Analysis of DevOps as a Performance Facilitator of Technology Enterprises in the Insurance Sector

Masterarbeit

Zur Erlangung des akademischen Grades „Master of Science (M.Sc.)" im Studiengang Wirtschaftswissenschaft der Wirtschaftswissenschaftlichen Fakultät der
Leibniz Universität Hannover

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Hannover, 30.09.2020

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1 Introduction

"It is not the strongest of the species that survive,
nor the most intelligent,
but the one most responsive to change." – Charles Darwin

Change is a constant companion of our society, politics and economy. It often occurs when a tried and tested system or behaviour turns out to be unsuitable for a new situation, or even a crisis. Traditionally, change or transformation is seen as an irregularly recurring and sudden event. Adapting to new, given conditions is often a longer process, which faces initial acceptance problems.

One example is the invention of machines to improve and support production performance. Their introduction led to great dissatisfaction among the population and job losses due to machine replacements. Today, however, production machines are indispensable for the economy. The acceptance of this way of working manifested itself gradually over several decades and required several regulatory changes to satisfy the parties involved. But changes do not always have to be associated with major transformation. Even minor changes such as cash free payment also contributed to change and faced fewer obstacles. Regardless of the scope and volume of the transformation, it is a stimulus for new ideas and innovation. Thus, change is not a negative aspect and should be seen as progress.

One area with a mass of innovation and constant change is the global technology competition. This includes not only the development of new devices or hardware, but also the development of software. The change consists of creation of new products, as well as the maintenance of existing applications in form of updates or patches. In general, the concentration of the economy on the service sector is constantly increasing and currently amounts to approx. 69,3% (cf. Statitisches Bundesamt, 2020). One reason for this market share is that nowadays almost every company is seen as an IT organization due to its importance (cf. Hering, 2018, p. 217). In this sector, the focus is particularly on the market leaders, or "giants", such as Amazon, Google or Facebook. Their gap to the remaining IT companies is noticeably large (cf. Bessen, 2017, p. 3).

Bessen (2017) explains this gap with initial high investment in software development, but later lower marginal costs. Hence, IT can generate economies of scale as well as emerge network effects. If this is additionally coupled with proprietary IT systems, competitive advantage can be created. Therefore, systems that are not available to other market participants are to be preferred and increase the value of the own company. Due to similar suppliers the hardware is usually very similar between the market participants. But it is the human and organizational capital that produces the difference to other IT companies. Ultimately, the combination of scale

and network effects, proprietary systems, and the use of human and organizational capital leads to the formation of clear market leaders. Another finding of Bessen (2017) is that this phenomenon is no coincidence, but is due to the intelligent use and orientation of IT. Therefore, IT and the higher labour productivity have made a significant contribution to the profits of these giants.

This efficient alignment and use of IT enabled the market leaders to implement the constantly increasing and new requirements of the IT industry. However, the question arises, which component of IT use and alignment has led to this success. First, the area can be limited to software development and its products. The decisive factor is that software as a core factor contributes to customer satisfaction and stakeholder interests. But software is also a key factor within the company, as it extends vertically across the entire business process (cf. Forsgren et al., 2018, p. 4). The requirements for external or internal software are the same. For example, improved UX/UI (user-experience/user-interface), higher security, realizability and lower costs are demanded. The pressure on software development teams is increasing. However, these changes also make it possible for innovative ideas to emerge and be implemented. Examples are microservices, Cloud Computing or DevOps (cf. Vasilescu et al., 2015, p. 805f).

Especially DevOps, which is a portmanteau of the words development and operation, is becoming increasingly popular and used in software development. The basic idea of DevOps emphasizes the necessity of bridging the gap between development and production teams in order to meet the aforementioned requirements for the continuous adaptation and modification of software. DevOps is used to elaborate the deployment process by connecting it to the deployment structure. By creating a continuous deployment process, outcomes like software or systems can be provided much faster to customers (cf. Brunnert et al., 2015, p. II). From this background, DevOps can be a possible component that contributes to an overall corporate success. It is necessary to examine more closely whether DevOps has a well-founded connection with the general organisational performance.

