# Understanding Effective Use in the (Post)-Implementation Phase of Information Systems

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# Abstract

Organizational information systems (IS) must be used effectively to maximize their benefits for the overall organization. However, their complexity creates significant challenges for conducting the IS project of an implementation in such a way that users are subsequently enabled to use a system effectively. The challenge is also present in the post-implementation phase whenever employees have to learn how to use a system effectively for a given task and develop their own adaptations. Thus, this thesis presents a research effort on the means that effect users' perception and ability to use a system effectively during an IS project as well as in the phase of use in post-implementation. Thereby this thesis provides a more detailed understanding of the concept of effective use and the conditions that enable effective use of IS. The analysis of IS projects contributes to research on the ambiguous and subjective nature of the evaluation of IS project success and explores the configuration of user involvement and participation in implementation projects that is most likely to be related to project success. The results of the analysis show that the participation of the appropriate users in the requirements analysis phase is most often related with IS users that feel enabled to use an IS effectively. Research on the IS use in the post-implementation phase presented in this thesis provides more detailed conceptual development of the relationship of user behaviors such as learning, user adaptation, and workarounds with effective use and thereby extents the nomological net of theory of effective use (Burton-Jones & Grange, 2013). Results of further analysis show that workarounds can positively affect the use of an implemented IS. Finally, this thesis contributes an operationalization of the concept of effective use based on the initial conceptualization by Burton-Jones and Grange (2013). This answers a call for research on richer conceptualizations of IS use. In sum, these findings add to research on concept of IS use and user behaviors that influence the effective use of IS. Therefore, they enable a more detailed understanding of the concept of effective use and allow future researchers to extent and refine the nomological net of effective use. Practitioners may also employ these new measures to measure the effectiveness of their efforts to improve the effective use of IS. They also benefit from the insights on the perception of IS success in organization and appropriate phases and forms of user participation in IS projects.

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# List of Abbreviations

| | |
|---|---|
| ACA | Adaptive Conjoint Analysis |
| ADWeb | Agent DesktopWeb |
| ANOVA | Analysis of Variance |
| AP | Asia-Pacific |
| AVE | Average Variance Extracted |
| ASU | Adaptive System Use |
| BMC | Building Materials Company |
| BU | Business Units |
| CA | Cronbach's Alpha |
| CAD | Computer Aided Design |
| CeCo | Chemical Company |
| CI | Confidence Interval |
| CSC | Customer Service Centers |
| CSV | Coefficient of Substantitive Validity |
| CR | Composite Reliability |
| CReal | Critical Realism |
| CRM | Customer Relationship Management |
| DI | Deliberate Initiative |
| DP | Discrepancy |
| DUR | Degree of User Representation |
| EFA | Exploratory Factor Analysis |
| ES | Enterprise System |
| EU | Effective Use |
| ERP | Enterprise Resource Planning |
| EUR | Europe |
| FC | Feature Combining |

| | |
|---|---|
| FCond | Facilitating Conditions |
| FIU | Features-in-Use |
| FS | Feature Substituting |
| fsQCA | Fuzzy-Set Qualitative Comparative Analysis |
| FR | Feature Recombining |
| IA | Informed Action |
| InfQ | Information Quality |
| IS | Information System |
| IT | Information Technology |
| LMS | Loan Management System |
| MCRF | Multi-Channel-Fashion-Retailer |
| MIMIC | Multiple Indicators and Multiple Causes |
| MS | Microsoft |
| NA | North America |
| NS | Novel Situation |
| NT | New Tasks |
| OU | Others' Use |
| PCA | Principle Component Analysis |
| PE | Prior Experience |
| PEOU | Perceived Ease of Use |
| PIIT | Perceived Innovativeness in the use of IT |
| PIMS | Product Information Management System |
| PLS | Partial Least Squares |
| PLS-SEM | Partial Least Squares Structural Equation Modelling |
| PRI | Proportional Reduction in Inconsistency |
| PSA | Proportion of Substantitive Agreement |
| PUF | Prior Use Frequency |
| QCA | Qualitative Comparative Analysis |

| | |
|---|---|
| RF | Representational Fidelity |
| RUP | Rational Unified Process |
| RQ | Research Question |
| SAS | Shop Assistant System |
| SCM | Supply Chain Management |
| SE | Changes in Systems Environments |
| SUS | System Usability Scale |
| TAM | Technology Acceptance Model |
| TI | Transparent Interaction |
| TPB | Theory of Planned Behavior |
| TR | Trying New Features |
| TRA | Theory of Reasoned Action |
| TTF | Task-Technology Fit |
| UI | User Involvement |
| UIP | User Involvement and Participation |
| UK | United Kingdom |
| UPD | User Participation in Development/Customization |
| UPI | User Participation in Implementation |
| UPR | User Participation in Requirements Analysis |
| USA | United States of America |
| VIF | Variance Inflation Factor |
| WK | Workarounds |

# 1 Introduction

Many potential benefits are associated with the implementation of information systems (IS) in organizations. These can be cost savings, efficiency gains, elimination of requirements definition and development processes, and integration of best practice business processes (van Fenema, Koppius, & van Baalen, 2007). However, even if ISs are implemented on time and within budget, expected benefits are often not realized (Boudreau, 2003; Boudreau & Seligman, 2005). This might be due to the reason that the availability of IS alone does not lead to an increase of productivity of workers (Orlikowski, 2000), only the effective use (EU) of such systems can ensure higher productivity (Burton-Jones & Grange, 2013).

## 1.1 Motivation

Increasing efficiency and effectiveness of operations is a permanent concern in almost all organizations. Business environment and continued technological and societal changes drive this ongoing challenge for many organizations. Managers often pursue improvements to gain a relative or absolute competitive advantage (Barney, 1991). Especially valuable competitive advantages are inimitable for other organizations and organizationally integrated, i.e. part and parcel of the business processes (Barney, 1991). In light of the development of digital technology in recent decades, pursuing a competitive advantage involves the introduction and continued improvement of organizational information systems (IS), so called enterprise systems (ES) (Markus & Tanis, 2000; Seddon, Calvert, & Yang, 2010; Sykes, Venkatesh, & Gosain, 2009). Corporations spend approximately $335 billion (Gartner, 2015) per year to maintain information system as the basis for their competitiveness and to gain competitive advantage. However, an assessment of the success of IS often reveals disappointing returns on investment (Staehr, Shanks, & Seddon, 2012). This finding is underlined by a recent study from Gartner (2014) who predicted that only 30% of the efforts and projects for digital business transformation will be successful. It is a dramatic problem for many organizations that a large number of IS projects fail to reach their objectives despite the ongoing acquisition of experience with IS projects in many organizations (The Standish Group International, 2013). These insights are illustrative of the interesting phenomenon that years of practice and established approaches for IS projects have not led to a situation in which this high rate of failure could not be reduced significantly (The Standish Group International, 2013). In this thesis, we explore potential reasons and solutions for the illustrated persistent phenomenon of underperforming IS implementation or renewal projects (Andersen, 2006). In many cases, organizational decision makers seem to know what steps they should take. However, they do not know how they should execute them (Wade, 2015). From a researcher's perspective, incomplete and varying definitions of project success make the assessment of IS project success difficult and very subjective (Thomas & Fernández, 2008). Therefore, research on the reasons for varying perceptions of project success as well as the need for a new assessment and measurement of project success is necessary. Moreover, it is potentially insightful to analyze the relationship of user involvement and participation and IS

project success because they have been identified as important influencing factors for perceived project success (The Standish Group International, 2013; Bano & Zowghi, 2015).

Nonetheless, even if an implementation or renewal project has been completed successfully, the effective and efficient use of the IS in the organization is not ensured. This can endanger the organizational goal of an IS implementation or renewal projects such as maintaining competitive parity or maintaining and developing a competitive advantage. An IS in an organization has an impact on business processes, organizational structures, and thereby individual tasks and roles (Devadoss & Pan, 2007; Markus, 2004; Markus & Tanis, 2000). Changes to core IS in many organizations can therefore change and often infringe on the process of task execution of individual employees, they are also challenged whenever there is a change to the IS they are working with (Sykes, 2015). Changes to an IS lead individual employees to evaluate the impact of these changes to them as users (Beaudry & Pinsonneault, 2005). Their evaluation can result in efforts of learning and adaptation (Barki, Titah, & Boffo, 2007). More specifically, for many users, reinstating their interaction based on a new IS involves participation in trainings as well as the adaptation of the system for personal preferences (Jasperson, Carter, & Zmud, 2005; Sun, 2012). In some instances, this can be linked to the use of workarounds to make the completion of a new or altered task possible, given some technological restraints (Alter, 2014). However, users may also partly or fully resist the change and the new technology (Rivard & Lapointe, 2012). Thus, while the value from the implemented system can be created by individuals' use it can also be reduced by their use behavior or lack thereof. Furthermore, "more than 90 percent of costs […] are attributable to the post-implementation stage" (Erlikh, 2000, p. 17), i.e. the time span during which users use the IS. It is therefore important for organizations to extract the maximum value from system use over the life-cycle of a system (Venkatesh, Brown, Maruping, & Bala, 2008), when considering the costs associated with implementing and also running an IS.

In this thesis, in light of the presented challenges to ensure an efficient and effective use of an IS after an implementation, we also explore the role of individual users in realizing the potential of implemented IS. From a researcher's point of view, it is necessary to develop a measure of efficient and effective IS use because the individual usage of IS in organizations is currently still a „black box" (Beaudry & Pinsonneault, 2005; Elie-Dit-Cosaque & Straub, 2011). Existing conceptualizations and measures of individual system use do not sufficiently explain the relationship between system use and the realization of expected outcomes (Sun, 2012). Moreover, the existing conceptualizations have been considered to be unable to capture the richness of the concept of use because research on IS use behavior has been primarily focused on initial usage and adoption (Benbasat & Barki, 2007). Therefore, we engage in the exploration of potentially more comprehensive concepts such as effective use (Burton-Jones & Grange, 2013; Burton-Jones & Straub, 2006). There has been an increasing research interest in the effectiveness of IS use (e.g. Liang, Peng, Xue, Guo, & Wang, 2015; Veiga, Keupp, Floyd, & Kellermanns, 2014). Effective use of an IS can be defined as "using a system in a way that helps [to] attain the goals for using the system" (Burton-Jones & Grange 2013, p. 633). This thesis is the first to research the concept of effective use and explore of the nomological net of effective use and its relationship with user adaptation and learning. With regard to adaptation, the

research in this thesis also extends the nomological net of effective use by analyzing the interesting role of organizationally sanctioned workarounds as a mode of users' adaptation that allows them to use flawed systems (Alter, 2014) effectively.

Overall, the outlined practical and theoretical issues show that the foundations for effective and efficient use of an IS are laid during an IS project. However, efficiency and effectiveness of operations in modern organizations are closely linked with the efficient and effective use of IS. As aforementioned, especially valuable competitive advantages are inimitable for other organizations and organizationally integrated, i.e. part and parcel of the business processes (Barney, 1991). This means that the organizational IS also need to be appropriately integrated in a company's structures. Organizations set course for achieving efficient and effective use during the IS projects for implementation or renewal. However, the actual goal of efficient and effective use of an IS can only be realized during the use phase. Hence, there is a need to investigate both phases of an IS project. Therefore, this thesis thoroughly investigates the important influencing factors for effective and efficient use of an IS during the IS projects and the actual use phase. In this thesis, these phases are referred to as implementation and post-implementation phase, as this general separation suffices for the purpose of our research. The research questions and the subsequent empirical studies in this thesis are developed with these two phases in mind.

## 1.2 Research Questions

When examining the means of organizations and individuals in the implementation and post-implementation phase, it is evident that the foundation for effective use can be strongly influenced by an organization and particularly its managers. For instance, they can help to improve project success in terms of effective use by involving end-users of a future or current system over the course of an implementation or renewal project (Abelein & Paech, 2013; Bano & Zowghi, 2013, 2015). User involvement and participation (UIP) in different phases of an IS implementation project is a potential means that managers can use to improve the effective use of an IS in use. The sanctioning of workarounds, if an implemented IS has a lack of fit for the task (Alter, 2014), is another means of managers which can be used in the post-implementation phase. The means of individual users are more relevant in the post-implementation phase where they have direct control over the efficiency and effectiveness of their use. Users can achieve a higher level of effective use via learning and adaptation of the system. However, as mentioned above, existing theoretical conceptualizations of individual system use do not sufficiently explain the relationship between system use behavior and the realization of expected outcomes (Sun, 2012; Tong et al., 2015). Hence, we also add to the scientific discussion about the measures for IS use with an operationalization and adaptation of the theory of effective use. An integration of the aforementioned insights leads to the following overarching research question:

*RQ: Which organizational and individual means in the (post-) implementation phase lead to effective use of an IS?*

We approached the research on this question with a series of six studies. First, we explored the issue of planned change of an IS, essentially a renewal project, in a longitudinal single case study. The case is an IS renewal project in the e-commerce department of a medium-sized fashion retailer (FASHION), which should have had minor direct influences on users, as it just concerned the introduction of a new release and technological adaptations of the backend of the system. However, we observed a substantial effect of the project on users' and other stakeholders' attitude during the project. Thereby we got a better understanding of the expectations and adaptation behaviors of different stakeholder groups in a changing organization. We observed that the IS project which specifically concerned a new release of a product information management system (PIM), essentially a renewal of software, and its communication triggered the development of expectations in stakeholders. The individual stakeholders had different expectations regarding the share of individual adaptation, speed of delivery, and effort that they had to put in over the course of the project. The mismatch of expectations led to a situation of disillusionment for many system end-users after it became apparent that their expectations and requirements could not be fulfilled. We will refer to this significant difference between expectations and reality as discrepancy (Armstrong, Hardgrave, & Armstrong, 2007, p.456; Sun, 2012). However, the experience of the management and the technicians in the organization was completely different and they came to regard the project as a relative success. Over time, the same view took hold among end-users. Separately, we measured the level of perceived usability by end-users as an independent measure for IS project success. A lack of the usability in the organizational context of the system has been identified as one of the potential drivers for unsuccessful IS projects (Scheiber et al., 2012). We measured the usability of the PIM in terms of the system usability scale (SUS) (Albert & Tullis, 2013; Brooke, 1996) before the introduction of the new release and six months after the introduction of the new release. This observation period and the points of measurement are likely to cover the whole shakedown phase of the change (cf. Bala & Venkatesh, 2013). Results showed that the level of usability was not significantly improved from the state before and after the release. This deviance between measures, statements, and observations was the phenomenon of interest, which we chose to explore. Thus, we posed the following research question for the analysis of the FASHION case study:

*RQ 1: How and why is there a discrepancy between end users' perceived and real IS renewal project success?*

Once we had explored the issues with the perception and measurement of renewal projects success, we focused our research on the remedies for the described issues, also in the context of implementation projects. At first, we decided to address the organizational means in the implementation phase, which help to ensure a higher level of effective use of an implemented IS. These means are the steps that management could take in a conjoint effort with end-users before and during an implementation project. We chose to investigate user involvement and participation (UIP), which has been identified as a very important factor with a strong influence, on project success (e.g. Bano & Zowghi, 2015).

Thus, in our second empirical study we focused on the analysis of the configurations of UIP, which are typically related with project success or failure. The topic of UIP and the usage perspective have long been important parts of the field of IS research and have been revitalized in the recent past (Markus & Mao, 2004). A number of rather recent studies contribute a variety of perspectives. While the implementation phase has often been analyzed with a focus on user resistance (Rivard & Lapointe, 2012), later episodes of user resistance during the post-implementation phase have been called IS avoidance (Kane & Labianca, 2011). Managers of an implementing organization can avoid user resistance by involving users even before the commencement of a project (Jiang, Klein, Chen, & Lin, 2002) and they can also ensure system success by involving the users in development (Bano & Zowghi, 2015) and during implementation projects (Bano & Zowghi, 2015; Baronas & Louis, 1988; Hirschheim & Newman, 1988; Rivard & Lapointe, 2012). While it has been established that UIP is generally related with system success, it has not been established which specific forms of UIP in which specific sub-phases of an IS implementation project can be related to system success (Bano & Zowghi, 2015). Furthermore, there is a lack of knowledge about the different forms of UIP that are required to make an implementation project successful (Bano & Zowghi, 2015). Also the user-centered design literature does not explain implementation process procedures that are particularly user-centered (Iivari & Iivari, 2011). It has also been established that UIP is the second most important factor for project success from a practitioner's point of view (The Standish Group International, 2013). Only the widely researched factor of top management support is deemed to be more important (The Standish Group International, 2013). However, UIP is still not very widespread in large projects and in private companies and organizations (Abelein & Paech, 2013; Alleman, 2002).

