Quality Improvement Models for Business Process Change – A German Case Study

Matthias Kaiser[1], Frederik Kerssenfischer[1], Frederick Steinke[2], and Tobias Fritsch[3]

[1] Technische Universität München, Garching b. München, Germany
[2] Humboldt-Universität zu Berlin, Berlin, Germany
[3] Freie Universität Berlin, Berlin, Germany
Matthias.Kaiser@mytum.de, ozodis@gmail.com,
SteinkeF@student.hu-berlin.de, T.Fritsch@gmx.net

Abstract. This paper describes the role of business phase models with regards to modern IT-service design. Hence, the usability of two models incorporated for IT-service design in modern business environments will be evaluated. The two examined models are namely the classic four-step model also referred to as PDCA-Circle of Deming on the one hand and the lean Six Sigma model on the other hand.

The approach includes qualitative interviews with six different specialists of German companies in disjoint practices. This practice-diversity is needed to profile the current process of IT-service design over cross-sectional areas. Based on the standardized interviews, seven drivers of the research framework have been identified as quantification guidelines for the performance of phase models in current IT-service design. Thereafter, a case study of a large German insurance IT-department was analyzed. The results are showing differences in the explanatory power. Thereby, the lean Six Sigma model offers a wide set of tools for customer orientation, whereas the classic four-step model scores lower on average. Based on these insights, this paper analyzes if the findings can be generalized for other practices and how future IT-services can be supported by a modification of the theoretical frameworks.

1 Introduction

The IT-evolution of the last decade has shown rapid trends in terms of complexity and interface design towards business applications. Currently, nearly every company (despite of their business practice) is using IT-systems and their functionality is still growing.

This leads to new challenges for Managers, since the market pressure is reducing the available budget and the expectation for high-quality applications as well as innovation is growing ever since. The IT itself faces a change from a pure tool, which is used to automate processes, towards an enabler for new business models [WBK07]. In most business practices the flexibility and value add relies significantly on a performing, depending, flexible and adoptable IT.

The leverage of IT-standardization and partial automation is concluded in the current trend of “IT industrialization”. This includes the cross-industry best-practice

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exchange from production of real assets and services [We09]. The arising IT-service management aims to tailor customized IT products to the necessities of the customers. This change reflects a constant migration from technical aspects and feasibility towards a support oriented IT-product perspective, which consequently includes the needs of the customers [OB91].

The key question for the analysis in this paper is: How well can modern IT-service design be predicted by using theoretical concepts. On par with this topic the question about how future IT-service concepts can be further supported by modifying the existing approaches.

2 Background

This section contains background information about the history of process optimization and both evaluated models.

2.1 History of Process Optimization

[ZBP05] state that IT-services usually only require a performance approach in sole phases. For these areas typical production related approaches are often used, such as total quality management or Six Sigma. With regard to the performance, the total quality management ensures the necessary level of quality through a systematic and ongoing improvement management. Six Sigma uses statistical methods for controlling, hence trying to minimize the variation for strategic aspects of the product [Br06].

Business processes in service industrial practices show a different level of standardization. This difference is based on the level of predictability. The current controlling literature is concluded in [Ri08]. The authors state that the immateriality and the missing customer focus are the main drivers for the limited quantification of the business influence factors. Thus, the management is often not capable of finding first-best-solutions due to the complexity and interdependence of business processes [Ku08].

A typical process classification between type A and type B processes helps to identify, how the underlying problems need to be engaged. Type A processes are mostly standardized application flows. The input and output as well as the interfaces are mostly clarified. In contrast, type B processes are neither standardized with regard to the output nor towards the process itself. They pose a high degree of freedom, which leads to uncertainty and in some situations (with inadequate specifications/exception handling) missing stability.