1.1 Objectives of the Thesis

If DevOps is transferred more explicitly to the enterprise context, enterprise applications (EA) are in particular focus, as they have an influence on the business processes and thus the value-stream of the company (cf. Brunnert et al., 2015, p. 2). A general example from the insurance context for an EA are applications that are used for registering a customer in a system or processing a claim. If these applications run slowly or are cumbersome to use, this will have a negative effect on customer perception and satisfaction. It is important that these applications run stable to maintain the performance of the business. DevOps can meet these requirements through its content, structures and continuous update cycles.

Furthermore, the consideration of DevOps enables competition-relevant aspects. Wiedemann (2018) emphasizes that IT governance plays an essential role in the company's orientation towards agile teams. Often a predominantly strategic orientation is set on higher customer orientation and faster reaction time to customer needs. According to Wiedemann (2018), IT governance and thus DevOps helps to achieve an additional operational orientation. In this way, the overriding goals manifest themselves in the company in a much more transparent and comprehensible manner. In addition, due to its effects on team dynamics, DevOps leads to the development of a broader skills portfolio of the team members. This means that each team member is able to complete a wide variety of positions and tasks (cf. Wiedemann, 2018, p. 4938). Consequently, DevOps promotes the formation of T-shaped skills. T-shaped skills describe an employee who combines both technological knowledge and business skills and hence covers a broad spectrum of abilities (cf. Demirkan and Spohrer, 2015, p. 13). In the long run, T-shaped skill employees facilitate innovation thinking, which can give the company a competitive advantage (cf. Wiedemann, 2018, p. 4938).

Regarding the development process itself, DevOps provides new time management capabilities. For example, Silva et al. (2018) investigated the productivity gains of DevOps considering teams. To investigate this connection, they introduced DevOps methods such as continuous business planning, collaborative development or continuous monitoring. The results show that through these measures operation activities were reduced significantly. This opens up new opportunities to invest the gained capacity and time in other tasks, such as business analysis or automated testing. Also, Fedak (2019) states DevOps benefits in easier software lifecycle predictability due to early error detection. Silva et al. (2018) also observed that this positive impact on time management or error detection led the companies to implement DevOps in other projects to make more efficient use of team capacities. More business-related benefits comply on the use of additional elaborate and high-tech structures such as serverless computing or blockchain infrastructure (cf. Fedak, 2019).

But especially for insurance companies DevOps provides huge productivity gains (cf. Fedack, 2019). Insurance companies have to adapt their products even more to their customers, since insurance policies are often only concluded once. They also must keep pace with the leaders in the industry. Data analysis also plays a major role in providing customers with more effective and personalized advice. Additionally, legacy systems are a huge challenge for insurance companies. Legacy systems are long-term used systems, which may be outdated and could hinder improvements. However, one of the biggest challenges is the incorporation of increasing regulations, for example regarding security (cf. Fedack, 2019; Martingale, 2020). With DevOps these challenges can be tackled.

Nevertheless, there is a persistent grey veil over the efficiency of DevOps. Many companies adapted the DevOps idea, but sooner or later returned to their usual processes. One reason for this is that the results of DevOps are not immediately visible (cf. Perera et al., 2016, p. 6). If employees or the top management don't recognize DevOps efficiency, it is most likely to be dropped. Additionally, implementing a new deployment and development approach could create acceptance borders (cf. Ghantous & Gill, 2017, p. 6). If the company or employees do not see a benefit of the change, the probability of resistance is even higher (cf. Lewin, 1958, p. 341). But DevOps needs time and employee engagement to distribute its methods in order to show its potential. Thus, there is a lack of connection between the potential of DevOps and organisational performance. As mentioned before, if no value is perceived by employees or the top management, DevOps won't be able to show its efficiency. One way to solve this issue is monitoring. Monitoring is able to support decision making (cf. Stem et al., 2005, p. 296) by surveying the alignment of processes or procedures with a company's goals. Furthermore, it is able to identify problems early on (cf. Jili & Mthethwa, 2016, p. 104). Nonetheless, monitoring is often neglected in development. Reasons are a lack of knowledge (cf. Tuckerman, 2008, p. 21), time restriction or missing top management support. But, as stated by Fitzgerald & Stol (2014), monitoring in relation to DevOps is necessary to detect problems early on and give further insights into processes. Furthermore, progress gets more traceable and noticed when it is measurable. With a visualization or constant measurement process, employees as well as the top management will see progress more clearly and see benefits from the beginning.

