze its processes and environment and to lay out its strategy more suitable to the industry's development. IoT will be one central technology to collect these data and specifically to understand the interconnectivity of actions.	***Motivating Factor*** Positively influencing the manager's decision-making process Key factor affecting the variable 'Performance Expectancy' in the framework.
	Process Optimization	IoT makes processes more transparent and supports a company in identifying bottlenecks in the process or poorly allocated resources. The technology will make such processes more efficient by emphasizing these problems and by offering data that can be used to evaluate new opportunities for solving these situations.	***Motivating Factor*** Positively influencing the manager's decision-making process. Key factor affecting the variable 'Performance Expectancy' in the framework.
	Value Chain Expansion	Collecting more data contains the creation of new opportunities to add value to products or services. Data about materials, manufacturing or composition gives new	***Motivating Factor*** Positively influencing the manager's decision-making process.

		insights into the current product's features and supports the research about alternative materials or designs that could increase its value.	Key factor affecting the variable 'Performance Expectancy' in the framework.
	Profitability	The overall motivation for a company should be IoT technology's potential of making the business model more profitable. Improvements such as cutting costs and allocating processes more time efficient will save money, while the collected data can also create new revenue streams when business models are redefined and adapted to industry changes.	***Motivating Factor*** Positively influencing the manager's decision-making process. An underlying motivation that is relevant for most of the manager's decisions / not specifically only for this research about IoT implementation.
Effort Expectancy			
	Security & Data Privacy	Making internal operations dependent on technology that uses the internet for communication makes a company more transparent and bears the risk of becoming a victim of cyber-attacks. Especially when most of the collected data is than stored in clouds or shared databanks with third parties.	***Impeding Factor*** Gained awareness in the past years due to several data scandals. A central factor in the framework affecting the variable 'Effort Expectancy'.
	Skills Gap	Human interaction is reaching a new level when implementing IoT technology. While the workforce had to work *with* the machinery until now, sensor-devices are more dictating the work by giving real-time updates. This can easily create problems in the right interpretation of the collected data, resulting in misunderstandings throughout the process.	***Impeding Factor*** Difficult to predict and therefore a factor in the framework linked to uncertainty A key factor to consider when dealing with the variable 'Effort Expectancy' Has the potential to affect other variables in the framework significantly when poorly treated
	New Partnerships	To become an expert for the use of IoT-technology, new partnerships with IT-solution-providers needs to be created. When reaching a secure handling with the technology, new partnerships with potential customers also searching for advice in that field can be created. IoT contains an enormous potential for expanding the company's business and its partnerships.	***Driving Factor*** A central factor in the framework representing the wide scope of effects the implementation can has.
	Technology Infrastructure	IoT is not a stand-alone technology. Supporting software as well as compatible technologies are required to implement the technology and to process the collected data most efficiently. Throughout the whole company, therefore, an infrastructure is required for understanding the technology and for executing the right handling with it. That can be costly and time consuming, since benefits from that technology are expected to be seen after three to four years.	***Impeding Factor*** An important factor for the framework because it highlights the effort needed to be spend to create a suitable environment for the technology.
Industrial Influence			
	Competition	Competition drives a company to constantly search for ways to improve. Research about IoT technology has revealed its potential and that a lot of future projects get built on that technology. Competitors that make use of that technology can quickly react to industrial changes and become more attractive for corporations in which compatible companies using IoT are necessary. Therefore, pressure by competitors clearly drives a manager's decision-making process when elaborating about IoT.	***Driving Factor*** A constant driver pushing the company towards dealing with IoT. Strong factor for the variable 'Industrial Influence' due to increase global competition.
	Customer Expectations	IoT allows to track a company's or individual's actions in real-time, collecting more personal data about it. Customers or clients are aware of that and expect a	***Driving Factor*** Less important factor since most