We take a configurational view (Ragin, 1989) on IS implementation projects in this second empirical study. A configurational approach helps us to identify the interdependencies of different factors of IS implementation projects and does not just identify the critical factors overall. It has been identified as an ideal research approach for a complex analysis of several cases (Fiss, 2009). Thus, it is suitable for our exploration of the role of UIP in 16 implementation and renewal projects, for which we gathered data. We analyze the configurations that are related with IS implementation project success in terms of usability and effective use. We define IS project success as a significant increase in usability (SUS) (Albert & Tullis, 2013; Brooke, 1996), which we use as a proxy for effective use. We use this set of measures as a response to the incomplete and varying definitions of IS project success that make the assessment of IS project success generally difficult and very subjective (Cecez-Kecmanovic, Kautz, & Abrahall, 2014; Thomas & Fernández, 2008). As our research in the second empirical study increases our understanding of UIP benefits in particular phases of an implementation project, we posed the following research question:

*RQ2: How are different forms of user involvement and participation in IS implementation projects related with effective use?*

Whenever an implementation project is completed, employees still need to learn how they can use an IS. To be able to effectively use an IS, employees also need to spend a considerable amount of time and effort

on learning how to operate its user interface and how to leverage its information to make better decisions at work (Burton-Jones & Grange, 2013; Liang, Peng, Xue, Guo, & Wang, 2015). Many organizations spend large amounts to enable users to use systems effectively after an implementation or renewal project. For instance, U.S. organizations spent approximately $164.2 billion on employee training, particularly to support IS implementations in the year 2012 (ASTD Research, 2013). The effect of learning in correspondence with user adaptation might also be explained by the fact that learning allows users to make educated adaptations, which are more effective in raising their level of effective use than uneducated adaptations (Burton-Jones & Grange, 2013). Learning is particularly important in an organizational context because most organizational ISs, such as enterprise resource planning (ERP) systems, allow little individual technical adaptations after the implementation (Boudreau & Robey, 2005). Moreover, these systems automate and integrate best-practice business processes which cannot be modified by individual users (Boudreau & Robey, 2005; Sasidharan, Santhanam, Brass, & Sambamurthy, 2012). Given this complex nature of ISs, along with the fact that adaptations of system or tasks are rarely possible, ISs pose significant challenges for individual learning (Boudreau & Robey, 2005; Yamauchi & Swanson, 2010). Employees inevitably need to learn how they can effectively use the system to do their job (Burton-Jones & Grange, 2013; Sykes, Venkatesh, & Gosain, 2009). Typically, the ongoing learning process starts when users attend training sessions before a new IS is rolled out (Sykes, 2015), but they continue learning to use the system while they incorporate it in their day-to-day activities (Boudreau & Seligman, 2005). Initially, users need to divert time to learn characteristics of the new system (e.g., its user interface) (Burton-Jones & Grange, 2013) and newly introduced business processes (Robey, Ross, & Boudreau, 2002). On their own initiative, they explore a new system's features or additionally available materials, such as manuals or online tutorials (Barki et al., 2007; Liang et al., 2015; Saeed & Abdinnour, 2013), experiment with unknown features (e.g. Spitler, 2005; Tennant, Mills, & Chin, 2015) or discover new ways of exploiting the system by trial and error (Beaudry & Pinsonneault, 2005). Furthermore, users communicate with peers or support staff to learn better ways to accomplish their work (e.g. Bruque, Moyano, & Eisenberg, 2009; Nan, 2011; Sykes et al., 2009). In sum, there are different learning opportunities in different contexts and at different points in time. However, it has not been clarified in which contexts users engage in learning and how this behavior ultimately affects the different dimensions of the effective use construct and their level of effective use overall. Thus, we contribute to research by refining the conceptual understanding of the effect of learning on effective use. Hence, we posed the following research question:

*RQ3: How do different forms of learning influence a user's ability to achieve effective use?*

While different forms of learning have an important effect on users' ability to use a system effectively, they are forms of an intermittent behavior that influences the behaviors that user actually engage in to use a system more effectively. Workarounds are one form of users' actions that show the level of knowledge that users have about a system and the intentions for its use as well as the shortcomings (Vassilakopoulou, Tsagkas, & Marmaras, 2012). Furthermore, these are present during the use of an IS and not just before the use. Users and organizations actually work around the problems they have during the use of their IS. The

sanctioning of the use of workarounds, is a symbiosis of organizational and individual means to improve the effective use of an IS, if an implemented IS has a lack of fit for the task (Alter, 2014). This is another means of managers, which they can use the post-implementation phase to improve the effective use of an IS. Hence, in our fourth study, we also tried to understand the influence of workarounds on the effective use of IS in the post-implementation use phase. The term "workaround" has been defined in various ways in different papers (Alter, 2014). Alter (2014) grounds the concept of workaround on agency theory and work system theory, and indicates that using a workaround is a collective action with the purpose to adapt insufficient functionality. Prior empirical evidence provides hints that workarounds can lead either to positive or negative impacts on individuals' ability to use a system – whether effectively or at all. From the perspective of negative impacts, a workaround can show the lack of understanding of an IS (Staehr et al., 2012). With regard to effective use, Burton-Jones and Grange (2013) argue that workarounds generally reflect uneducated adaptations. Nevertheless, workarounds can be an adaptation strategy for enhancing effective use. Workarounds can actually represent a group of users' consolidated knowledge of the standard system and show their ability to work around the issues of the standard system. Workarounds highlight these issues (Vassilakopoulou et al., 2012). As there is little research (Yang, Ng, Kankanhalli, & Luen Yip, 2012) which comprehensively explains how and why workarounds can improve the performance in a work system (Alter, 2013), we explore the relationship between workarounds and the effective use of implemented IS.

For this explorative research, we had the opportunity to analyze the use of an implemented supply chain management (SCM) system at a large chemical company. We conducted our explorative case-study research during a project in which the central IT department of the corporation aimed to understand and manage the several workarounds that had been developed around the implemented SCM system. The workarounds of interest to our research were part of employees' collective action to work around the shortcomings of a SCM for their particular business domain and their required routines. Thus, we posed the following research question:

*RQ4: How and why do workarounds influence the effective use of an information system in the post-implementation phase?*

In our fifth study, we focused on the analysis of users means to react to difficulties in use of implemented IS. Specifically, end users' adaptation behavior with regard to the system has a significant role in maintaining individual users' effective use after an implementation or renewal project. In contrast to our previous study, here it involves all means to change ones work with a system, except working around it (Burton-Jones & Grange, 2013). A higher level of technology integration into work systems can be achieved by a higher degree of adaptation (Beaudry & Pinsonneault, 2001; Cooper & Zmud, 1990; Leonard-Barton, 1988). This higher degree of integration can in turn be related to higher performance of the individual users (Beaudry & Pinsonneault, 2001). As outlined above, most current models of IT acceptance and use (e.g., Information System Success Model (DeLone & McLean, 1992, 2003), TAM (Davis et al., 1989), UTAUT

(Venkatesh, Morris, Davis, & Davis, 2003), and TTF (Goodhue & Thompson, 1995) treat user responses to working with systems as a black box (Barki et al., 2007; Elie-Dit-Cosaque & Straub, 2011). Elie-Dit Cosaque and Straub (2011) have answered Beaudry's and Pinsonneault's (2005) call for quantitative research on user adaptation in part, when they identified empirically distinct user adaptation strategies (Elie-Dit-Cosaque & Straub, 2011). In another study, Sun (2012) developed the concept of adaptive system use (ASU), which describes the user adaptation of features in use (FIU) initiated by triggers of user adaptation, which are not only planned changes such as projects, but also novel situations in an individual's work context or a discrepancy between initial expectation and the perceived reality. This study was one of the first studies to conceptualize and develop a construct for user adaptation and warrants further analysis and replication. Hence, we linked this construct of user adaptation with a newly developed measure of effective use (Lauterbach, 2015). We specifically analyzed the effect of user adaptation in the form of ASU on effective use, since the relationship of user adaptation and effective use has been conceptualized, but not yet measured empirically (Burton-Jones & Grange, 2013). Beaudry and Pinsonneault (2005) suggest that there is a reciprocal relationship between actual usage and effective use. This would be constituted as loops of appraisal of the changes and subsequent adaptation and explain an individuals' ability to adapt his/her own work (Burton-Jones & Grange, 2013), for example by adapting the system to fulfill a task. Hence, based on initial explorations in our first case study and theory we conceptualized a link between a replication of the original model by Sun (2012) and effective use for one adaptation cycle. We posed the following research question:

*RQ5: What is the effect of adaptive system use on effective use?*

In order to evaluate this link we needed to replicate the ASU model (Sun, 2012) and to operationalize the concept of effective use. When we look at the literature, we find that empirical studies on effective use are scarce (Burton-Jones & Grange, 2013). Thus, we had to open the aforementioned black box by developing a new measure for effective use. A colleague had already developed an initial set of measures (Lauterbach, 2015). This had allowed us to evaluate RQ5. Furthermore, it was necessary to analyze effective use in more detail in order to understand the relationship of its subdimensions. Specifically, we analyzed the relationship of the different sub-dimensions of effective use, which are transparent interaction (TI), representational fidelity (RF), and informed action (IA) (Burton-Jones & Grange, 2013). Although Burton-Jones and Grange (2013) discuss the concept of effective use and the possible relationships of its sub-constructs, there has been no empirical evaluation of the subdimensions. As an operationalization and resultant measurement is a crucial prerequisite to test and expand theories on effective use, we suggest that there is a need to operationalize the concept of effective use. We developed specific measures for the constructs of TI, RF, and IA. This enables us to seek an answer for the following research question:

*RQ6: What is the real relationship of transparent interaction, representational fidelity, and informed action as sub-constructs of effective use?*

We followed up on this initial study with a refinement of the operationalization of effective use based on a new operationalization. Our previous results had shown that further refinement of the measurement instrument and work on understanding the circumstances in which it can be used and deliver reliable results is needed. We also took into account that there might be alternative conceptualizations for the relationship of user adaptation, learning, and effective use that are more appropriate for the measurement of effective use.

By answering these research questions, this thesis adds to the refinement, analysis and extension of the nomological net of effective use and its subdimensions. This is the core theoretical contribution of this thesis. This thesis also contributes to the literature with two sets of items for the measurement of effective use and its subdimensions. These can be used in further research for additional and more detailed analysis of the nomological net of effective use in different contexts. Furthermore, this thesis contributes to literature by successfully replicating Sun's (2012) ASU Model. You can find an overview over the research questions in Figure 1.

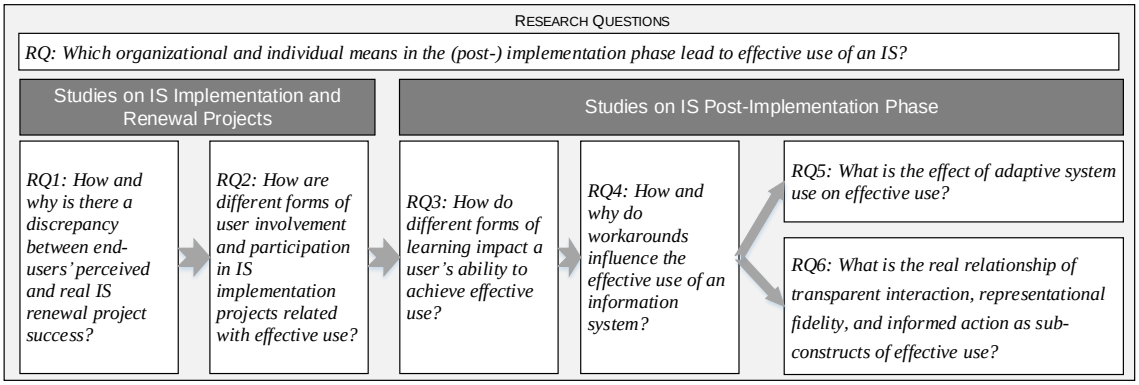



Figure 1: Overview of Research Questions and Research Areas

## 1.3 Research Paradigm

Overall, this thesis is based on a positivist perspective, which entails to assume that there is an objective reality that exists independent of individual observers (Orlikowski & Baroudi, 1991). Generally, we therefore assume the existence of an objective truth. Nonetheless, we followed the critical realism perspective for the specific purpose of exploring our research topic in the initial study. The critical realism perspective allows identifying the mechanisms behind the development of different perceptions of reality (Wynn & Williams, 2012). Following this perspective for the initial study was instrumental for identifying the significant drivers for effective use in implementation projects and use.

The research into the different identified research gaps (see also Figure 3) required the application of different research methods that allowed us to explore the different means in the implementation phase and in the post-implementation phase that lead to effective use. For the first explorative study in implementation projects, we decided to analyze one case company longitudinally with a single case study approach. This

single instant serves as a starting point for the search for an explanation in this dissertation project (Yin, 2009). For our subsequent analysis of multiple cases of IS implementation projects with regard to the effect of user involvement and participation (UIP) during projects on the perception of effective use we used a configurational approach (Ragin, 1989; 2000), which allowed us to identify the key UIP factors influencing effective use. The empirical studies for the investigation of the influence of individual user behavior in the post-implementation phase on the perception of effective use needed a different research approach. For the third empirical study we again used a case study approach and conducted an interpretive case study on the basis of the seven principles for interpretive field research developed by Klein and Myers (1999). This allowed us to refine and extend the effective use theory with regard to the effect of workarounds on effective use. Furthermore, we engaged in the extension and evaluation of the effective use framework with conceptual work based on insights from a systematic literature review (Webster & Watson, 2002) to further investigate the role of learning for effective use. For the identification of the role of user adaptation on effective use, we execute the replication of existing models in the domain (Dennis & Valacich, 2014), while we also develop and measure new items for effective use (MacKenzie, Podsakoff, & Podsakoff, 2011).

## 1.4 Thesis Structure

This thesis has the following structure subsequent to this introduction. First, I outline the theoretical background of the research presented in the following sections. This involves the presentation of research on IS projects and their success (see 2.1.) and research on user participation and involvement (UIP) in such projects (see 2.1.1). These are the necessary conceptual foundations for the research on the link between implementation projects and effective use. Furthermore, I will present different concepts of IS use and particularly the concept of effective use as developed by Burton-Jones and Grange (2013) (see 2.2). The theoretical foundations also include the presentation of research on individual user behaviors (see 2.3).

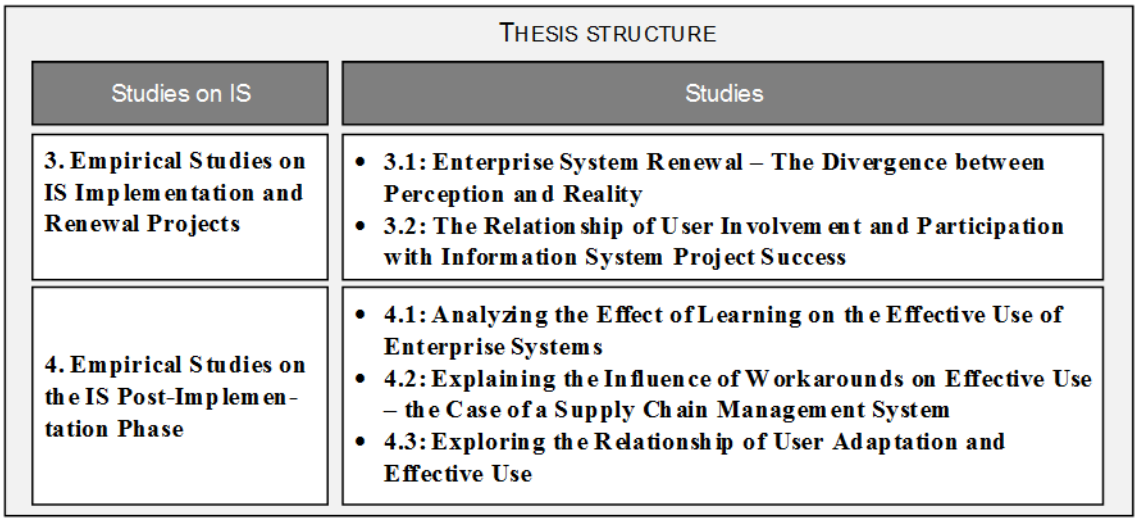



Figure 2: Overview of the Presented Studies

Specifically, those behaviors, which have been theoretically linked to influencing effective use (Burton-Jones & Grange, 2013). The main research focus has been on learning and user adaptation (Burton-Jones & Grange, 2013) (see 2.3.1 and 2.3.2). I add a presentation of the relationship of user adaptation and work-arounds (see 2.3.3.). Subsequently, I present the different studies. I present the studies on implementation projects in section 3 and the studies on post-implementation use in section 4 (see Figure 2). The study in section 3.1. addresses RQ1, while the study in 3.2 addresses RQ2. The corresponding study to the conceptual analysis of RQ3 is in section 4.1. Furthermore, I present the study on RQ4 in section 4.2. and the studies on RQ5 and RQ6 in section 4.3. This is followed by a discussion of the results of these empirical studies, the contributions, and their implications. Finally, I conclude this thesis with a short summary of the work and the contributions.