This master thesis aims to make a scientific contribution to this gap. It is important to back up DevOps benefits with scientific procedures to ensure validity and overall applicability. It is essential to prove, that DevOps is not an additional trend, but facilitates company's reaction time in a new way. The subject of this thesis is not to expose DevOps dominance, but to highlight the capabilities of monitoring. Hence, monitoring is used to classify the state of companies regarding their development processes. That way, DevOps becomes more manageable and contributes to remove the veil of its efficiency. In order to pursue this goal, critical success factors will be researched and analysed, which are then evaluated. Once, appropriate metrics have been established, they are implemented in an HDI System AG project to examine their reliability and validity within an applicability-check.nIn order to analyse and discuss this issue comprehensively, two main research questions are set up and worked on in this thesis. These are:

RQ1. Which critical success factors are relevant for DevOps?

RQ2. How to measure the efficiency of DevOps and prove business value?

In the further course of the master thesis, the first question will be addressed first, which then serves as a basis for the second one.

1.2 Structure of the Thesis

For the processing of the research questions the sources Google Scholar and the database dblp of the University of Trier were mainly used. To create a foundation the keywords *DevOps* and *DevOps definition* were used as a starting point. Secondly, papers, which specifically dealt with monitoring of DevOps or development processes in general, were helpful. Keywords like *DevOps performance monitoring, development monitoring* and *software monitoring* were especially helpful. As DevOps being a relatively new approach in software development care was taken to ensure that the studies were as up to date as possible. In addition, suggestions for similar articles were pursued and analysed. Books were also checked to ensure scientific procedures. Additionally, websites were cited to include most recent perceptions and developments of DevOps.

The most important sources for this thesis were the books by Forsgren et al. (2018) and Hering (2018) as well as the papers by Lehtonen et al. (2015) and Brunnert et al. (2015). Forsgren et al. (2018) followed a long-term study to scientifically prove DevOps and to document its development in companies worldwide. The names of the authors, Forsgren and Humble, are frequently used in other publications, blogs and presentations. This was particularly helpful in creating a first approach to possible monitoring measurement variables and understanding the DevOps approach. Hering (2018) provides more guidance in his book for companies. Particularly, how DevOps can be implemented in companies and which skills and steps companies need to take to do so. Especially the infrastructure components for DevOps have been worked out in more detail by Hering and enabled the technological perspective to be included comprehensively. Lehtonen et al. (2015) examined the effects of DevOps on a smaller level and concentrated on a single project team. This allowed important insights into the visualization of the results provided by DevOps. In addition, new measurement variables were presented, which could not be found in other papers. Nevertheless, the new variables offer interesting and new aspects. Finally, the paper by Brunnert et al. (2015) provides a comprehensive overview of possible measurement methods in software development. Its advantages and disadvantages were also discussed. Although the study of Brunnert et al. does not specifically refer to DevOps characteristics, general correlations could be derived from it.

Based on this research the following structure was established in this master thesis. In order to be able to discuss the research questions comprehensively chapter 2 deals with a general literature review with particular attention to chances and opportunities of DevOps. Then, chapter 3 states necessary basics regarding software development processes, agile development and the design of DevOps. Afterwards, chapter 4 further highlights essential constructs, such as organizational performance and the need for adaptive capacity and organisational learning to increase information flow processes.