In this context both, [Ti07] and [ZBP05] discuss the current trend of IT-services shifting from mainly type A processes towards a growing percentage of type B processes. With this fundamental change in the role of IT-processes, a more flexible and structural background is needed. While common models may not support the current evolution of IT-services enough, this paper analyzes the usability of the four-step model and the Six Sigma approach for an IT-case, which includes type A as well as type B problem fields.

2.2 Four-Step Model

The four-step model is based on [De82], who listed 14 different points to improve the productivity and quality in business processes. These improvement potentials indicate guidelines for the management, mainly focusing on services. His focus within the optimization is the improvement of processes and operation towards a best-in-class quality.

In order to reach the benchmark quality level, Deming's model is based on four steps. It is commonly known as the Deming Circle or PDCA-Circle (Plan, Do, Check, Act). The rudimentary idea is an iterative circle that supports constant quality improvement in four given steps:

1. **Plan:** Establish the necessary objectives and processes to deliver results in accordance with the expected output. By focusing on the expected output, it differs from other techniques by integrating the completeness and accuracy of the specification into the improvement process.
2. **Do:** Implement the new processes. This is often done on a small scale and, if possible, via test-scenarios of prototyping.
3. **Check:** Implement the new processes and compare the results with the expected results to identify any differences.
4. **Act:** Prove the differences to clarify their causes (root-cause-analysis). Each will be part of either one or more of the P-D-C-A steps. Determine where to apply changes that will lead to an improvement. These four steps complete the 'circle' – the journey from facing the problem (Plan phase) to solving the problem (Act phase).

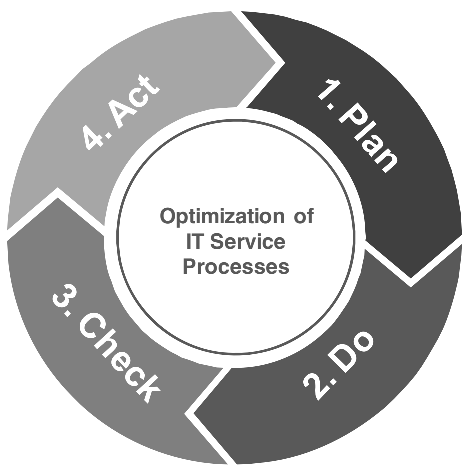

Fig. 1. PDCA-circle (Four-step model) from [DM92]

The PDCA circle or four-step model is commonly used from a management perspective. For IT-processes [Ol08] gives an overview about an ITIL v3 continual service improvement with this method. The four steps and their results are explained. For this paper the PDCA circle will act as one of the two chosen models for IT-service improvements.

2.3 Six Sigma

The Six Sigma model is a business management tool to evaluate strategies to improve quality and reduce variances of a process. The name Six Sigma is the result of the initial goal to achieve an error rate of less than 0.00034%, which is six times the standard deviation in the normal distribution. Complementary to the PDCA circle of the four-step model, the six sigma model uses a similar approach of different steps to follow in order to improve a process. The main difference lies in the addition of a fifth step. Even though it follows the Deming Circle, it offers a wider variety of input while improving an existing business process [Re06].

The acronym of these five steps is DMAIC:

1. Define the problem, including all stakeholders of the process chain. Set a project goal.
2. Measure the data of the current process and try to collect important key figures.
3. Analyze the collected data and try to find interactions between the parameters, which can be improved. In order to reduce or raise a certain parameter, make sure to consider the influencing factors.
4. Improve the process by adjusting important key factors that were identified before. Use test- and pilot-runs to ensure an improvement of the new process.
5. Control the new process and compare the results with the expected results. Finally, deviations from the new calculated figures can be corrected by reacting and fine tuning the new work process.

Six sigma aims to improve the quality of manufacturing and business processes by identifying and eliminating the source of errors. Variability is analyzed with statistical methods and has to be avoided. The method was developed originally by Motorola in 1981 and is used today in many sectors of industry with adoptions for example for service industries [KA06]; [PNC07]; [St07]; [Wi07].