# 2 Theoretical Background and Related Work

We introduce the theoretical background and the related work necessary for this thesis in this section. This allows understanding the contribution to the research domains and the nomological net of this thesis. We present the overview of the three research domains in Figure 3. This also includes the presentation of the identified research gaps with the corresponding research questions. We have outlined that ensuring effective use (EU) early on in the implementation as well as in the post-implementation phase is a multi-level phenomenon (Gallivan, 2001). In both stages of an IS project, various stakeholders, such as end-users, key users, management, IT department, and customers have different, sometimes competing interests. However, we have identified the organizations and managers as the key influencing stakeholders during the implementation project. In post-implementation, individual users can influence the EU of an IS with their individual behavior and the level of use can be measured with different measures of use.

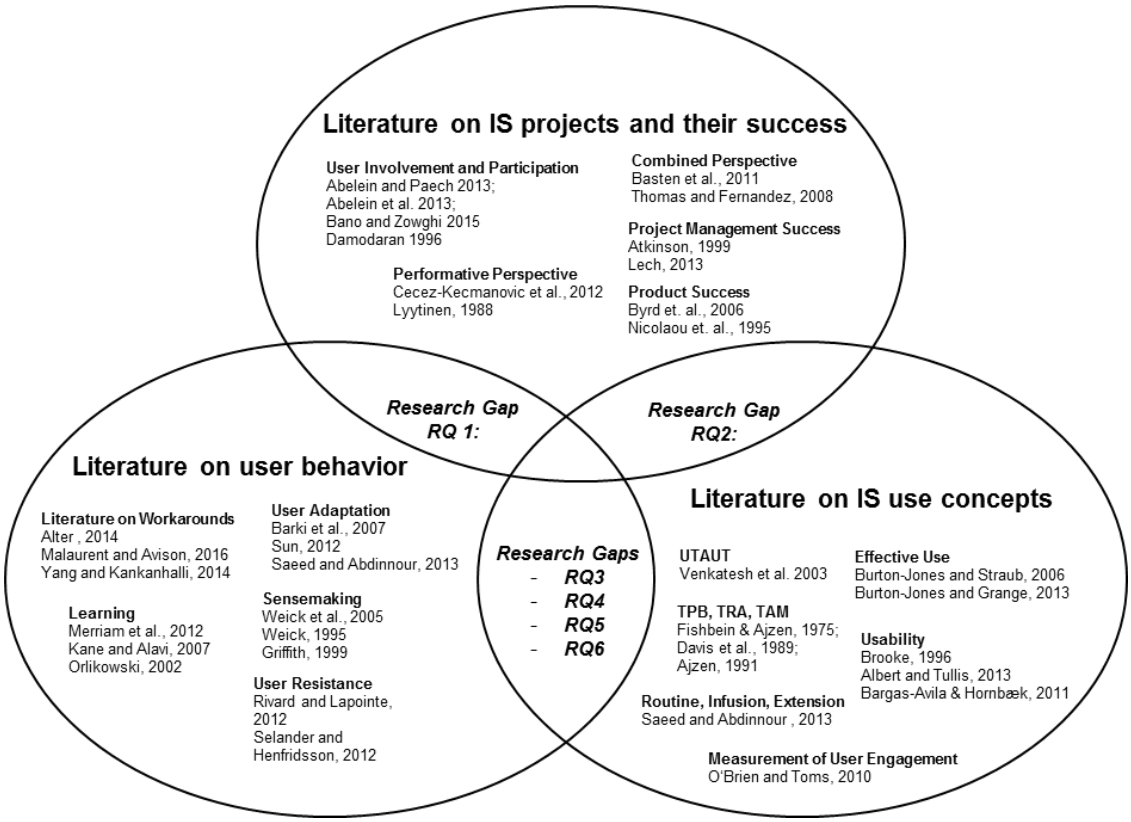



Figure 3: Overview of Identified Research Gaps

In light of the understanding of the crucial influence of different stakeholders in IS projects, we initially started to investigate the literature on IS projects and their success. Thus, we present an overview of the research on IS projects and particularly their success or the perception of success, respectively (see Figure

3). Keeping in mind that projects are multi-level phenomena, we identified the research gap that different perceptions of a projects success between users and managers had only been partially explained in current literature on sensemaking or the perception of success of IS projects. Upon further research, we also identified a second research gap in relation to different projects to manage users' involvement and participation in IS projects because we had also started to investigate the literature on different measurement concepts of IS use (see Figure 3). This, in turn, allowed evaluating a difference in level of use between different project conditions or perceptions of success.

For the IS post-implementation phase, where the system has been implemented and is used by end-users, we focused on evaluating the necessary research on drivers of effective and efficient use. We therefore studied the literature on user behavior and the measurement of IS use, which would allow us to relate certain use behaviors to measures of IS use (see Figure 3). Here, we identified the outlined research gaps with regard to the effect of user adaptation, workarounds, and learning on the effective and efficient use of IS as well as the need for an operationalization and measurement of the construct of EU. Only such an operationalization makes future specific evaluations of EU possible.

## 2.1 IS Projects and their Success[1]

In this section, we introduce relevant studies for research on IS implementation projects and their success, such as our studies presented in chapter 3. We have stated that IS projects are multi-level phenomena (Gallivan, 2001). They have an effect on many different stakeholders from management to end users. During a project interests of different stakeholders need to be observed and coordinated (Gallivan, 2001). Generally, a project has been defined as a temporary organization, which is established by its base organization to carry out an assignment on its behalf (Andersen, 2006). IS implementation, reorganization, organizational development, human development, and training projects can all be incorporated under the label of renewal projects (Andersen, 2006). These projects are initiated by the base organization to improve its level of functioning (Andersen, 2006). We define *renewal* projects as a special form of implementation project: the implementation of a new release of an already implemented software. However, we also analyze IS *implementation* projects that are initial IS implementation projects of standard software or specialized solutions, which involve customization.

Before and during an IS project, different stakeholders form expectations about the features and connected capabilities of the IS (Baronas & Louis, 1988; Bjerknes & Bratteteig, 1995; McKeen & Guimaraes 1997).

[1] This content is part of a submission to the International Journal of Project Management, which is currently under review. I also presented and discussed these parts of my research at the OASIS 2015 Workshop. Related content can also be found in the paper presented at WI2017 in St.Gallen:
Haake, P., Maedche, A., Müller, B., 2015. User Involvement in Enterprise System Implementation Projects – A Configurational Approach. 2015 OASIS Pre-ICIS Work. Fort Worth, TX, USA, December 12th, 2015.
Haake, P., Schacht, S., Mueller, B., Maedche, A., 2017. Enterprise System Renewal - The Divergence Between Perception and Reality. 13. Int. Tagung Wirtschaftsinformatik (WI 2017), St. Gall. Switzerland, 12.02. - 15.02.2017. Ed. J.M. Leimeister.

This is true for a renewal as well as for an initial implementation project. Aligning the expectations and related requirements of different user groups requires successful coordination efforts (Gallivan, 2001). Prior research with a specific focus on IS implementation and renewal projects has been based on the assumption that such projects are essentially disruptive and lead to changes to the technology as well as the work environment and the task (Bala & Venkatesh, 2013; Beaudry & Pinsonneault, 2005). Thus, stakeholders constantly evaluate the success of an IS project based on their daily experience of the implemented IS in relation to their original expectations of the changes to technology and work environment. This evaluation process can be very subjective for many stakeholder groups (Thomas & Fernández, 2008) and is grounded in diverse theoretical perspectives.

Hence, there is a lot of research about IS projects and system success as well as failure (Cecez-Kecmanovic et al., 2014; Doherty, Ashurst, & Peppard, 2011; Ewusimensah & Przasnyski, 1994; Fincham, 2002). Nonetheless, research and practice lack an agreed definition of success for IS projects in general (Thomas & Fernández, 2008). In part, this is attributable to the multiple facets of project success. As success is a multidimensional construct, it is subjective and depends on perceptions (Thomas & Fernández, 2008). However, many projects are considered to be failures (Love, Irani, Standing, Lin, & Burn, 2005). Moreover, several measurement criteria for the critical success factors have been defined in order to develop a common definition of IS project success. Nevertheless, it is important to distinguish between project management success and overall project success, if one wants to define whether a project has been successful or failed (de Wit, 1988). Organizations have to align many organizational goals in order to achieve project success. Unfortunately, little research has been conducted on IS project success which is bordering the research on IS success and project management success in general. It is widely agreed that the adherence to planning as in the "Iron Triangle" of time, budget, and quality is one part of project success. The Iron Triangle is the preferred measurement criterion for project management success in research (Atkinson, 1999; Lech, 2013) as well as business practice (Thomas & Fernández, 2008). Adhering to the iron triangle can be understood as project management success.

The measurement of project management success based on the Iron triangle of time, budget, and quality has many advantages, but also clear and distinct disadvantages. Time is an important criterion because it is easily measured, has a low complexity (Jugdev & Müller, 2005), and is an objective and rational criterion (Cecez-Kecmanovic et al., 2014). Adherence to a schedule can be measured upon the closure of a project and its progress can be assessed continually (Thomas & Fernández, 2008). However, problems with time as a measure of IS project success are that projects can be pushed through and managers lose sight of the other overall goals for the project (Jugdev & Müller, 2005). A project that finishes on time is not necessarily a success if it fails other objectives of the project (Lech, 2013). Furthermore, there is often a lot of uncertainty about the necessary timeframe at the beginning of a project (Atkinson, 1999; Lech, 2013). Realistic deadlines are therefore difficult yet crucial for project success (Thomas & Fernández, 2008). Other factors are also an issue as increases in the required time often occur because a project's scope changes (Lech, 2013).

The required budget is also a very important factor for the measurement of project success. Most projects are focused on the fact whether a project should be funded in general and not whether the project delivers the expected benefits (DeLone & McLean, 1992). It is important to measure the success of IS projects based on the variance itself and the reason for the variance of project budgets. Subsequently, a comprehensive analysis of the project and whether it stayed within budget can be carried out (Devine, Kloppenborg, & O'Clock, 2010). Adherence to a project budget is also of crucial importance to practitioners. It was ranked as being of highest importance in a study of Polish companies with large investments (Lech, 2013). Hence, completing a project within budget is a major goal in almost any organization, due to limited resources. It is also possible to measure whether the budget was met after each budgeting period, which makes it easy and timely to assess. However, the quality of the budget forecast is a crucial determinant for the assessment of project success based on the budget criteria (Thomas & Fernández, 2008).

Quality is also a rather inconsistent measure for project management success. In the common understanding, the term quality refers to the notion whether the product actually provides the initially determined functionalities (cf. Atkinson, 1999; Liberatore & Pollack-Johnson, 2013). This is also true for an IS. Quality and a sense of personal achievement have been identified as the most important determinants of project success in the eyes of project managers (Procaccino & Verner, 2006). Nevertheless, there might be issues with the assessment of quality. For instance, it is possible that the goals of a project are adapted or additional requirements are added (Atkinson, 1999). However, it is possible that users' and sponsors' requirements have changed during the course of the project or that they were not appropriately obtained. A project can be considered a success by some and as a failure by others (de Wit, 1988), even if a certain aspect is achieved whilst others are neglected (de Oliveira Lacerda, Ensslin, & Rolim Ensslin, 2011). Hence, even a project that meets all its predefined requirements can turn out to be perceived a failure.

However, there are also other dimensions of project success, such as a product related dimension that includes an evaluation of the project outcome (cf. Thomas & Fernández, 2008). IS project success has been defined in the past as the combination of a successful product and successful project management (Atkinson, 1999). Hence, we adopt the definition of Basten, Joosten and Mellis (2011), who defined that the adherence to planning in the form of the "Iron Triangle" is project management success. Product success is then defined as the effect of the product such as customer satisfaction and organizational benefits, whilst overall project success is measured as the combination of these two goals.

IS projects' success has generally been measured based on the dimension of IS product success (Byrd, Thrasher, Lang, & Davidson, 2006; Nicolaou, Masoner, & Welker, 1995). DeLone and McLean's model of IS success is the most widely known model for research on dimensions of IS success (1992). A more generalized approach for product success only includes the factors of the product and benefits provided to stakeholders (Atkinson, 1999). Product success for an IS on the user level is defined differently in different cultural contexts (Agourram & Ingham, 2007). Hence, product success is currently an ambiguous measure as the wide range of criteria for measuring project success suggest. Generally, it can be assessed based on

system performance, defined as the aspects of success that are directly related to IS products. These include for instance, perceived usefulness, information quality, and system quality (ease of use) (cf. Masoner, Lang, & Melcher, 2011) or items such as system reliability (Lech, 2013). Moreover, it is also possible to measure IS product success on the basis of indirect indicators such as user satisfaction (e.g. DeLone & McLean, 1992; Lech, 2013; Masoner et al., 2011; Saleh & Alshawi, 2005) or more general customer or stakeholder satisfaction (Thomas & Fernández, 2008). Customer satisfaction is partly defined as the combination of user satisfaction, project manager satisfaction, and senior managers' satisfaction (Basten et al., 2011; Lech, 2013). Another indirect and more general aspect of IS product success are the delivered business benefits such as business continuity (Thomas & Fernández, 2008), financial impact (Saleh & Alshawi, 2005), net benefits (DeLone & McLean, 1992), higher efficiency, and contribution to realization of company goals (Lech, 2013). Abelein and Paech (2013) identified strong interdependencies between the various system success factors user satisfaction, system use, system quality, project in time and budget, ease of use, data quality. Most studies avoid the issues of the unclear definition and use the construct user satisfaction as a proxy for system success. This could be due to the bias of researchers who focus much more on the human (Abelein & Paech, 2013). Wixom and Todd (2005) see perceived usefulness as synonymous to user satisfaction, as they equate perceived utility with satisfaction. Thus, we also deem usability (cf. Brooke, 1996) an appropriate measure of system success from the point of view of an individual user.

It is also important to determine the perception of success and its subjectiveness (Lech, 2013; Thomas & Fernández, 2008). Projects can be considered a success by some and failures by others (de Wit, 1988), even if a certain aspect is achieved whilst others are neglected (de Oliveira Lacerda et al., 2011). The perception of information system failure or success is largely stakeholder-dependent (Lyytinen, 1988). However, when goals are clearly defined and measured, these goals are more likely to be achieved (Thomas & Fernández, 2008). Whether a project is judged successful is then based on the importance that is assigned to the measures. It is especially important what was measured as the prime goal of the project (Atkinson, 1999). Nonetheless, items that are part of project success can be difficult to quantify, e.g. because they are intangible (Gable, Sedera, & Chan, 2003). These insights in combination with a socio-material approach have led to the development of a performative perspective on IS project success. IS projects can be determined to be successful and a failure at the same time (Cecez-Kecmanovic et al., 2014) - one man's trash is another man's treasure. This has been determined to be due to relational effects between actors in IS project networks. Actors in a project network value different aspects of the project and an implemented IS. Thus, they measure and evaluate IS project success differently as well. Different framings of IS success and failure have to be compared for such a measurement of IS success. IS project success is, therefore, socially constructed and perceived (Cecez-Kecmanovic et al., 2014). Generally speaking, IS project as well as the IS product can be evaluated and represented either on the basis of objective, positivist measures for IS success and socially developed, interpretivist measures (Cecez-Kecmanovic et al., 2014). We adjust for the different perceptions and use an objective approach that is grounded in the analysis of users' perception of project success.