After establishing the framework step by step, chapter 5 presents a wide compilation of possible measurement variables to provide evidence of the efficiency of DevOps. Subsequently, an evaluation will be performed to filter out the most reliable and stable variables. Once suitable metrics are created, there will be an initiation to include these in a project of HDI System AG. This will be pursued with an applicability check. The goal is to derive important conclusions to incorporate improvements for future projects. Accordingly, chapter 6 deals with project specific conditions and requirements as well as the execution of the applicability check. Finally, the results will be analysed and discussed in chapter 7, which also resolves RQ1 and RQ2. Additionally, implications and recommendations will be drawn for enterprises. Afterwards, limitations as well as a conclusion and outlook will be stated in chapter 10 and 11. Figure 1 reconstructs the structure of the thesis.
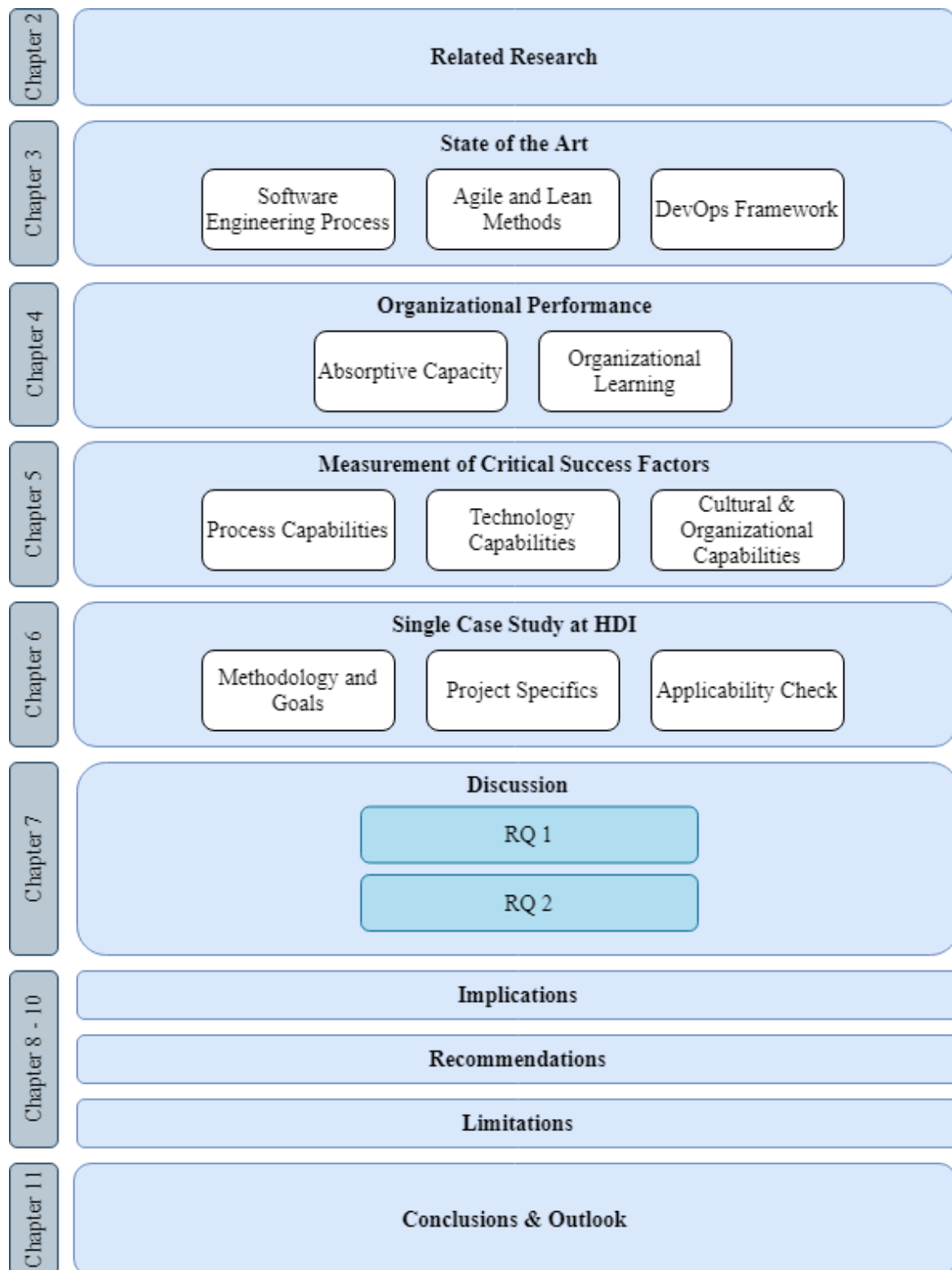
Chapter 2