		company to include individual demand into product or service offerings.	company's address a broad customer base with their products/services Still crucial for the framework because customers are important stakeholders
	Technology Maturity	For small- to medium-size companies, it is definitely a high financial risk when heavily investing in one specific technology. However, investing in technology and digitizing the company's business is essential nowadays and taking the risk appears to be with it when having a look onto the promised potential of technology like IoT.	***Driving/Impeding Factor*** Difficult for the company to term it driving or impeding factor in the framework Stated to be critical to smaller companies and strongly affecting the variable. Also driving factor for companies with enough resources that constantly search for improvements.
	Industry Boundaries Expansion / Abolition	IoT technology will be the key for future success. Such technologies will reshape a company's business model and allows a company to strive for expanding its business operations and product or service portfolio. Moreover, this factor clearly drives a manager when making the decision, because the risk of losing market share due to competitors' changes in their business models is a thread to the company. A company has to ask itself, whether its current business is sustainable or whether IoT technology make the actual business dispensable.	***Driving Factor*** Emphasized as the most important driving factor with influence on the variable 'Industrial Influence'. Seen as the underlying driver for a company to create a sustainable business model. Emphasized as the most important driving factor with influence on the variable 'Industrial Influence' Seen as the underlying driver for a company to create a sustainable business model
Facilitating Conditions			
	Costs	High costs occur on various levels within the company. Accepting the implementation of IoT entails also the investment into a capable technology infrastructure, the training of employees and the upgrading of objects that should be part of the interconnected network of communicating devices.	***Impeding Factor*** Factor of high relevance since financial resources are not always given. Highly relevant factor for the framework because project financing is a central element of every strategy.
	Company Culture	This factor is one of the most critical ones. It is difficult to assess a company's culture and to define it. Therefore, it is always complicated to identify the consequences of the technology implementation on the culture. However, the culture is the underlying driver within the company, motivating the employees and creating commitment to the company's business.	***Impeding Factor*** Often underestimated factor, but highly relevant. Important factor in the framework because a culture is difficult to change but can determine the success of the implementation.
	Digital Capability	When using IoT, a company has to be able to store the massive amounts of data and to effectively process the gained knowledge from it.	***Impeding Factor*** Important factor of the variable 'Facilitating Conditions', because IoT is not a stand-alone technology. Key factor in the framework that determines how much use the company can get from the implementation.

Leadership	Problems in communicating the intention of the implementation and failures in motivating the workforce to include the technology into the everyday work can make the implemented technology useless. Employees that do not see the need for using the technology or do not understand the benefits of using it can be problematic when striving for the technology's full potential.	***Impeding Factor*** Often underestimated factor, but highly relevant. Can affect other factors in the framework when wrong leadership style is chosen or the right one is poorly performed
Training	Offering possibilities to get familiar with the technology, such as trainings or workshops, is essential for the implementation process. However, this is very time consuming and the learning curve can differ between the employees. It is always a high risk for the company, because offering these possibilities does not automatically mean, that everyone directly understands his or her new task and the perfect handling of the technology. It could result in constantly existing skills gap and overall drop in the employee's performance. Therefore, time and enough budget has to be spent, which is not always given in every company.	***Impeding Factor*** Often underestimated factor, but highly relevant. Can affect other factors in the framework when wrong training is chosen or the right one is poorly performed.
Stakeholder Convergence	To bring a project from theory to praxis, everyone in the implementation process needs to support the idea. It is therefore crucial to convince all affected stakeholder. This can be very time consuming and requires a well elaborated plan of action. Sometimes, it takes years for having all relevant factors together for completing the action plan.	***Impeding Factor*** Gets evaluated as one of the most important factors in the framework. Without the support of the involved stakeholders, the implementation cannot be executed.

Additional Findings*:*

It is still difficult to give a clear definition of the term IoT. The potential for the future is only slightly known and with technological improvements, it will constantly increase. However, therefore an enormous amount of uncertainty is also brought by that technology, since the clear development is not identified.