This aspect of perception of success is crucially related to organizational sensemaking. Organizational sensemaking is focused on determining what an event means for members of an organization (Weick, Sutcliffe, & Obstfeld, 2005). Sensemaking is based on the idea of retrospectively making sense of events (Weick et al., 2005) such as a renewal project (Andersen, 2006). During the course of such a project, sensemaking in a group can be influenced by the social dynamics in the group of affected people. For instance, it is a crucial characteristic of a good team that members show a great deal of synergy and loyalty to each other and to their leader (Huczynski & Buchanan, 1991; McAvoy & Butler, 2009). However, these are also factors, which can lead to groupthink (Huczynski & Buchanan, 1991). In particular, hierarchical groupthink, which originates in the desire of individuals to please their leader by agreement in opinion, can have a strong influence on the assessment of project success. Especially, since employees' sensemaking can be strongly influenced by a management's narrative (McAvoy & Butler, 2009). For instance, employees (i.e. end-users) develop a reliable system (Weick & Roberts, 1993) to cope with perceived adversity, which might be caused by technological glitches in their work environment. This aspect of group dynamics is an important factor, when managers in organizations try to evaluate the most appropriate point in time to involve end users in an IS project. The appropriate involvement can have an influence on overall project success (The Standish Group International, 2013).

### 2.1.1 User Participation and Involvement and IS Project Success Research[2]

Generally, user participation and involvement (UIP) have been identified as positively related to IS project success in previous research (Abelein & Paech, 2013, Abelein et al., 2013, Bano & Zowghi, 2015, Harris & Weistroffer, 2009), although earlier literature reviews have produced conflicting results (Cavaye, 1995; Ives & Olson, 1984). Harris and Weistroffer (2009) name several advantages of UIP including preventing the adoption of unneeded, costly features and an improved quality of IS due to requirements that are more precise. The role of users in the provision of the tacit process and work context knowledge, which is necessary to evaluate requirements, is also highlighted by other researchers (Bano & Zowghi, 2015; Hendry, 2008). If users participate in a project, they are also more likely to claim ownership of a system (Hope & Amdahl, 2011) and thus get involved psychologically (Barki & Hartwick, 1989). Based on such an understanding, user participation can be seen as an antecedent of user involvement (Barki & Hartwick, 1994). McGill and Klobas (2008) have shown that such participating users perceive a new system as more useful and will have a more positive attitude towards a project. This aspect has also been identified by Abelein and Paech (2015), who state that UIP can help to increase user acceptance and users' understanding of an IS. In part, this can be attributed to

[2] This content is part of a submission to the International Journal of Project Management, which is currently under review. I also presented and discussed these parts of my research at the OASIS 2015 Workshop in Fort Worth, TX:
Haake, P., Maedche, A., Müller, B., 2015. User Involvement in Enterprise System Implementation Projects – A Configurational Approach. 2015 OASIS Pre-ICIS Work. Fort Worth, TX, USA, December 12th, 2015.

the fact that users develop a more realistic expectation regarding the features and connected capabilities of the IS (Baronas & Louis, 1988; Bjerknes & Bratteteig, 1995; McKeen & Guimaraes 1997).

The terms "user involvement" and "user participation" have often been used synonymously by researchers (Harris & Weistroffer, 2009; Bano & Zowghi, 2015; Kujala, Kauppinen, Lehtoja, & Kojo, 2005). This has happened in spite of early efforts to develop distinctive definitions for these two aspects of project management. For instance, Barki and Hartwick (1989) introduced the following definition: User involvement is a "subjective psychological state of the individual, defined as the importance and personal relevance of a system to a user", while user participation is a "set of behaviors and activities users perform in the system development process" (Barki & Hartwick, 1989, p. 53). We are going to follow this definition in this paper. Users can therefore be involved in an IS project without participating and performing any activities on their part (Bano & Zowghi, 2015). Similarly, Abelein, Sharp, and Paech (2013) define user involvement as the human aspect and user participation as an aspect of the development process.

Discussing UIP in more detail also requires a definition of the actual users of an IS. Several definitions of users have been employed in IS project research (Bano & Zowghi, 2015). Broadly defined, users are all non-technical employees of an organization who are affected by the IS (Carmel, Whitaker, & George, 1993). This implies that managers are also users, even if they do not use the system directly. A more detailed definition of users was provided by Eason (1989), who developed three categories of users: primary users, secondary users, and tertiary users. Primary users are frequent hands-on users of the system while secondary users use the system only occasionally or employ the system through an intermediary. Tertiary users are affected by the introduction of an IS or influence the purchase decision. The definition of user employed in this paper is informed by previous research and based on the definition provided by (Bano & Zowghi, 2015). Thus, we define a user as someone with direct interaction with the system or as someone who is going to have it in the future. We also include those users in our definition whose work and work environment is somehow affected by the IS. This definition includes primary and secondary users. We therefore consider tertiary users such as higher-level managers to be other stakeholders of an IS project.

With regard to the ideal point in time for UIP, Bano and Zowghi (2015) state that it is widely believed that user participation in early project phases is most effective, but they also point out that "user involvement and participation have been recommended throughout the software development lifecycle" (p. 161). However, it is not enough to involve users in any project stage. Instead, this has to be done in an appropriate manner. Bano and Zowghi (2015) also argue that the different project phases require different types and levels of UIP for an ideal contribution to project success. Considering different phases in more detail, UIP in requirements analysis helps to better understand the users' requirements (Bano & Zowghi, 2015) while in design and development it helps that the user requirements are purposefully transformed into technical solutions (Carmel et al., 1993); Lynch & Gregor, 2004). Moreover, user participation in the testing phase can ensure that the user requirements are fulfilled by the developed system while end user training helps that users learn how to use the system and therefore contribute to project success (e.g. Sabherwal, Jeyaraj, & Chowa, 2006). Based on the aforementioned

insights, we define the classification of phases for user participation (see Figure 4) (cf. Bano & Zowghi, 2015). Nonetheless, in all phases there can also be "token" user participation that does not really influence overall system success, but is rather a half-hearted measure to gather input from users (Lynch & Gregor, 2004). Thus, the degree and level of UIP as well as the point in time can influence project success (Bano & Zowghi, 2015).

The extent of user participation in an IS project can be categorized based on the assessment provided by Damodaran (1996) (see Figure 4). Damodaran (1996) developed an approach, which we adapted for the assessment of user participation over the course of a project. There are three levels of user participation of which the latter is the most extensive form: informative, consultative, and participative. The informative form of user participation means that users provide information to and receive information from the project team. That implies that users affect the project indirectly, but do not actively participate. If users have a consultative role, they comment on predefined services or a range of facilities. For instance, they comment different types of artifacts developed during the project (Bano & Zowghi, 2015). In a participative role users influence decisions that are related to the whole system (Damodaran, 1996). In such a setup, at least some users can be understood as part of the project team and are likely to be colocated with software developers (Bano & Zowghi, 2015). The level of user participation and the types of participating users is an additional characteristic of the particular configuration of a case.

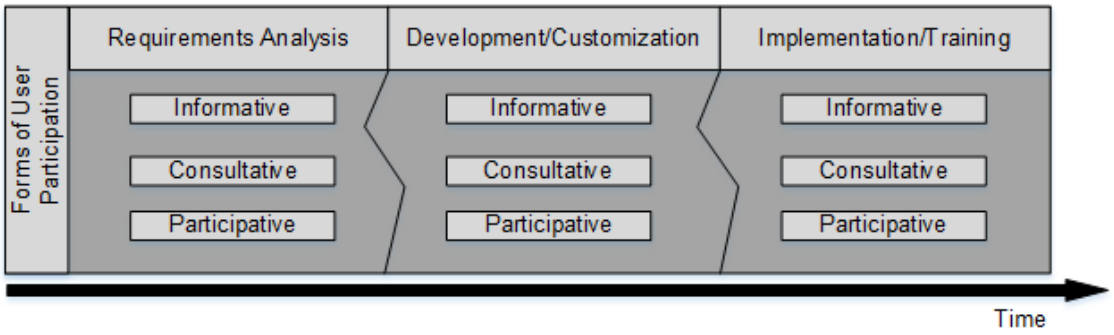



Figure 4: Research Framework User Involvement and Participation (based on Bano and Zowghi 2015; Damodaran 1996)

## Phases of IS projects and the relationship of UIP and IS project success

In previous research on UIP and IS project success different authors point out that UIP in early phases like requirements analysis is most important to capture the users' needs and therefore is most effective in improving IS project success (Bano & Zowghi, 2015; El Emam, Quintin, & Madhavji, 1996; Kujala, 2003). Especially regarding the 'requirements analysis' phase, Bano and Zowghi (2015) state that UIP has a positive effect on system success and assume that it is more effective in this stage than in other phases. UIP in requirements analysis can help to get more precise requirements and therefore can avoid expensive features, that might even not be needed, and improve the quality of the system (Abelein & Paech, 2013; Harris & Weistroffer, 2009).

Furthermore, different authors suggest that user training is a very important post-implementation intervention that increases user acceptance and system success (Sharma & Yetton, 2003; Venkatesh & Bala, 2008). Sabherwal et al. (2006) explain that user training within a project can lead to higher user involvement, even if users do not have a positive attitude towards the system. When involving users into an IS project, it is important that the participants represent a large part of the stakeholders to achieve system success (Markus & Mao, 2004), meaning that not only users of one specific user group should be included. Similarly, Damodaran (1996) point out that it is important "to ensure that those appointed [to present the users] are genuinely representative of the user population and possess the necessary personal attributes" (p. 366). Bradley and Lee (2004) point out that training has a positive influence on efficiency, effectiveness, and ease of use and therefore also on usability. However, it needs to be measured to which degree the different initiatives such as user training improve the level of efficiency, effectiveness, ease of use, or usability have a positive effect. Therefore, we introduce different IS use concepts and particularly a conceptualization of a theory and measure for efficient and effective use in the following section.

## 2.2 IS Use Concepts and the Concept of Effective Use[3]

Many different IS use concepts have been developed in IT acceptance and use research to measure system use. However, as mentioned before, most of the concepts (e.g., Information System Success Model (DeLone & McLean, 1992, 2003), TAM (e.g. Davis et al., 1989), UTAUT (Venkatesh, Morris, Davis, & Davis, 2003), and TTF (Goodhue & Thompson, 1995) treat user responses in their interaction with a system as a "black box" (Barki et al., 2007; Elie-Dit-Cosaque & Straub, 2011). Earlier results have shown that there is a significant relationship between system use measured with lean measures and individual impacts (DeLone & McLean, 2003). Furthermore, in many studies a significant relationship between system qualities such as the perceived ease of use and individual impact such as job performance was identified (DeLone & McLean, 2003). There were similar results for the influence of information quality (DeLone & McLean, 2003). However, research on IS use has been primarily focused on initial usage and adoption (Benbasat & Barki, 2007). An integrative view of the different approaches and stages of the adoption process as well as a common definition of post-adoptive use are scarce and not established in the field (Schwarz & Chin, 2007). However, research in this area focuses rather on the initial adoption or continued use, once the system has been adopted. Whether system use is mandatory has a significant impact on the evaluation of adoption and use. In our research, we focus on the usage of IS, which is essential for executing the job in the respective enterprises, and where usage is enforced (Hsieh & Wang, 2007). Nevertheless, the extent and kind of system usage still dependents on users' satisfaction with prior system use (Bhattacherjee, 2001). User satisfaction is determined by perceived usefulness and confirmation of expectation following actual

[3] This is in part content from Gnewuch, U., Haake, P., Mueller, B., Maedche, A., 2016. The Effect of Learning on the Effective Use of Enterprise Systems. Proc. Int. Conf. Inf. Syst. 2016, December 11-14, 2016, Dublin.
Related content is also included in the submission to Information & Management, which is based on the SIGADIT- workshop-paper: Haake, P., Schacht, S., Lauterbach, J., Mueller, B., Koegel, C., Maedche, A., 2016. Operationalization and Measurement of the Concept of Effective Use. Proc. 26th Annu. SIGADIT-Workshop, De-cember 11-14, 2016, Dublin.

use. Perceived usefulness is expected to directly influence IS continuance intention. In addition, users' extent of confirmation is positively associated with the perceived usefulness of IS use.

The measurement of different forms of use requires different measures in all phases of use. Lean measures are purely focused on usage alone, while rich measures are also a reflection of the nature of use, and involve system, user, and or task (Burton-Jones & Straub, 2006). Mainly, individual system use has been measured with surveys due to a lack of access to other data gathering methods. Burton-Jones and Straub (2006) developed an overview of such rich and lean measures of system usage. Measures that measure only whether a system is used at all, were defined as very lean (Alavi & Henderson, 1981). Other lean measures measure the duration or extent of use (e.g. Venkatesh & Davis, 2000). Richer measures either measure the breadth of use in terms of number of features (e.g. Saga & Zmud, 1994), the cognitive absorption of the user (e.g. Agarwal & Karahanna, 2000), the variety of use (number of sub-tasks) (e.g. Igbaria, Zinatelli, Cragg, & Cavaye, 1997), and the extent to which a user uses the deep structures of a system to carry out a task (Burton-Jones and Straub, 2006).

It has therefore long been recognized that simple IS use in itself is not sufficient to result in significant productivity gains in the post adoption phase (Jain & Kanungo, 2005; Zmud & Apple, 1992). In order to reach a sustainable increase in productivity, the consideration of the variable nature of this use and the assurance of an effective continuance (Bhattacherjee, 2001; Jain & Kanungo, 2005) are of great importance. It has therefore been a concern to conceptualize IS use in the post adoption phase (Jasperson, Carter, & Zmud, 2005) and to develop rich measures for it. Jasperson et al. (2005) describe post-adoptive use as a combination of the initial feature use decisions, the feature use behaviors themselves, and further feature extension behaviors. This definition highlights that in the post adoption phase, an expansion of the scope of IS usage can take place. Moreover, conceptualizations that refine the post-implementation phase into further stages suggest that each phase might, in turn, embody a different use pattern (Saeed & Abdinnour, 2013; Saga & Zmud, 1994): In the first phase, routinization, users get acquainted with the features that they need for their regular tasks. This can be measured based on the extent of integration of an IS into an employees' normal work routines (Saga & Zmud, 1994). This is also the part of usage during which habits form, i.e. users perform usage behaviors automatically because they have learned how to execute tasks with a software (Limayem, Cheung, & Chan, 2003; Polites & Karahanna, 2012, 2013). We can understand routine use as an exploitative use behavior.

Infusion, the next stage, describes the point at which users begin to integrate the IS into their work and integrate it in the organizations' work processes (Saeed & Abdinnour, 2013). Furthermore, infusion refers to the extent to which an employee fully uses an IS to improve her productivity (Jones, Sundaram, & Chin, 2002; Sundaram, Schwarz, Jones, & Chin, 2007). Therefore, infusion on the individual level can be understood similarly to infusion on the organizational level, where it has been studied concerning the diffusion of innovations in organizations (Cooper & Zmud, 1990; Sundaram et al., 2007; Zmud & Apple, 1992). In the stage of infusion, end users use an IS comprehensively and use more of the available features for the

existing tasks (Cooper & Zmud, 1990; Saeed & Abdinnour, 2013; Saga & Zmud, 1994). Thus, it is an exploitative use behavior. Other authors have named this use behavior as integrative use (Abdinnour-Helm & Saeed, 2006). For instance, an individual does not just use the features of a system for which usage is regularly enforced, but also makes voluntary use of additional features, which enable her to make a better job. Sundaram et al. (2007) have shown that infusion can have a significant impact on the performance of end users.