Related Research

Chapter 3

State of the Art

| Software Engineering Process | Agile and Lean Methods | DevOps Framework |

Chapter 4

Organizational Performance

| Absorptive Capacity | Organizational Learning |

Chapter 5

Measurement of Critical Success Factors

| Process Capabilities | Technology Capabilities | Cultural & Organizational Capabilities |

Chapter 6

Single Case Study at HDI

| Methodology and Goals | Project Specifics | Applicability Check |

Chapter 7

Discussion

RQ 1

RQ 2

Chapter 8 - 10

Implications

Recommendations

Limitations

Chapter 11

Conclusions & Outlook

Figure 1. Structure of the Thesis.
Source: own Illustration.

11 Conclusions & Outlook

"It is not the strongest of the species that survive,
nor the most intelligent,
but the one most responsive to change." – Charles Darwin

Looking back at the quote stated at the beginning of the master thesis, it becomes evident that DevOps serves its goal to increase awareness and the responsiveness to change. Not only do IT processes benefit from it, but also the whole company, their strategy and employees. DevOps is a digital innovation and originated from the need to provide stable, fast and reliable systems or products to the customer. By emphasizing collaborative, loosely coupled, feedback centered and continuous monitoring as well as development methods, DevOps enables companies to challenge new circumstances and adapt to the ever-changing market. In order to be able to easily react to changes it is important for companies to be in a constant process of improvement. It promotes openness to change by opening departmental boundaries and focusing on speed, flow and information exchange.

Moreover, continuous monitoring is a crucial task. It should not be perceived as a control mechanism, but as an opportunity to identify and resolve obstacles early on. Therefore, setting appropriate measurements to monitor development speed and flow, the quality of the product, infrastructural support and social and team dynamics helps to track the effectiveness and efficiency of DevOps. Additionally, a dynamic perspective of measurement variables is needed to include the dynamic processes of the market environment. Nonetheless, a company must be knowledgeable about their IT structure and processes to be able to implement and exploit the approaches potentials successfully.

Furthermore, the single case study showed that companies often monitor development related tasks but neglect overall project organization as well as operational aspects. Media breaks, ambiguously communicated tool use and the resulting data uncertainty were the main obstacles. However, even if DevOps processes were not optimally embedded and monitored, improvements were already visible in early phases. This immediate progress in the speed of development is motivating to pursue DevOps and restructure other areas with its methods and mentality.

The approach enables processes to be adapted and linked to the production environment. For example, EA are crucial services for companies due to their usage by customers. Now, EA are developed and reviewed more often and closely to meet the requirements and quality standards. This incorporation does not only reduce the time to market, but also strengthens the absorption and further use of information. As a result, the customer is more intensively involved in the development process. Additionally, DevOps enables networking effects between departments

and overall economies of scale. Likewise, T-shaped skills of employees are established. Employees acquire new tasks and face new responsibilities. With that said DevOps permits a more efficient use of team capacities with re-structuring teams and development as well as deployment processes. To exploit these advantages, companies need to elaborate their absorptive capacity and organizational learning skills. These two components do in fact influence information collection, transformation and long-term use.

Now that the research is aware of DevOps effects and their efficiency improvements, other areas such as team dynamics, tool selection and the integration of a central data collection must be pursued more closely. The relevance of monitoring is only vaguely addressed and needs to be examined thoroughly. Mostly research papers focus on the benefits of DevOps but forget to address tracking mechanisms as well as continuous evaluation of previous decisions, measurements and processes. Likewise, DevOps calls for a change in employee training and education. DevOps is a complex approach that demands a broad spectrum of skills, which are necessary to provide suitable support. The focus on in-house expertise must be further emphasized.

All in all, DevOps originated from change and further pursues change in companies. It corresponds to the statement that stagnation results in regression. Even though DevOps portrays a young and emerging development approach, it addresses new and important aspects of an application life cycle. Neglecting to incorporate operational tasks or connecting development and operation departments lead to miscommunication, redundant work, tedious processes and unclear responsibilities and traceability.

With DevOps those challenges are tackled and lead to more transparent and progress centered structures. DevOps promotes continuous "everything" and thus enables companies to keep up with, manage and most importantly contribute to the altering market environment.