Since it is focused and because it is offering a framework, the hypothesis for the PDCA circle and Six Sigma performance in modern IT-service can be described as:

> The PDCA circle and Six Sigma are usable for type A processes but fail to deliver the necessary business support in terms of tools to address more dynamic problems (type B processes).

3 Research Framework

After describing the history of process optimization as well as giving an introduction of the two theoretical business management tools (four-step model and Six sigma model), the following part focuses on the paper's framework parameters and approach.

Due to the increasing complexity and growing importance of IT-processes, a structural procedure at enterprise level is essential. Subsequent to the literature meta-analysis, seven success factors are derived. These factors should be used for structuring the improvement of IT-processes. Moreover, the factors serve as a starting point for the quantification of the expert interviews. With the help of these interviews, a transfer of the theory to the practice is possible. A detailed explanation will follow in the next chapter.

3.1 Literature Meta-analysis

For a first general overview about the complexity of the topic a meta-analysis of the literature was conducted. The authors used three different channels for their research in order to reach the widest possible coverage. The search terms used in the literature research were used in German and the according terms in English to assure good coverage of the topic.

1. **Textbook-Research:** The electronic media search of the library of the Technical University of Munich has relevant sources (in terms of papers and journals). The following key words were used: “IT-Services, Operational Management, Business Process Management and Quality Management”.
2. **Research in scientific databases:** To determine current scientific articles "Google Scholar" and "Ebsco” were used and likewise searched for the above keywords.
3. **Systematic evaluation of scientific journals** (amongst others “International Journal of Service Industry Management” and “Zeitschrift für Wirtschaftsinformatik”): The vintages 2006, 2007, 2008 and 2009 of different magazines were analyzed using abstract titles and texts.

Following the meta-analysis more than 150 selected documents with the above-named keywords were available.

3.2 Development of Seven Success Factors

These documents were evaluated and recurring facts collected. Clusters for different topics were built to identify the most important success factors for the optimization of IT-processes. As the result of the literature analysis the following table presents seven success factors and the most important associated sources (Table 1).

Table 1. Success factors in the optimization of IT processes (authors design)

Success factor	Description and sources
(1) Customer Integration	The typical interaction in the service sector between supplier and customer in service delivery has to be optimized [Fl09]; [Kr10]; [ZBP05].
(2) IT- Services Characteristics	The optimization should consider the characteristics of IT service providers, namely hardware (using standards), software (customization) and service (customer involvement) of the hybrid products, which are available and specifically tailored to customer needs [Bo04]; [Za07]; [ZBP05].
(3) Process View and Industrialization	The optimization should examine standardized processes, which follow the expiry of a predefined schema and return a certain result [Ri08]; [Ti07]; [Wi07].
(4) Operational Control	The optimization shall support the implementation of processes in daily execution and improvements through appropriate measures [Bl04]; [Fl09]; [MW08].

Table 1. (Continued)

(5) Effectiveness and Efficiency	The optimization should consider both internal efficiency targets for economic performance and efficiency targets for the satisfaction of customer needs [Br96]; [GHK08].
(6) Quality Management	The optimization should include the observation, measurement and control of the customer perceived service quality [BH01]; [Br06]; [DM92]; [Py03] [Sh39].
(7) Roles in Process	The optimization should distinguish between different roles, including IT-managers, employees, suppliers, customers and users in the process and respond to their interests and information needs [Kr10]; [ZBP05].

3.3 Expert Interviews

The next part of the approach includes standardized interviews with six different specialists from German companies in disjoint practices to highlight the performance of the business phase models regarding the seven success factors in the corporate context. In general, the qualitative research aims to receive a deeper understanding by open questions and smaller, more intense information gathering. Moreover the interview implies a quantitative component in which the experts have to rate the seven success factors relating to the two theoretical management process tools. The 5-point Likert scale serves as quantification guideline for the suitability of phase models in the current IT process optimization [Li32]. Based on the approach to qualitative research [Ei89] the procedure for the interviews in this paper is arranged. Some phases are reduced or combined and a quantitative part is supplemented.