In the last stage of the post adoption phase, users explore the potential of the IS in a novel context and apply it to new tasks (Saeed & Abdinnour, 2013; Saga & Zmud, 1994). This is an innovative form of use which goes beyond the usual norms for IS use in an organization. It is the explorative use behavior. For one part, the use behavior in this phase can involve pure extension, which means using more new features of a system for supporting one's task execution (Hsieh & Wang, 2007; Wang & Hsieh, 2006). Another part of this use behavior can involve emergent use, which means using an IS in an innovative manner to support one's own task performance (Wang & Hsieh, 2006). As such the concept of emergent use also refers to use of an IS for tasks that were not recognized or feasible without the use of the IS (Saga & Zmud, 1994; Wang & Hsieh, 2006). The concept of emergent use is also very close to the concept of 'trying to innovate' as conceptualized by Ahuja and Thatcher (2005), who define it as an individual's goal of finding novel uses of information technologies. Extended and emergent use are relatively rich measures for user behavior (Burton-Jones & Straub, 2006). Moreover, they can be described as generally being attributes of the phase of extended use as categorized by Saeed and Abdinnour (2013). Thus, these different concepts of use belong to the same class of things (Weber, 2012), which we call deep usage similar to the concept of deep structure use (cf. Burton-Jones & Straub, 2006; Wang & Hsieh, 2006). Using features that support the underlying structure of a task is defined as deep structure usage (Burton-Jones & Straub, 2006), while deep usage is defined as the extent of use of different features of an IS (Wang & Hsieh, 2006). Both concepts capture the extent of use of an IS. One describes the concrete state of extensive use of features of an IS (Burton-Jones & Straub, 2006), while the other (Wang & Hsieh, 2006) encompasses use behaviors in the state of extensive use. While these different conceptualizations of exploitative and explorative use capture different forms of use in the post-implementation stage, they do not measure the effectiveness of users' interaction. We therefore engage in the exploration of potentially more comprehensive concepts such as effective use (EU) (Burton-Jones & Grange, 2013; Burton-Jones & Straub, 2006). This decision has also been informed by the increasing research interest in the effectiveness of IS use (e.g. Liang et al. 2015; Veiga et al. 2014).

EU of an IS can be defined as "using a system in a way that helps [to] attain the goals for using the system" (Burton-Jones & Grange 2013, p. 633). For instance, the EU of an IS can be hampered by confusing menus or screens. An ill-designed feature will reduce employees' ability to extract the meaning of the presented data (lack of representational fidelity). As a consequence, they get less time to focus on the implications (lack of effectiveness) and may have to spend extra time to search for complete data in order to get the full picture (lack of efficiency) (Burton-Jones & Grange, 2013). The presented definition of EU is an adaptation of the definition for system use by Burton-Jones and Straub (2006) in that a system, a user, and a goal-

directed task are the basic conceptual constituents of system use. The focus of this expression was shifted towards the use of a system to attain a *relevant* goal, which introduced the distinction between plain system use and EU. Moreover, EU builds upon representation theory following ontological considerations of Wand and Weber (1995) and Weber (1997). Representation theory, which has been used to conceptualize enterprise systems in general (Strong & Volkoff, 2010), defines three layered structures. Surface structures are "the facilities that are available […] to allow users to interact with the information system" (Weber 1997, p. 78) such as graphical user interfaces. Deep structures are scripts that represent real world entities such as things, properties, states, and transformations between these states. In other words, deep structures represent for example data, functionality, and behavior of the software system. Physical structures describe how deep structures are mapped to the underlying hardware system. These structures "represent" states and state changes of real world systems or a domain such as an organization (Burton-Jones & Grange, 2013). Important in representation theory is that the structures are faithful representations of a real world domain. People use systems to interact with its representations and users want faithful representations, because they "provide a more informed basis for actions than unfaithful representations do" (Burton-Jones & Grange 2013, p. 636). In interactions with a system, a user will access representations in the underlying deep structure through surface and physical structures (Wand & Weber 1995; Burton-Jones & Grange 2013).

From these theoretical foundations, Burton-Jones and Grange (2013) define EU as an aggregate construct formed by three dimensions: Transparent Interaction (TI), Representational Fidelity (RF), and Informed Action (IA). To obtain benefits from an IS – that is, achieve work goals such as successfully completing a task – a user must be able to access the representations through the system's surface and physical structures (Burton-Jones & Grange 2013). Following these ideas, TI is defined as "[…] the extent to which a user is accessing the system's representations unimpeded by the system's surface and physical structures [while interacting with the system]" (Burton-Jones & Grange 2013, p.633). How faithfully deep structures represent a domain (e.g., characteristics of a task in a certain business domain) could be defined as a property of the system, that is, how well data structures and data objects in a data base system of the IS match the real world entities they are supposed to represent. For example, a loan contract needs to be correctly mapped on data fields and values in a Loan Management System (LMS). However, RF is defined in terms of what users obtain from the system when using it, that is, fidelity that users' actions such as entering, manipulating, retrieving, or viewing representations are processes by the system appropriately and that the system and the tokens that populate the system, in turn, faithfully reflect the domain the system represents (Burton-Jones & Grange 2013). Thus, RF is defined as "[…] the extent to which a user is obtaining representations that faithfully reflect the domain that the system represents [while interacting with the system]" (Burton-Jones & Grange 2013, p. 633). The main purpose of using a system (utilitarian use) in an organizational context is to achieve an organizational goal such as completing a task. For that purpose, users interact with a system and leverage representations (enter, viewing, retrieving, etc.) of the system to perform actions. The more the user is able to act upon faithful representations, the more informed will her actions be. Ill-informed actions based on unfaithful representations lead to additional effort for correcting errors or bad

decisions (Burton-Jones & Grange 2013). Ergo, IA is defined as "the extent to which a user acts on faithful representations that he or she obtains from the system to improve his or her state in the domain" (Burton-Jones & Grange 2013, p. 633). As mentioned before, the sub-construct TI, RF, and IA are hierarchically related to one another with their aggregate constituting EU (Burton-Jones & Grange, 2013). TI helps to increase RF, which in turn can lead to IA (Burton-Jones & Grange, 2013). Burton-Jones and Grange (2013) propose that the overall level of EU of an individual using a system is defined by the aggregate levels of TI, RF, and IA. In effect, EU is defined as an aggregated construct (Burton-Jones & Grange, 2013; Law, Wong, & Mobley, 1998) and can be described as the desired state that users try to achieve once they are confronted with a new technology. Users who make few errors in their work will likely reach an improved state in their business domain. The type of performance improvements that can be expected are likely to be the reduction of errors, faster work, and increased revenues for the firm overall (Beaudry & Pinsonneault, 2005; Goodhue & Thompson, 1995; Pentland, 1989; Vessey & Galletta, 1991). Our research focuses on the hierarchical relationship of TI, RF, and IA and how they collectively form EU.

In addition, we also relate the concept of usability with EU. To perform their work in an effective way, users are reliant upon the usability of an IS. Usability can therefore be interpreted as a proxy for users' ability to use a system effectively. End users' perception of usability can be measured with the system usability scale (SUS) (Albert & Tullis, 2013; Brooke, 1996), which can be used for the evaluation of overall project success and therefore to compare the level of overall usefulness of implemented IS. This perception is based on the knowledge that usability is a very important software product characteristic (Grudin, 1991). It is a higher design objective and an attribute of software quality (Folmer & Bosch, 2004). Moreover, it is not considered a functional, but rather a quality requirement. Especially in the eyes of psychologists, it represents a hygiene factor for users (Bargas-Avila & Hornbæk, 2011). Keeping these insights in mind, we used usability as a proxy and alternative measure, while we continually strived to expand and explore the nomological net of EU and to develop a set of measures for EU and its subdimensions in the empirical studies that we present in the following sections.

Exploring the nomological net of EU also involves the investigation of the behaviors that influence the level and effectiveness of use, such as learning and adaptation (Barki et al., 2007; Benbasat & Barki, 2007; Burton-Jones & Grange, 2013). Therefore, Burton-Jones and Grange (2013) link their concept of EU with user adaptation behavior during system use and the general concept of learning, which influences the ways to use the system. Furthermore, we also explore the link of user adaptation and workarounds, which extends the nomological net of EU.

## 2.3 Literature on User Behavior

In the preceding section, this thesis presents literature on different forms IS use concepts, which are often measuring some form of use or describing the adoption and diffusion of IS use in a stage model (Jasperson et al., 2005). As mentioned before, most of the literature in this area has been focused on adoptive and diffusion

of IS use (e.g. Venkatesh et al., 2003) and only recently developed towards measuring different forms of use, such as effective use (EU) in the post-adoption phase (Burton-Jones & Grange, 2013). Those forms of use are likely to be influenced by a users' behavior in and around their use. For instance, in the post-implementation stage, users' resistance, indifference, routinization, exploration, and extension of use can influence the obversable level of their use (Jasperson et al., 2005). These user behaviors can influence the measurements for lean measures such as frequency of use but also rich measures such as EU (Burton-Jones & Grange, 2013). Since the research in this thesis is focused on the EU of IS in the post-implementation stage, this thesis addresses mostly the user behaviors, which have been conceptualized as having a strong influence on EU (Burton-Jones & Grange, 2013). Burton-Jones and Grange (2013) identify learning and adaptation actions as drivers of EU. Users' learning and adaptation actions can help to improve EU immediately. Learning allows users to become more knowledgeable and they can use this knowledge to improve their interaction with the system or the systems content in such a way that their interaction with the system becomes more efficient and effective. Furthermore, learning is also part of the sensemaking process of individuals whenever they encounter a system and start using it (e.g. Henfridsson, 2000). Whenever users do not engage in learning of the system, but instead reject using a system overall or parts of it, they are in a state of user resistance (e.g. Kim & Kankanhalli, 2009; Rivard & Lapointe, 2012). While we explore the sensemaking of different stakeholders in the first case study, this was just part of our initial explorative research and therefore not the main focus of our research. Hence, we do not present detailed background on sensemaking, but much rather on the specific aspect of learning. We also do not present more details on user resistance, as it is very unlikely that user resistance results in EU of an IS. Hence, we are initially going to present theoretical background on the concept of learning and then proceed to presenting insights on user adaptation as well as the relationship of user adaptation with the concept of workarounds (Alter, 2014).

### 2.3.1 The Concept of Learning[4]

Psychologists have extensively studied human learning processes and developed various competing learning theories based on behaviorist, humanist, cognitivist, social cognitive, or constructivist approaches (Merriam, Caffarella, & Baumgartner, 2012). We adopt the definition of learning as "a process that brings together cognitive, emotional, and environmental influences and experiences for acquiring, enhancing, or making changes in one's knowledge, skills, values, and world views" (Merriam et al., 2012) and now address learning in IS research.

**Forms of learning:** Learning to effectively use an IS takes place in different contexts or situations. Based on a literature review, we identified three main contexts: (1) training, (2) individual (self-learning), and (3) social interaction. First, training has been found to be an important source for learning (Boudreau & Seligman, 2005) and users seek training when they want to learn how to use an IS (Beaudry & Pinsonneault, 2005). In general,

[4] This is in part content from Gnewuch, U., Haake, P., Mueller, B., Maedche, A., 2016. The Effect of Learning on the Effective Use of Enterprise Systems. Proc. Int. Conf. Inf. Syst. 2016, December 11-14, 2016, Dublin.

organizations offer their employees training programs before a new IS is implemented to prepare them for using the new system in their day-to-day tasks (e.g. Sharma & Yetton, 2007; Venkatesh, 1999). Therefore, for most users, training represents the first opportunity to learn about the features of a new IS and as a result, it will affect their beliefs and attitudes towards it (Xia & Lee, 2000). Formal training approaches include classroom-style training sessions (Sykes, 2015), technology-mediated learning methods (Gupta & Bostrom, 2013) and the provision of training materials, such as manuals or documentation (Sasidharan et al., 2012). However, researchers point out that even the best training programs cannot anticipate all complexities of actual on-the-job use because the opportunities for learning are limited (Sasidharan et al., 2012; Sykes, 2015). These limitations result, for example, from rigid training cases which hinder individual exploration of the system (Lauterbach, Mueller, Kahrau, & Maedche, 2014). Second, users learn independently to improve their knowledge of an IS (Barki et al., 2007) to use it more effectively. In this individual context, users experiment with a new system (Maruping & Magni, 2012; Spitler, 2005; Tennant et al., 2015; Yamauchi & Swanson, 2010), explore previously unused features (Ke, Tan, Sia, & Wei, 2012; Liang et al., 2015), or read more about a system's functionalities in provided manuals (Bagayogo, Lapointe, & Bassellier, 2014; Spitler, 2005). Furthermore, IS research highlights the importance of learning-by-doing, that is, users learn from experience by using the system to work on their specific tasks (Ryu, Kim, Chaudhury, & Rao, 2005; Torkzadeh, Chang, & Hardin, 2011). Third, learning how to effectively use an IS also occurs in the context of social interaction (Sasidharan et al., 2012; Spitler, 2005). Social interaction unfolds through interpersonal ties between employees which may be embodied by communication, advisory, or supervisory relationships (Nan, 2011). Nan (2011) defines social learning as the "mental activity of perceiving, evaluating, and adopting the more productive practices of others in the workplace" (p. 520). If users experience problems during the usage of an IS, they frequently rely on their social network to get help (Bruque et al., 2009). Typically, users ask more knowledgeable peers for support (Sykes et al., 2009) or contact the help desk or IT staff (Saeed & Abdinnour, 2013). Sykes (2015) stresses the advantages of peer support over support from IT specialists because peers possess better work domain knowledge. Researchers have observed that users freely share their knowledge (e.g., how to use a particular functionality) within their team without any formal instruction (Wagner & Newell, 2007). Thus, users constantly learn from others by observing their peers and adopting their work practices, which enables them to use the system more effectively. It is an important difference between these contexts that training is typically a structured and formal activity to stimulate learning, while learning in an individual context and via social interaction mostly occurs in an unstructured and unplanned way based on a "need to know" basis (Boudreau, 2003). As mentioned before, training typically takes place before go-live of a new system, whereas users engage in individual learning or ask peers for assistance when they are actually using the system in the post-implementation phase. Hence, user training often takes place before users actually have to deal with the new system and new processes on a daily basis, implying a temporal separation (Sykes, 2015).

**Learning subject:** In the context of IS, learning processes often involve different learning subjects (i.e., what is learned). Learning how to effectively use a system can be achieved through learning its structures (i.e., surface or deep structure), the tokens (i.e., data) that populate it, and the domain (Burton-Jones & Grange,

2013). Boudreau and Robey (2005) observe that ERP system users have learned the surface structure because they know which buttons to push but struggle with its deep structure and rely on shadow systems for complex tasks. For example, during training, users learned how data (e.g., simple loan contracts) is represented in a loan management system (Lauterbach et al., 2014). Domain knowledge is another import subject of learning because it helps users to navigate and use a system effectively (Sykes et al., 2009). Moreover, users can learn the business processes which are defined by the organization and embedded in an IS (Robey et al., 2002). ESs represent the state of business processes (Liang et al., 2015) and through learning these processes, users can better understand how the system is meant to support them in carrying out their tasks.

**Factors influencing learning:** Several factors influence a user's learning behavior and significantly affect the learning success: (1) technical, (2) individual (i.e., user), and (3) organizational. Technical factors, such as IS' complexity, affect how users perceive the need to learn a system (Kanter, 2000). A user needs to spend more time for learning complex systems as opposed to simple systems (e.g., ES vs. word processor) (Boudreau & Seligman, 2005). Moreover, individual characteristics, such as a user's self-efficacy (Barki et al., 2007), personal innovativeness (Sun, 2012), or intrinsic motivation (Ke et al., 2012), have been found to influence the learning process. Additionally, research indicates that demographic factors (e.g., age, gender) can impact the learning process (Maruping & Magni, 2012). Finally, organizational factors, such as organizational learning climate (Maruping & Magni, 2012), influence how individuals engage in learning.