In the following the selection of interviewees was made by using defined selection criteria. Respondents with a deep understanding project management and control and optimization of IT-processes were selected. This ensures that the interviews cover the desired topic. Six employees of the internal IT-staff of independent IT-services, as well as employees of other chemical and insurance companies were selected. Due to the sensitivity of the information the names of the companies will not be published. The interviews were conducted in a semi-structured way. This implies that the interview process was only roughly outlined in advance in order to allow a responding to the interview situation. The developed standardized questionnaire guaranteed a consistent structure for the six interviews.

The interviews in the present work were conducted face-to-face or by telephone. The interviewees had no personal interest in the results and could describe their objective point of view. Moreover, reliability and validity of the statements were ensured. All interviews were recorded to facilitate subsequent evaluation. For the analysis of the individual interviews, transcripts of the conversations were prepared. For evaluating the suitability of the developed success factors with reference to the four-step model and the Six sigma model the participants were asked for their estimation on a 5-point Likert scale.

After describing the analytical proceeding of the separate interviews, the search for comprehensive patterns will be brought into focus in the next part. The mean of the responses of the six interviewees marked on the presented 5-point Likert scale is shown in the chart below (Figure 2). The left hand side (--) represents a limited suitability of the particular model in terms of the success factor whereas on the right hand side (++) there is a major suitability. For example, for the factor (5) Effectiveness and Efficiency the four phase model shows a very low and the Six sigma model a high suitability.

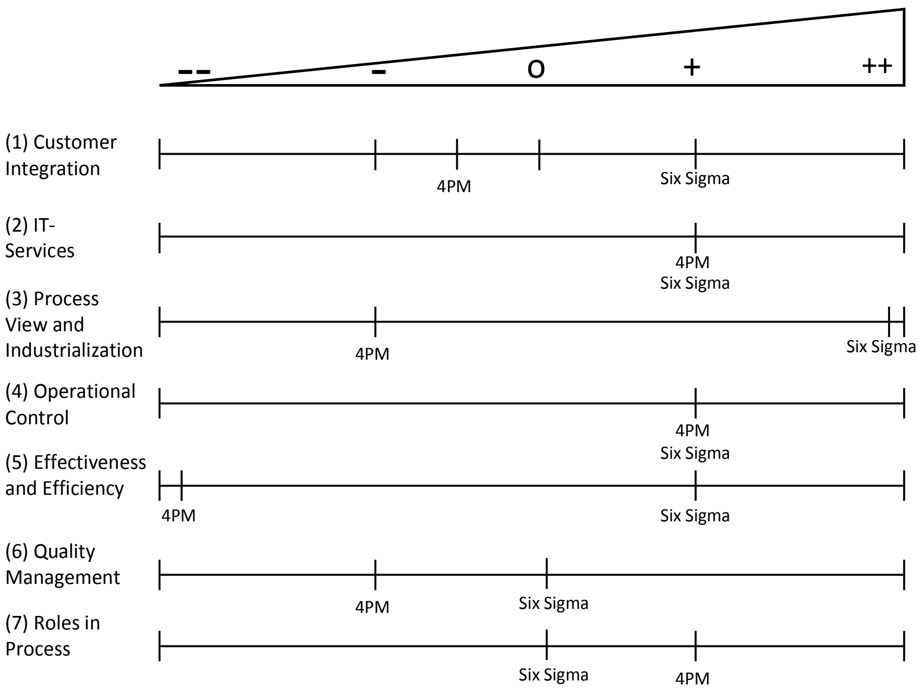

Fig. 2. Expert opinion on the suitability of the two theoretical models (authors design)

The responses given by the six experts have shown noticeable differences between the suitability of the two analyzed models in reference to the developed factors. The graphic illustrates the cumulative assessment of the six interviewees. With regard to the seven success factors, the advantages and disadvantages of the four-step model and the Six sigma model in practice can be clarified. It can be seen that four success factors display advantages for the Six sigma model whereas only one shows advantages for the four phase model (Figure 2).

The additional scientific value of the literature meta-analysis, the subsequent creation of the seven success factors for the IT-process optimization, and the application on the two theoretical models has to be reviewed with help of the case study. In order to underline the individual interviews' findings, it is useful to analyze a current practical IT case study and monitor the results related to the previously made results below.

4 Case Introduction

In the digital age the manual processing of paper files is not productive. Therefore, the transformation of traditional paper files into metafiles and integration in a uniform database is an absolute requirement. During the transitional period it is necessary to scan old paper files and provide them electronically.

In this context, the optimization of the digitalization process of different types of paper files plays an essential role. Using the case of paper file digitalization in a large German insurance company, this section describes the use of business phase models for process optimization. The original digitalization process consisted of relatively complex steps with a significant proportion of manual work. For an optimization of this process, the daily manual work had to be minimized. Moreover, an improvement of this component has influences on the processing time, error rate, and cost factors and brings quality intensification.

This case was chosen as a representative one for the application of the Six sigma model. It is both IT-service specific (i.e. the technical scanning process) and relevant for the daily business of the insurance company which is the customer of the process. Additionally, the chosen framework is a standard tool for process optimization of service processes in the focused group of companies. The activities of one process optimization project are shown as follows to give an insight on the application of one of the models.

4.1 Structure and Results

First, the setting of the case is described. Both new files and all kinds of incoming mail for existing files are stored digitally. However, there still are archives of paper files for which storage and access cause notable costs. A paper file digitalization process is used for scanning files systematically in order to empty archives.

Both the use and the results of a Six sigma approach with five phases for analyzing and optimizing that process are described now. For confidentiality reasons, relative improvements are presented rather than absolute figures.

1. Define

In workshops with the all stakeholders of the process (clerks, IT-specialists, management) the present process chain was modeled and goals for processing time, error rate, and average costs per file were set. A set of 17 optimization points was discussed and the best ones were selected.

The first process step is the selection of the files that should be scanned. These files are shipped to a service provider, who prepares the files for scanning and digitalizes the files using high performance scanning devices. Metadata is collected to connect the images with the corresponding digital files.

Goal of the optimization is to ensure that the process design fits into the customer requirements regarding the days until the digital file is available. A certain error rate is accepted because achieving a lower error rate would be more expensive than dealing with a rather small amount of failures.

2. Measure

To have a qualitative reference to which results can be compared to, important parameters of the present process are collected over a period of two months. Therefore, automatically generated reports are used as well as collection by employees that are responsible for process execution. Result of the measurement is a gap between the actual as-is-process and the goal values of the define-step. The long term sigma value of the present process is 2.4.

3. Analyze

To realize a process improvement, the usability of the actions defined in the plan-step has to be evaluated. Therefore, all gathered data is analyzed and a business cases is calculated concerning the costs and use of implementation regarding the defined goals. A result of this analysis was that the most promising action is a change from using an external scan service to scanning the files with free in-house resources using already available hardware and processes. To illustrate this, the further steps of the proceeding will be outlined in what follows.

4. Improve

To realize gains calculated in business cases the best actions were conducted. Therefore, the as-is-process was adapted as planned by informing the right people and changing technical implementations. To use the in-house resources instead of the external provider, necessary process adjustments were taken and a pilot run was used to ensure correct results.

5. Control

Finally, the new process was controlled to measure the results of the optimization, to decide whether another run through the five steps is necessary, and to make sure that these achievements are used in the future as well. The outcomes of the new process are a reduction of average processing time by 32% while reducing cost per file by 40%. The sigma value of the process could be improved to 4.2. Compared to other service processes the result is satisfying and so another run through the steps was not necessary.