### 2.3.2 The Concept of User Adaptation and the Construct of Adaptive System Use (ASU)[5]

There is a diverse body of research on the adaptation processes during technology implementation and use (DeSanctis & Poole, 1994; Fichman, 2004; Leonard-Barton, 1988; Orlikowski, 1996, 2000; Rice & Rogers, 1980; Tyre & Orlikowski, 1994). Researchers in this field commonly agree on the following: The flexibility of interpretation of a system's purpose makes adaptation possible (Fichman, 2004; Orlikowski, 1996). Thus, identical technology can be used in very different ways (DeSanctis & Poole, 1994; Fichman, 2004). The lack of technological fit of standard software often makes adaptation necessary (Fichman, 2004; Leonard-Barton, 1988). Furthermore, the need for technology adaptation emerges over the course of an implementation project (Fichman, 2004; Orlikowski, 1996). Thus, the modification or introduction of an IS can cause changes in an organizational environment or be disruptive for it (Louis & Sutton, 1991; Lyytinen & Rose, 2003). Users are required to adapt when such an IT event occurs. User adaptation actions have been defined as any actions users take to improve a system's representation of a domain of interest or any action to improve the systems physical structures and surface to improve the access to the representations (Burton-Jones & Grange, 2013). This definition of adaptation actions is grounded in the assumption that users can conduct adaptation actions,

[5] This section contains content from Haake, P., Lauterbach, J., Mueller, B., Maedche, A., 2015. The Effect of User Adaptation on the Effective Use of Enterprise Systems. ICIS 2015 Proc. 36th Int. Conf. Inf. Syst. Fort Worth, United States, December 13-16, 2015. and Haake, P., Schacht, S., Maedche, A., 2017 Adaptive System Use Revisited – A Methodological Replication. AIS Transactions on Replication Research (TRR), resubmitted after first review.

for example by changing programs or data directly or at least by sending a change request to the IT department (Barki et al., 2007; Burton-Jones & Grange, 2013). Thus, adaptation behavior can be understood as coping acts (Beaudry & Pinsonneault, 2005). These acts are mainly based on the user's initial assessment of new IT (Beaudry & Pinsonneault, 2001). Beaudry and Pinsonnault (2005) established the two staged appraisal process and subsequent individual adaptation strategies based on initial appraisals. The adaptation strategies that follow from this are empirically distinct (Elie-Dit-Cosaque & Straub, 2011). Users often go through several adaptation cycles and continuously adapt to technology (Beaudry & Pinsonneault, 2005; Sun, 2012).

We can take an example from our case study in our first empirical study to illustrate the definition of the concept of user adaptation: The team leaders were enabled to modify the user interface for their role in system use. They adapted to the occurring discrepancies between system design and their current task by modifying the display of items on their user interface depending on the degree of convenience for their daily job and their most common tasks. This indicates that when users adapt to gather more knowledge about an IS and deploy more features, they are more likely to understand and leverage the representation more effectively and approach a state of EU (Liang et al., 2015). Hence, we observe similar to Stein et al. (2015) that when users are pleased with the system function, but are frustrated by other unexpected changes, users personalize the way they use the standard system. Stein et al. (2015) further explain that in such cases, users do not have to make a trade-off between the benefit and threats brought by the standard system. Instead, users can reach a win-win situation, in which both the organizational and their own goals can be achieved. For our quantitative research in this area, we base our efforts on a specific understanding of user adaptation explained by Sun (2012), which in turn was based on the aforementioned research.

ASU has recently been suggested as a concept to capture user adaptation behavior to a new IS (Sun, 2012). Sun (2012) defined the new term of *features in use* (FIU), which is to him the "basket of system features that are ready to be used by a particular user to accomplish a task" (Sun, 2012, p. 455). ASU concerns not just an individual feature of a system, but rather an individual user's FIU. In relation to the aforementioned aspects of FIU, Sun (2012) states that ASU has two sub-dimensions, which are a user's revisions of the content of FIU and the revisions of the spirit of FIU, i.e. how the individual uses features. These two dimensions also have sub-dimensions. A revision of the content of FIU, i.e. which features are used by individual users has the sub-dimensions of "trying new features" (Barki et al., 2007; Jasperson et al., 2005; Sun, 2012) and "feature substituting" (Parthasarathy & Bhattacherjee, 1998; Sun, 2012). Alternatively, users might use features not in the way that they were specified to be used by a vendor. This would be a revision of the spirit of FIU. The sub-dimensions of the revisions of the spirit of FIU are "feature combining" and "feature repurposing".

**Original Model:** The original model was developed by Sun (2012) based on Louis' and Sutton's (1991) research on the behavioral change of individuals between active and habitual thinking (see Figure 5). Louis and Sutton (1991) identified three triggers for active thinking in their original study. These triggers were

*Novel Situations*, *Discrepancies*, and *Deliberate Initiatives*. The definition of the triggers is linked to contradictions or interruptions. These contradictions can be, for instance, a misfit between a tool and a task (Kuutti, 1995). A *Novel Situation* is a situation in which a user has a new task, which requires the use of a new feature or system. This can be linked to the example that an employee needs to work with the "track changes"-function because she started to work collaboratively on a document with her boss. A *Discrepancy* is given, when there is a contradiction in the current use of a system (Burton-Jones & Straub, 2006). This can be the case, if a feature does not create the expected outcomes (Jasperson et al., 2005) because of a contradiction between a feature and a task. For instance, if a user employs the feature vlookup instead of hlookup, when that would have been appropriate. A *Deliberate Initiative* can be understood as a contradiction between two system use activities. For instance, if a boss asks employees to use a feature that is new to them and the employees have to adapt/ to learn/ to use the new feature.

The aforementioned triggers do not automatically result in a specific adaptation action or active thinking (Louis & Sutton, 1991). It is rather due to an individual's sensemaking of a trigger what and if specific action follows. The aforementioned triggers might be present in parallel and influence each other. For instance, if a new employee joins a company and faces novel situations as well as a discrepancy in the use of technology compared to a previous employer (Sun, 2012; Louis & Sutton, 1991). Sun (2012) developed his research model of this basic understanding of the adaptation context. Individual and external influencing factors are represented in the overall research model. The individual factors are captured with the measure of personal innovativeness in the use of IT (PIIT). PIIT is defined as an individual trait which is supposed to reflect an individual's willingness to try out new technology (Agarwal & Karahanna, 2000; Agarwal & Prasad, 1999; Sun, 2012). Sun (2012) chose PIIT, because it is a domain specific determinant of individual behavior. External influencing factors are obtained by describing the facilitating conditions (FCond) comprising the degree to which an individual feels supported by the organizational and technical infrastructure for support of his or her use of an information system (Venkatesh et al., 2003, p. 453).

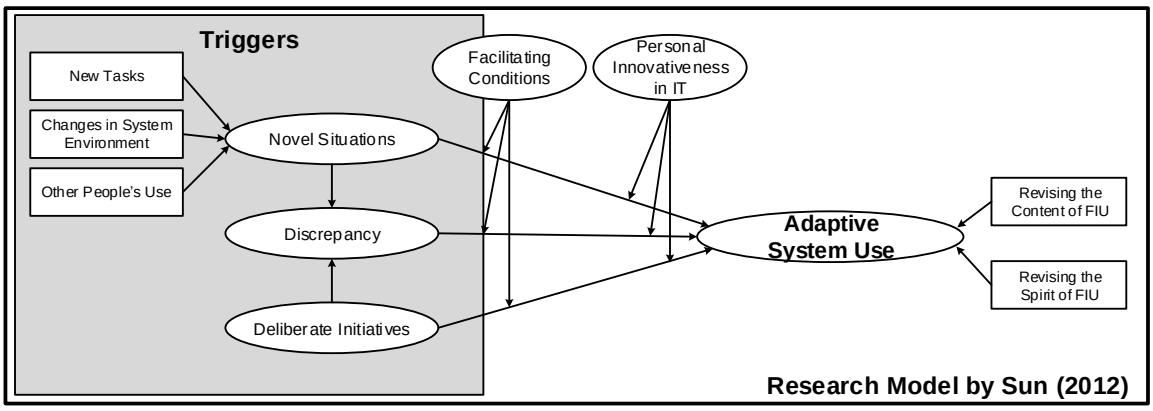



Figure 5: Research Model for ASU by Sun (2012)

The model overall describes just one iteration of ASU and as mentioned before, some triggers and parts of the process may run in parallel, while others run in sequence (Beaudry & Pinsonneault, 2005; Jasperson et al., 2005). This process continues until the level of adaptation has closed the discrepancy to a point that the marginal value of another episode of adaptation is too low.

### 2.3.3 The Relationship of User Adaptation and Workarounds[6]

Whenever the adaptation within the confines of a system is not possible for end users, for example in the form of ASU, they are likely to adopt workarounds to reach the goal of their system use. Gasser (1986) was the first to define working around inadequate computing systems as an alternative adaptive strategy with the purpose of overcoming IS misfit. However, in the past 30 years, the term "workaround" has been defined in various ways in different papers (Alter, 2014). Alter (2014) grounds the concept of workaround on agency theory and work system theory, and indicates that using a workaround is a collective action with the purpose to adapt insufficient functionality. Alter (2014) implies that the given definition of workarounds covers many situations, but lacks specificity (cf. Gasser, 1986; Koopman & Hoffman, 2003; Schwarz, Chin, Hirschheim, & Schwarz, 2014). Furthermore, Alter (2014) indicates that these definitions lack a clearly defined boundary for distinguishing workarounds from other concepts. For example, Sun describes adaptive action as behavior through which users revise the spirit of IS features and define new ways of using IS features (Sun, 2012). However, this action is very similar to the definition given by Alter (2014).

Prior empirical evidence has given hints that workarounds can lead either to positive or negative impacts on individuals' ability to use a system – whether effectively or at all. From the perspective of negative impacts, a workaround can show the lack of understanding an IS (Staehr et al., 2012). Burton-Jones and Grange (2013) argue that workarounds generally reflect uneducated adaptations. Moreover, solutions based on workarounds often lack support from IT professionals and cannot be efficiently reused (Zolper, Beimborn, & Weitzel, 2014). Additionally, workarounds lead to an illusion that problems have been solved, but in the long term this illusion will erode the standard IS and cause uncertainties (Morrison, 2015). Nevertheless, other papers imply that using a workaround can be a proper adaptation strategy for enhancing EU. Even though it is a common comment that using workarounds reflects a lack of understanding of the standard system (e.g. Staehr et al., 2012), some authors argue that workarounds can actually represent a group of users' consolidated knowledge of the standard system. Monteiro and Rolland (2012) regard using workarounds as a reflection of technology malleability, which is part of technology appropriation. Regarding technology appropriation, Orlikowski (2000) indicates that users start to appropriate technology in use when they are more knowledgeable about the technology. Sun (2012) also makes a similar argument by showing that users adapt their usage of a particular system drawing on combinations of features from other

[6] This content is from Li, Y., Haake, P., Mueller, B., 2017. Explaining the Influence of Workarounds on Effective Use: The Case of a Supply Chain Management System. ECIS 2017 25th Eur. Conf. Inf. Syst. Guimarães, Port. June 5th-10th 2017.

systems. Moreover, researchers have identified that workarounds are sometimes monitored or even promoted by central IT. For instance, Malaurent and Avison (2015) observe a case in which a workaround was built on request of a project team from the headquarter and thereby endorsed by central IT. Other similar examples are from Kitto and Higgins (2010), Novak, Brooks, Gadd, Anders, and Lorenzi (2012), and Cabitza and Simone (2013), in which the developing process of the workaround is mediated by parties with deep knowledge of the standard system.

Additionally, workarounds can considerably facilitate the integration of a formal system into routine tasks. Such routine tasks often face an unpredictable range of contingencies that make it unlikely that the task's performance will be identical in all circumstances (Weick, 1995). Similarly, a complete match of standardized, prescribed technology use and work procedures is unlikely (Ferneley & Sobreperez, 2006). Consequently, users have to employ available resources to deal with low-level problems in order to make sure that routine tasks can be executed. While those problems will not influence the work situation dramatically, they still have a strong impact on the actual execution of routine tasks (Gasser, 1986). In such situations, a workaround that requires limited resources can be a functional ad hoc strategy to facilitate task execution. This phenomenon, first captured by (Gasser, 1986), is also reemphasized in more recent papers. Goh, Gao, and Agarwal (2011) indicate that workarounds are usually designed to support routine tasks rather than altering the business process. Similarly, Novak et al. (2012) explain that computing workarounds enable better implementation of IS in the routine tasks by providing flexibility. Additionally, workarounds can help to identify root problems, which impede the alignment of an IS with organizational goals and provide signals for further system optimization (Vassilakopoulou et al., 2012). Several papers have also suggested that users proactively develop workarounds to bypass the imperfection of the standard system and to enhance their job performance. For instance, McGann and Lyytinen (2008) suggest that users are likely to improvise IS use because of not only the system's shortcomings, but also the new opportunities to enhance performance. Also, Vassilakopoulou et al. (2012) indicate that motivations, such as saving time and saving effort, can lead to the adoption of workaround regardless of system imperfections. Finally, workarounds are a more feasible resource for adapting the system or the way work is done with the system (Gattiker & Goodhue, 2005). Sia and Soh (2007) indicate that organizations usually have to make a trade-off between system customization, which requires technological resources, and organizational change management, which requires organizational resources, for solving a misfit of a packaged enterprise system. Here, workarounds offer a solution that requires limited change in both the business process and/or the system (Sia & Soh, 2007).

Despite these apparent virtues of workarounds, very few papers (Yang et al., 2012) comprehensively explain how and why workarounds can improve the performance in a work system. Following this thought, we propose that workarounds can facilitate the EU of an implemented IS and thereby enhance a work system's overall performance. On this basis, our view differs from Burton-Jones and Grange (2013) original argument that workarounds generally reflect uneducated adaptations. We argue that they indicate educated adaptions of capable individuals in order to increase their EU of an IS. For instance, for a company's SCM

software this goal can be accurate information and subsequent forecasting and planning. The workarounds of interest to our research are part of employees' collective action to work around the shortcomings of a SCM for their particular business domain and their required routines. In particular, we analyze workarounds that are incorporated and managed by a central IT department. Employees have to learn about a system and its capabilities in order to use it effectively with regard to the implemented solutions for their tasks. However, this knowledge is also valuable to develop workarounds that can help to use a system effectively whenever not all necessary steps are implemented in the IS.

# 3 Empirical Studies on IS Implementation and Renewal Projects

In this chapter, we are going to present our research on different IS projects. The first study, presented in section 3.1 is a longitudinal case study of a renewal project. The second empirical study that we present in this section is a multiple-case study of different implementation and renewal projects, which we conducted to investigate the important role of user involvement and participation in IS projects. This is especially true for all IS that end users interact with directly. Hence, the work presented in this section is foundational for our later analysis of use behaviors and effective use in particular.

## 3.1 Enterprise System Renewal – The Divergence between Perception and Reality[1]

Issues with backend enterprise systems (ES) can have a critical impact on business performance. In particular, e-commerce based companies suffer from an ineffective usage of backend ES and might struggle to cope with competition. A prominent example for the effect of such issues on once prosperous businesses is the Otto Group, a large German distance retailer ("Otto: Anachronistischer Einkauf," 2013). Due to underinvestments, the technology base of the Otto Group had become outdated and scattered. For instance, 130 different IS were used to support the frontend services for customer interaction. This led to complicated and delayed technological changes and made internal processes inefficient. In turn, the inefficient processes and the high complexity of the backend ES affected the number of available products online and the lapse rate at Otto Group. In sum, Otto has failed to reign in that toxic complexity and to manage a successful renewal project.

Cases like this sparked our interest in the reasons for successful ES renewal projects. We were able to select a multi-channel fashion retailer in Central Europe as our case site. In particular, we analyzed a renewal project (Andersen, 2006) for a Product Information Management System (PIMS) in the e-commerce department of a multi-channel retailer. IS project success research in general, which is relevant for this type of project analysis, can be subdivided into two main streams. In the first stream, researchers are assessing project management success by the 'Iron Triangle' of a project's cost, time, and quality (Atkinson, 1999; Lech, 2013). Thereby, researchers aim to identify indicators that enable projects to reduce costs and time and increase the quality of the resulting product. The second stream focusses on the success of the project's

[1] A large part of the content of this section is published in Haake, P., Schacht, S., Mueller, B., Maedche, A., 2017. Enterprise System Renewal - The Divergence Between Perception and Reality. 13. Int. Tagung Wirtschaftsinformatik (WI 2017), St. Gall. Switzerland, 12.02. - 15.02.2017. Ed. J.M. Leimeister. and Haake, P., Schacht, S., Mueller, B., Maedche, A., 2017. Unternehmenssoftware "erfolgreich" erneuern - Divergenzen zwischen Wahrnehmung und Realität. HMD Prax. der Wirtschaftsinformatik 54, 375–388.

product (Thomas & Fernández, 2008). More recently, these aspects have been combined and resultant customer satisfaction (Basten et al., 2011) has become the focus. Prior research with a specific focus on ES implementation and renewal projects has been based on the assumption that such projects are essentially disruptive and lead to changes to the technology as well as the work environment and the task (Bala & Venkatesh, 2013). However, we have found evidence in our exploratory case study that even scheduled events that have no influence on the task can cause significant disruptions and adaptation efforts. As project success can also be considered as socially constructed and perceived (Cecez-Kecmanovic et al., 2014), the investigation of the discrepancy between perceived success and the reality is necessary to come to a real understanding of project success. Thus, we aim to explain the diversion between perceived and actual success of an ES renewal project. We applied the critical realism perspective to identify the mechanisms behind the development of such a diversion. For our research, this is the appropriate approach, because it allows to focus on establishing causality (Wynn & Williams, 2012). On this basis, we formulate the following research question: *How and why is there a discrepancy between end users' perceived and real IS renewal project success?*

We aim to provide an overview of the mechanisms that are behind the different perceptions of the renewal project. This will result in a type II theory (Gregor, 2006) and several relevant practical implications. We have presented the relevant theoretical foundations for this research paper in section 2.1. In the following section, we discuss the methodology of our explanatory, longitudinal single case study in section three, before presenting and discussing our findings in section four and section five, respectively. Finally, we conclude our research by summarizing the key results, discussing the limitations and contributions of our study, as well as providing an outlook on future research.

## Methodology and Case Description

To answer the aforementioned research question, we decided to analyze one case company longitudinally with a single case study approach. We reviewed the transition and change of end users' expectations in the organizational context of the e-commerce subunit, which is the unit of analysis. Thereby, we aim to explain the deviation of perceived project success over time. This single instant serves as a starting point for the search for an explanation (Yin, 2009). We also control for the perceived usability (Albert & Tullis, 2013; Brooke, 1996) with a survey, which we can use for triangulation of our other results (e.g. Venkatesh, Brown, & Bala, 2013). In combination with insights from the literature, this holistic view allows us to develop the explanation (Gregor, 2006) presented at the end of this paper.

We acquired a project for the analysis of the renewal and adaptation of an ES. During the course of the single case study, we analyzed the development of perceived and real ES renewal project success. As case company, we selected a multi-channel fashion retailer with a sizable online shop, which is located in Central Europe. Thereby, the e-commerce department (in the following referred to as FASHION) and its Product Information Management System (PIMS) were at the center of our research. A PIMS allows managing all information required to market and sell products on distribution channels such as FASHION's online shop

and marketplaces centrally. FASHION is a department of two managers, content managers, and supporting technicians. FASHION's deputy department head characterizes his business unit in the following way: *"I see us as a hub which compresses the product information and provides access to sales channels [for other departments in the company]." Due* to changing requirements, FASHION regularly undergoes changes of its e-commerce platform. At the center of the change process, the new PIMS release was supposed to significantly improve PIMS overall and the Web-Client version in particular. The release was supposed to update the software to the originally contracted level, since this version had not been ready for renewal for the original project. Changes in roles or assigned tasks were not planned. At the time, FASHION had a lead and a deputy technician who were responsible for the online-shop system and PIMS, which were the relevant, IS for e-commerce. The deputy technician had started his new job a month before the introduction of the new release.

There were 84 recorded users of the PIMS Web-client, which include the department heads, their deputies, the content management team, and users in various purchasing departments. We only evaluate the PIMS Web-Client, which is a content management system for product information, classification in the structure of the online-shop, and management of product images. Content managers focus on texting and classification of products. Texting and classifying a product took on average 7-8 minutes before the renewal project. Up to 50 articles had to be processed by a content manager per day. FASHION employs two teams of four content managers and two interns. The other employees in the purchasing department mainly search and read in the PIMS. Team leads in the content management team use a Master client version of the PIMS, which allows them to assign work packages of texting and classification work to team members. Two months after the renewal of the new release of the PIMS, one of the two remained team lead for the texting group and the other became head of a newly created product image production team.

The transition and change of management's and user's expectations in the organizational context of FASHION, which is the unit of analysis, are reviewed in qualitative and quantitative terms. Thereby, we aim to explain the deviation of perceived project success from the results for measured project success dimensions. This single instant serves as a starting point for the search for an explanation (Yin, 2009; p. 168-169).

**Data Collection**

We used several data collection methods during the case study. Our data collection included 22 *semi-structured interviews*, *participant observation*, and *document analyses*. We also conducted two online-surveys on the perceived level of usability. Semi-structured interviews are defined as interviews in which pre-formulated questions are used, but not strictly adhered. New questions can emerge during the conversation (Myers, 2009). We interviewed different user types, such as content managers, team leaders, managers, and employees of the technical support. The multi-level analysis in our research made it necessary to include different user categories for the analysis of the specific ES (Lawrence & Low, 1993). Thereby, we aimed to get an integrated view of user adaptation and developing experiences of the renewal initiative by interviewing a carefully selected set of people over the course of the renewal project for eight months. We

interviewed as many individual users of the PIMS as necessary to get an understanding of the typical user role in FASHION. Interviews with management focused on the department head and his deputy who were responsible for the PIMS project. Technology support included the positions responsible for the e-commerce related IT services and those responsible for the particular IS project. The first author conducted the interviews in person, recorded and transcribed them. The interviews lasted typically between 45 to 60 minutes. Before an interview, we provided some information to the interviewees regarding the interviewer, the background and purpose of the study, and the anonymity and use of gathered data (Myers & Newman, 2007). We conducted the semi-structured interviews at three points of time: (1) before the start of the project, (2) shortly after the renewal, and (3) after employees had settled in with the new system (see Figure 6). This time frame was chosen because researchers suggest a gap of one month between perception of a new system and usage measurement (Bhattacherjee & Lin, 2014). If the gap is longer, it might be motivated by factors that the researcher cannot control. However, if it is shorter, the gap may not give adequate time for adjustment in the perception process of individuals and their use of a new system (Bhattacherjee & Lin, 2014).

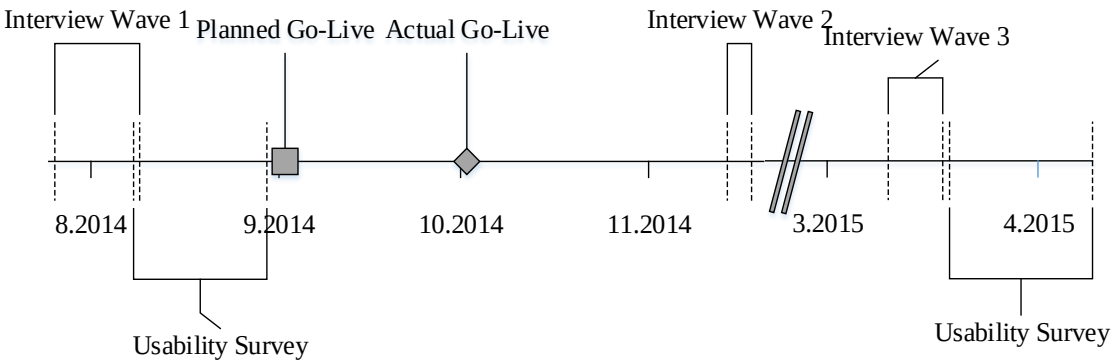



Figure 6: Data Collection Plan at FASHION

The first interview series started with an assessment of the system's version at the time and with an assessment of the typical adaptation of users with regard to the system. Furthermore, we asked for users' and managements' expectations regarding the introduction of a new PIMS release. In the second wave, we interviewed a content manager, the team leaders, a manager, and the technicians to assess their evaluation of the project and the actual progress made. This second round of six interviews, included questions whether the expectations were met by the new release. It also included questions about the user adaptation and the adaptation process necessary to deal with the new system shortly after its introduction.

Only the deputy department head could be interviewed during the mid-term sessions because of the ramifications of the busy holiday season. A content manager is the second missing interviewee interviewed before the project, as he had voluntarily dropped out of the company in the meantime. The third round of in total eight interviews included a final round of questions whether the expectations were met and questions

regarding the adaptation. We asked users about the amount and kind of organizational support that they received in each round (see Table 1).

Table 1: List of Interviews at FASHION

| **Interviewees** | **Total # of Persons** | **Interviews Wave 1** | **Interviews Wave 2** | **Interviews Wave 3** |
|---|---|---|---|---|
| Content Managers | 3 | 2 | 1 | 2 |
| Team Leaders | 2 | 2 | 2 | 2 |
| Lead Technician | 1 | 1 | 1 | 1 |
| Deputy Technician | 1 | 1 | 1 | 1 |
| Deputy Department Head | 1 | 1 | 1 | 1 |
| Department Head | 1 | 1 | - | 1 |
| Totals | **9** | **8** | **6** | **8** |

When possible, we used *participant observation* to gain a practical understanding of their interactions with the software. This aspect was supported by the previous role of the main researcher on this project, who had been an intern in the e-commerce department as a student. *Document analyses* were mainly part of the initial analysis during and after the first round of interviews and helped to understand the organizational structure, IT infrastructure, and IT architecture. In addition, we documented the rules and procedures of data collection in a case protocol to ensure rigor in data collection. Furthermore, a case study data base was used which contained the interview transcripts, field notes, collected documents, coded data, and the coding scheme (Dubé & Paré, 2003; Yin, 2009). We organized the data based on Spradley's suggestions (Spradley, 1980). This organization allows separating objective facts in the condensed and expanded account and subjective interpretations in the analysis account and fieldwork journal.

Subsequently to the first round of interviews, we distributed an online survey to FASHION's employees that work with the web-client version of the system in the content management team in FASHION and to users in the individual sales departments of the brick-and-mortar stores, who worked with the software, but were not hierarchically bound to FASHION's management. 84 web-client users received the link for the survey via email. In total, we received 33 (11 male; 22 female), which leads to a response rate of 39%. Four respondents were from the e-commerce department, 10 were department heads responsible for purchasing and sales, another 10 were deputy department heads, and one respondent was an assistant of a department head. We measured the perceived usability with the system usability scale (SUS) (Albert & Tullis, 2013; Brooke, 1996). Once the user has adapted to a technology and put it to use, the focus of the end-user tends to revert to the work tasks. During this use phase, technology becomes a barely noticeable part of the daily

routines (Henfridsson, 2000). Thus, we administered the online-survey shortly before and more than four months after the introduction of changes to PIMS to avoid a biased assessment (see Figure 6).

We concluded our data collection with a final survey of the employees in the sales and e-commerce department that work with the web-client version of the system. We sent the link for the online-survey to 84 web-clients users. We received 29 (6 male; 23 female) responses in total, which leads to a response rate of 35%. The high response rate for our surveys can be attributed to first-hand support and the involvement of the senior managers (Bhattacherjee & Lin, 2014). An aspect of being a relatively new business venture and arm of the company was the relatively young age (in the Central European context) of the respondents of 33 (still 33 in the second wave) years. Respondents were content managers from the e-commerce department; nine were deputy department heads and seven department heads for sales and purchasing. Six respondents were their assistants in the purchasing department.

**Data Analysis**

The unit of analysis of the case study is the work system of FASHION. For coding and tracking the qualitative data from the field, we used AtlasTI and followed an inductive coding approach. Inductive coding is appropriate in our research context as it allows to abstract themes, which are mentioned by interviewees on a reoccurring basis. We started with open coding of the interview transcripts. These open codes are descriptive and merely allow a categorization of constructs identified in the interview transcripts. We intensively compared and contrasted the developed categories with each other. In a second phase, we conducted axial coding to refine the interpretation of the categories and properties. At this stage, we also controlled for a possible researchers' bias in the categorization process by crosschecking the categorizations of the codes with an independent student assistant's categorization of a sample of three examples for each category. The categorization was very similar.

We used a critical-realism (CReal) as the epistemological perspective for the analysis of our gathered data. CReal distinguishes between a transitive and intransitive domain. The intransitive domain consists of the elements such as events and the causal powers in the ontological domain of the actual and the real that the researcher attempts to understand (Zachariadis, Scott, & Barrett, 2013). The transitive domain contains the observations, knowledge or theories about the independent world of the intransitive domain. A perfect match between theories and reality is not likely, and theories are fallible. Intransitive elements do not change over time, however, the theories about them do and presumably become less fallible (Wynn & Williams, 2012). Thus, this research approach is ideal for the analysis for complex interactions and consecutive smaller events (Wynn & Williams, 2012), such as the forming of perceptions of project success in iterative steps.

Specifically, we followed the principles for conducting the CReal research in IS by Wynn and Williams (2012) for our data analysis. The first principle is the detailed explication of events through the abstraction of individual's experiences, as the foundation of causal analysis. This step is crucial for understanding the

PIMS and FASHION as an organization. Second, we explained the structure and the contexts of these events. For instance, this involved the analysis of the sequence of the flow of information inside of FASHION. Third, in the process of retroduction we identified the hypothetical causal mechanisms, which could explain the specific occurrence of these events (Mingers, 2004; Wynn & Williams, 2012). Fourth, we evaluated with empirical corroboration whether the hypothesized mechanisms illustrate reality correctly, elucidate the events better than other mechanisms and are appropriate explanations with a high degree of causal power by referring to our obtained data (Wynn & Williams, 2012). This was executed by constantly referring back to our transcripts and the documents. Finally, we employed triangulation, mainly to emphasizes the necessity to use more than one source of evidence, that is in our case the combination of different interviewees insights with our observations and document analysis to find an appropriate causal explanation for the different perceptions of reality (Wynn & Williams, 2012). The resultant contributions of a CReal study can be classified as type II theory (Gregor, 2006), which provides explanations for the occurrence of a phenomenon in a social system (Wynn & Williams, 2012).

We used usability for the quantitative evaluation in our case because it is a relatively comprehensible and established quantitative measure for enterprise system quality. The data analysis of the perceived usability was based on the standardized evaluation of the system usability scale (SUS) (Albert & Tullis, 2013; Brooke, 1996).

## Findings

At first, we are going to outline characteristics of the interviewees and the stakeholder groups relevant to the case study. All people interviewed knew PIMS since its launch in the firm in August 2013 and had several years of experience inside the firm. The content managers were working in a rather small team that was the innovative "new" group in the company. Management had been familiar with the PIMS since its introduction and had been in the business area for two to three years. The in-house technicians were relatively new to the area and the technology. The head technician had joined the firm half a year before the migration project, while the deputy technician joined just one month before the start of the renewal project. As head technician, he was responsible for planning and organizing the renewal project. However, his background had been more in e-shop-systems. There was a multitude of ongoing projects at the same time inside FASHION. His only in-house technical support was the new deputy technician, who had worked with the PIMS at a previous employer. However, he had to familiarize himself with the renewal project and its scale.

Initially, the new release of the PIMS had been purchased. However, it had not been ready for the initial implementation. Management had made the decision to implement the old release with some upgrades, which were ready at the time, and to create a hybrid version. The organization was still incorporating that change, as the head technician noted*: "Just recently, we were at a user group meeting of the software producer. Based on their project status classification, we just finished the renewal phase and are currently*

*entering stabilization. However, the new release will disrupt that phase."* The project team for the introduction of the new release included the deputy department head, the head technician, and the deputy technician. A contract for the new release was signed in April 2014, which also included the move to a new service partner. The deputy department head gathered 23 end-user requirements, i.e. their expectations for the release of PIMS's Web-Client version in meetings in April and May 2014. Table 2 presents the four main requirements of this list as assessed by the head technician after the end of the project. These four common themes of expected changes emerged during the first round of interviews with content managers: First, the users expected an adaptation of the user interface for the product classification process. This included a change from a slow drag and drop process of individual product classifications, up to 20 at a time, to a simultaneous selection out of a list of characteristics. Second, an improved semantic search was required for the Web-client. Third, seamless navigation between product, variant, and article level in the PIMS Web-client also featured in the interviews. Fourth, product images should be available on all presentation layers in the system. The department head had the following expectations: *"[Whenever the new release is migrated and running], we will start by introducing a new design of the content management process. This will be a project of another five days […]."* This process has not been implemented to date, October 2016. Management's expectations were in clear divergence to the technicians' expectations. Both technicians mainly expected benefits for handling of the technology and background changes. Besides, they planned a 1:1 migration to the new service provider.