4.2 Assessment and Influence Factors

After the introduction of the case and the presentation of the results, the performance of the used Six Sigma model will be discussed in the following, using the 7 success factors presented in chapter 3.2. Therefore, project members were asked to answer the questionnaire presented in 3.3. The average results are presented in figure 3.

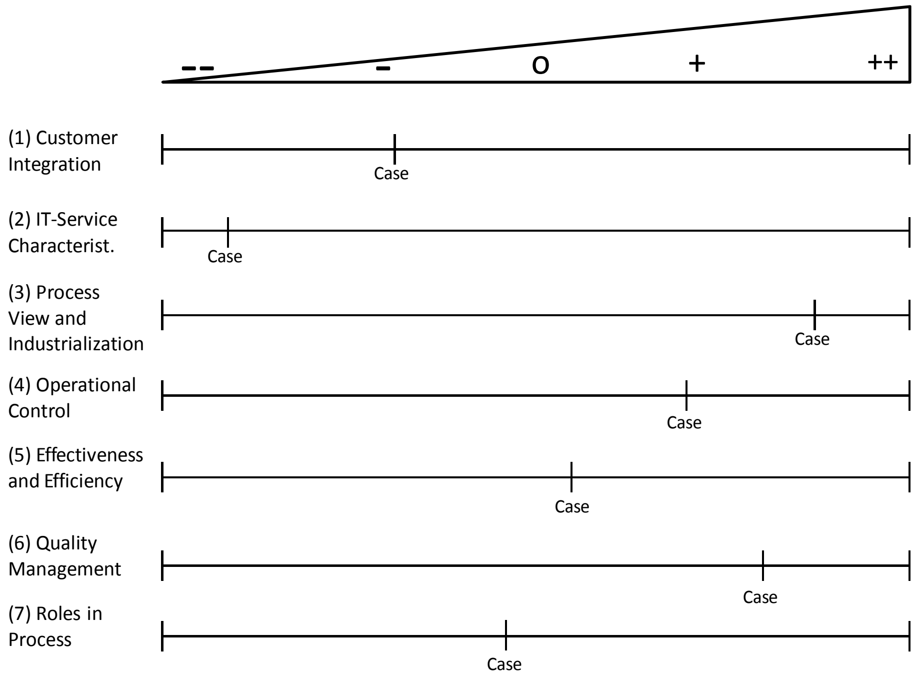

Fig. 3. Team members' opinion about the performance of the Six Sigma model (authors design)

To interpret these quantitative assessment qualitative interviews with four project members were conducted and the results for the seven success factors merged:

(1) Customer Integration tools of the Six Sigma Model were applicable to some extent for the digitalization steps of the process.

(2) IT-Service Characteristics are only partially supported by the Six Sigma model but were incorporated anyway in the project, i.e. the optimal fit of hardware, software, and staff for service execution. Skills of the project team had compensated that gap.

(3) Tools of the Six Sigma model for Process View and Industrialization could successfully be applied.

(4) Operational Control: Six Sigma instruments for measurement and improving daily work could gainfully be applied for the paper file scanning process.

(5) As proposed by the Six Sigma model, economically and functionally-oriented stakeholders were distinguished between to consider effectiveness and efficiency goals.

(6) Quality Management from a customer perspective was conducted with Six Sigma model tools for measurement and optimization of error rates, i.e. minimization of missed pages in the scanning process.

(7) Six Sigma tools could be applied to match process steps with different roles in the process, even though there were no predefined hints for each role. It was also part of the project to frame the different interactions during process execution.

The project members summarized that the Six Sigma model was very useful for the evolution of the paper file digitalization process. The framework for the project composition could successfully be applied. Solutions for very IT specific parts of the project could be generated using the skills of the team members.

The following chapter broadens the perspective of a single project and process optimization framework and compares the outcomes with the results of the interviews of chapter 3.3.

5 Analysis

In the following section, the results of the expert interviews are compared to the case results regarding the usability of the Six Sigma model for the optimization of IT-processes. As an indication we use the seven success factors that were rated on the 5-point Likert scale. The results show that there is a slight discrepancy between the expert opinions and the opinion of the team involved in the optimization process.

Referring to the first success factor Customer Integration, the gap between the experts and the team valuation of this factor is clear-cut. While the experts valued this parameter clearly suitable for the Six Sigma model the team members did not find this represented in their case.

Ongoing with the next factor, a severe gap for the suitability regarding the IT-Services characteristics was found. The opinions differed, ranging from the rather good usability evaluation of the Six Sigma tools by the experts to the lowest possible rating from the team members involved in the optimization of processing paper files. As mentioned before, we believe that this gap shows how the optimization process for IT-Services is not dealt with in an optimal way by using the Six Sigma model for it. This factor could be sufficiently considered during the process evaluation just by using the project staff's IT knowledge.

The remaining factors of the Six Sigma model, namely Process View and Industrialization, Operational Control, Effectiveness and Efficiency, Quality Management and Roles in Process where rated equally useful by the experts and the team members.

Therefore, the focus of the analysis should lie in the difference discovered for the first two factors concerning the Six Sigma performance. As mentioned in section 2.1 of this paper, two types (A and B) of processes could be roughly described for the field of IT-services. Whereas Type A is mostly standardized and input and output can sufficiently be described, Type B processes offer a higher degree of uncertainty about important parameters and mostly display more complex situations. Due to the lack of far-reaching IT-knowledge on the customer side, the requirements actually needed are most often only vaguely defined. This leads to a low rating for Customer Integration when using the Six Sigma model tools because the model fails to help creating the necessary information needed and defining adequate target figures for the IT-optimization. While on a theoretical level, Six Sigma appears to be a valid method also for IT-processes, in practice it shows it roots for optimizing manufacturing and business processes. The complexity of IT-solutions is hardly captured by the attempt to optimize one or two target figures that can be named by the typical IT-customer.

In accordance with the result of Customer Integration we find the most significant gap for the IT-Service characteristics where the team members stated the worst performance of the Six Sigma model, while the experts listed a good theoretical performance of the tools. As for integration, the characteristics in IT-processes do not fit in the usual manufacturing optimization scheme. Influence factors like hardware, software, and support service with their many different characteristics are at best only poorly addressed when using the Six Sigma model with a sparse number of indicators. Especially this discrepancy leads to our understanding of the actual lag in IT-process optimization.

6 Conclusion

The evolution of IT-processes rapidly progressed in the past years. The complexity rises with the linkage of customer-tailored software, hardware, and service solutions. As shown in this paper, different methods exist for process optimization in the IT-sector which are used by IT managers to reduce this complexity and optimally use the potential to create a performing, depending and flexible IT-solution.

Starting with an overall analysis of important factors for the optimization of IT-processes, this paper shows in an exemplary case the lag of optimization tools concerning IT-processes. We find that the seven factors which were named most important for the success of an optimization by experts where only partly matched with the current methods used in large companies for process optimization. By identifying two meanderings from the theoretical framework and the actual application of the methods in a real process optimization we discover the disadvantage of methods like Six Sigma for IT-processes. As stated before, both analyzed optimization models (Four-step model and Six sigma) show their weaknesses in customer integration and the characteristics of IT-services. Only with a larger involvement of the customer and a broadened approach regarding the target figures which are optimized, the complexity of modern IT-processes can be handled. Due to the interferences caused by the design of the mostly hybridly constructed modern IT-products, the next step has to be the development of a theoretical model that allows a wider variety of input.

The identification of future standard methods for complex IT-processes is to be developed and evaluated in further research. This new model framework is important because the limitations of the classical optimization tools become evident for IT-processes. As long as all seven success factors identified by this paper can be successfully integrated in the conceptual framework, we strongly believe it will improve IT-process optimization.

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