Table 2: Main Requirements for PIMS Assessed After Project Completion

| **Main Requirements** | **Status at Project's End** |
|---|---|
| Seamless navigation of system levels (product, variant, article) | Done |
| Integration of a spelling check | Testing |
| Automatic classification of products | To Do |
| Product images visible on all presentation layers in the system | In evaluation |

Subsequently, the two technicians and the renewal partner prepared technical changes for the actual project. The migration of the entire data for the PIMS to the new hosting and general service provider was planned for the end of August 2014 and the planned go-live was on the 1st of September 2014. Separate hosting and service partners characterized the previous set-up. A renewal of the new release involved a service partner, who hosts and provides maintenance services out of one hand. An attempt to go-live on the 1st of September was made. Soon after this go-live, users from the content management team experienced such a lack of system performance and data quality that the attempt was abandoned. The new release was deemed not ready and FASHION reverted to the old set-up for the rest of the month. A new attempt to go-live was made at the beginning of October. Even at this point, users soon experienced a severe lack of performance and responsiveness. The service partner had underestimated the server capacity necessary to run the old

PIMS implementation. In-house technicians began to learn that the original data model was incorrect for the design of the standard software. It lacked stability and had a slower performance than planned as it was used as a calculation tool for stock levels and other data, which was against the original design brief of the standard software. The head technician summed up the situation in the following way: *„The guys [from the first implementation partner] just screwed up a little. They were not capable of implementing a PIMS, at least of this scale."* Despite many separate efforts by the new service partner and the in-house technicians, a lack of performance persisted. Several data exports and imports were redesigned to reduce the workload for the PIMS. Ultimately, the stability of the system improved with a sequence of hot-fixes and bug fixes that were issued by the software producer and the service partner. Thus, it was possible to overcome the worst part of stability and performance issues within the first two weeks of the new release. The deputy technician stated: *"At the moment, we are happy that the system runs in an identical version on the new platform."*

It is evident, that end-user expectations were not confirmed positively. When asked about the share of expectations that were met, a content manager stated: *„About 30 to 35%. […]. Expected was 60% of fulfillment of requirements."* Hence, she subsumed: *"The product has improved a little."* The newly assigned team leader for content management commented: *"Currently, I would say that performance-wise we are back on the level of the old version of the PIMS."* Furthermore, it was noted that *"the new classification approach with drop-down lists takes longer now."* This was due to a lack of performance of the hardware with the new hosting partner. Thus, a goal of the renewal was initially missed. While management acknowledged these problems, the deputy department head had the following impression: *"You can feel it; they [the users] are also satisfied. Some of the things that have changed are things that they wanted. […] 30% of requirements were ready with the first version after the release. We are currently implementing another 20% of our requirements and the other 50% are extra goodies. They will follow later."*

A great variety of perceptions persisted to the end of the project. For instance, one content manager stated that she felt like only 20% of the requirements were actually met. Independently, the interviewed content managers and team leads stated similar figures. In an interview with the head technician after completion, it turned out that he had never been aware of the list of requirements from the workshop. Just one of the 23 requirements on the list was met over the duration of the project. Eight requirements were classified as a planned "To Do" by the lead technician, two more were being worked on or planned, while the rest of twelve requirements was not understood or seen as conflicting by him. A content manager subsumed that "*the performance after the introduction of the new release and the management of the transition issues is just back to the way it used to be with the old release […]*."

This perception of the overall progress did not square with management's perception. The managers felt that employees focused too much on the negatives and the deputy department head stated: *"The new release is still about 20 to 30% slower than the old release. Many employees focus on this downside during con-*

*versations."* His perception of the fulfillment of the initially gathered requirements was fundamentally different and more positive: *"I would presume that 50 to 60% of the requirements on our list have been met by now."* The attitude towards problems, which were raised by content managers, was clear: *"'Yes, everything was better in the past'. Yes, the change was not easy, it has brought additional workload, it also brought certain restrictions, but it was just necessary, […]."* The department head expressed a new idea of the initial project's focus: *"We are closer to the standard. We have almost 100% of the standard. This was the top priority."* This was a fundamental change to the beginning of renewal project when users were asked to formulate a list of requirements during the workshop. This raised user expectations, which were slowly crushed as the project progressed. The department head was aware of this, but did not inform the content managers or purchasing department end-users: *"[…] we did not ask for intensive feedback, because we implemented very little from the long list of requirements because we changed a lot in the backend instead. […], we can invest more in features and usability [when the backend of the system is stable]."* This decision was made because the department head had been aware of the issues during the migration process: *"[…] after the introduction of the new release, we had catastrophic system performance."* Nevertheless, the department head was of the impression that individual performance had increased substantively: *"We have an increase of 30% in productivity and speed compared to the previous release."* Considering everything, he specified: *"I am convinced that we have a "Ferrari" [i.e., PIMS] that we cannot use appropriately."* All the while also stating: *"That is just not a perfect system and we probably expect too much of it."*

Yet, technicians' perception of the overall project was different at the end of the initial renewal phase. The deputy technician acknowledged: *"We carry a huge load of requirements that were not met previously. There are plans, but neither the time nor the ability to create To-Do's to actually assess and implement the desired changes."* However, some parts of the transition were also perceived to be a success as it was possible to reduce the time needed for data imports and exports for the PIMS by about 50%. In part, this can also be attributed to changes in the hardware of the hosting partner. The technician was of the impression that this new speed in reaction motivated some users: *"The system pretends to help me, that's cool."*

During the course of the renewal project, many new projects and issues had overridden what the technicians wanted to achieve regarding their preparation of technology. The head technician's description of his interaction regarding the management of IT projects with FASHION's management illustrates the discrepancy in thinking: *"Management certainly listens, however it is unclear whether they truly understand and take note when necessary. Our department head admitted to me that we probably addressed too many issues at once. Overload will lead to failures. […]".* When the head technician perceived these issues during the migration process, he made the momentous decision to scale down the project. The project complexity was reduced by focusing on the main migration: "*In the end, everything had to be rushed because our management had communicated a deadline inside our organization. […] It is my belief that internal policy created an expectation inside the organization which resulted in pressure and eventually lead to friction losses."* End-users were not clearly informed, which allowed different expectations to linger.

The results of the usability measurement in the first survey gave a median value of 52.5 for the SUS. Bangor, Kortum, and Miller (2009) suggested based on their data that a SUS smaller than 50 is not acceptable, between 50 and 70 is marginal, and greater than 70 is acceptable. Thus, the SUS of the original implementation was barely marginal and not particularly good. The median for the SUS in the second survey with end-users in this wave was 60.0, which is still poor, but improved compared to several months before. These results generally reinforce the qualitative analysis, since the usability did not reach a good level, when comparing it to benchmarks (Bangor et al., 2009).

## Discussion

We identified several mechanisms that can help us to explain the evolving perceptions of end-users. An important mechanism, which influenced end-users' perceptions was the **narrative of success**, the focus in management's communication on motivating employees by showing them that they are successful and taking part in something meaningful for FASHION and the multi-channel retailer as a whole. All interviewed content managers perceived the new release as an opportunity to improve their work and its outcomes, and fundamentally believed in this narrative of success. As strong e-commerce growth required many rapid changes, they had developed a common culture of trial and error, which they all ascribed to themselves. This mechanism is closely linked to the insight that success and particularly project success is socially constructed and perceived by different stakeholders (Cecez-Kecmanovic et al., 2014; Thomas & Fernández, 2008) and can be linked to organizational culture (Jackson, 2011). The specific aspect of narratives of success has also been raised in previous research on IS projects (Brown & Jones, 1998; Fincham, 2002).

Furthermore, employees in FASHION's e-commerce department show a great deal of synergy and loyalty to each other, as well as to the department head. These are the aforementioned characteristics of a good team (Huczynski & Buchanan, 1991; McAvoy & Butler, 2009). However, in this situation, the mechanism of **hierarchical groupthink** was present based on belief in the e-commerce department's narrative of success. The following quote of the department head illustrates his power in setting an agenda: *"We have spent the last three quarters with very intense discussions and got a lot of scolding: Everything was better before [with the system before PIMS]. I have heard [this] so often, but all have to agree to it or have to engage with it, because there is no alternative. Now everyone agrees with it."* Janis (1972) provided six criteria to identify and determine a situation of groupthink: 1.) *Little or no consideration of alternate plans:* Management at FASHION did not have a back-up plan for a failed migration or further technical issues. For instance, downtimes were seen as a given. 2.) *Risk is not assessed:* Management and Technicians at FASHION did not assess the risk for the operations of the difficult migration that they planned. Subsequently, the migration and go-live of the new release failed. If people raised issues, it was stated that the project simply "had to be done in this way". 3.) *No review is taken of rejected plans:* There was just one option: The execution of the initial plan. This was further enforced by commercial arrangements for the release change, which had been designed by management inflexibly to save money. The failure of the first renewal attempt for the new release occurred, because the software of the new release had not been ready. 4.) *Advice from*

*outsiders is not sought*: Management did not feel able to fund a specification project by technical experts from a consultancy. *5.) Facts that support the plan are acknowledged, facts that do not support the plan are ignored:* This was observed in management's attitude to end-users input regarding project success. From management's point of view end-users simply focused too much on the negative. 6.) *Contingency plans are not created:* There was no alternative plan created for the renewal project and the implemented solution. The technology is a *'Ferrari'* and simply not used properly. The described groupthink had the effect that content managers bought in to this assessment and that significantly influenced, how they made sense of the renewal project.

As aforementioned, there were four different levels of information: technicians, managers, content managers, and purchasing department end-users, who were not informed about the particularities of the project. These different groups had different sensemaking experiences. This is due to the different points in time at which they received their inputs. At first, the technicians became aware of the issues with the initial implementation. This was crucial for other parties' sensemaking. As the management was made aware of the technological issues, the deputy department head commented: *"If you turn one stone, you have to turn them all."* This meant scope creep and a more comprehensive change then initially anticipated, but also a change of priorities. Consequently, the aforementioned list of requirements remained unknown to the lead in-house technician until one of the researchers presented it to him after the end of the project. The end-users realized a dawning failure based on the results they perceived in their daily work. A content manager commented: *"It became evident during the run of the project that our [the content management] team's wishes […] were difficult to implement."* The content management team reacted with not focusing on the wishes and expectations anymore. This can be described as the mechanism of **inherent fatalism** of end-users. Instead, they realized that the renewal project was a threat for their productivity. Overcoming the threat and the difficult phase was therefore a great success. According to a team lead, the new attitude to the project became: *"It simply had to be done."* She described their experience with the adversity as a *"state of war"*. She went on to say: *„It is a positive experience to go through such difficult periods. It is an opportunity to grow personally and to see what you are capable of."* We interpret the described personal growth and experience of performing against the odds as the seed for the perception of success that end-users reported. This appears to be at the heart of their sensemaking process. It overshadows the project and its original purpose over time. The other team lead stated in the third rounds of interviews: *"I do not know [how many requirements were met]. I have no idea. [...] You get used to situations and if something is suddenly missing from the tools that you use, you find other ways. […] Whenever you get used to something you stop questioning it. Hence, I do not know what can be improved at the moment."* The hallmark of success in such a scenario became reaching the previous level of performance and they abandoned the goal of renewal. As a group, the users at FASHION developed a reliable system, similar to those described in the literature (Weick & Roberts, 1993), to cope with the adversity that they perceived because of the technological glitches in their work environment. Overcoming the situation as a group also gave them a collective mind

and a collective feeling of success. This finding adds to previous research which has identified the importance of organizational culture for IS project success in general (Jackson, 2011). Aspects of inherent fatalism as a mindset, its antecedents, and its consequences have featured in previous research. For instance, research on perceived organizational support and psychological contracts of employees with their employer (Aselage & Eisenberger, 2003) has investigated conditions that might lead to inherent fatalism on the part of the employees. Part of the process to accept the situation in the workplace readily is the rationalization process of individual end-users. More specifically, motivated reasoning (Kunda, 1990; Rousseau & Tijoriwala, 1999), which is the reliance on a biased set of cognitive processes, is likely to be important for explaining end-users ability to focus on the aspects under their control. The end-users could have been motivated to avoid a reasoning that would stain the embraced narrative of success of FASHION. As a consequence, such an approach allows them to remain motivated to work (Gagne & Deci, 2005) at FASHION. The organization relied on the described combination of mechanisms, which has its roots in the instilled organizational narrative of dynamism and success, to motivate users to overcome the problems in daily use. As a result, the deputy department head believed that all people involved were satisfied and summarized: *"The users found ways to deal with the performance problems."*

## Conclusion

A CReal approach enabled us to develop a better nascent theory for the understanding of various perceptions and evaluations of success of IS projects in organizations. Our explanation of the link between the mechanisms identified above is the main contribution of our study. We use them to explain the discrepancy between end users' perception and real renewal project success: For *end users*, the perceived success of overcoming the adversity of the renewal project was a good match with the overall groupthink, and the predominant organizational narrative. They perceived themselves as the group of people that was working in a dynamic market environment and as those who successfully struggle with its dynamism. Overall, their sensemaking of the situation had a fit with FASHION's organizational narrative. From this, we draw the conclusion that overcoming the adversity of a project's ramifications is a big factor in the perception of successful projects by end-users. This creates a feeling of unity and resolve in good teams. The greater purpose of being part of something interesting (a growing and dynamic business – fitting the organizational narrative) is also an important aspect. For *management,* the resilience of end-users, who are motivated in such a way, is crucial to ensure relative success to their adjusted objectives. As observed in our case, managers seem to adapt their level of perceived success based on the information they receive from the technicians, who are closest to the matter at hand, but are not necessarily aware about the overall story that has been told by management about the project they are working on. Thus, there is a wider disconnection in the sensemaking of individuals in an organization about the success of a project. As long as management dominates the perception of the business environment and end-users buy into the derived organizational narrative, it is likely to influence the sensemaking process of end-users. In our case, this means that the adversity of the initially *planned* technological change is seen as inevitable on the level of end-users. End-users seem

to consider the greater cause inherent in the organizational narrative and respond with a fatalistic and resilient attitude and form a reliable system, which allows them to cope with the adversity related to technology project in their organization. For *technicians*, this means that their sensemaking is constrained by time pressure and in our case the inevitable lack of experience with the PIMS. In this situation, they had to make sense on the fly. Furthermore, they did not feel empowered to manage relationships with end-users and expectation management on their own. Overall, this led to the described situation in which the perception of the business environment and the resulting organizational narrative dominated the perception of a project's success. We think that this theoretical understanding is generalizable as the organizational narrative, which informs perception, is likely to depend on the organizational environment.

A possible limitation of a single case study is always generalizability. We deem a single case as appropriate for exploratory research and aim to challenge generalizability of our results based on multiple cases in future research. It is a practical implication of this paper that managers should make sure that they actively nominate someone, who plays the role of a devil's advocate (McAvoy & Butler, 2009) to manage the expectations related to a synchronized plan. This will alleviate the problem of groupthink based on a similar perception of the environment and the resulting organizational narrative. In our particular case, the common believe led to a lowering of expectations, which allowed reinterpreting failure as success in meeting adjusted expectations. This is a benevolent outcome. It is also possible, that the organizational narrative further aggravates end-users. A narrative told to motivate employees can ring hollow if it is not backed up by reality. Thus, management and technicians should communicate more directly and more transparently with end-users about the underlying technology. Even if they do not understand the technology in detail, they are likely to welcome the gesture of inclusion and the possibility to participate. In a different environment as in our case, users can resort to adverse behavior such as user resistance (Kim & Kankanhalli, 2009; Rivard & Lapointe, 2012). The circumstances of resistance, involvement and participation can be at the center of future research. As the general focus of this thesis is on the ability to use an IS effectively, we assume that users are willing to use a system and therefore focused on the drivers of user involvement and participation in our second research effort on IS implementation projects.

## 3.2 The Relationship of User Involvement and Participation with IS Project Success[2]

A large number of IS projects fail to reach their objectives (The Standish Group International, 2013). Many attempts have been made to develop an understanding of the critical success factors for IS projects. However, the project success rate has not improved significantly in the past (The Standish Group International, 2013), despite of the comprehensive knowledge gathered by practitioners and researchers. We suggest that the lack of improvement can be partially attributed to the fact that the analysis of the underlying factors for IS project success is hampered by the analysis methods that are currently applied. The wealth of research in the area of IS projects is focused on approaches that follow a non-set-theoretic logic, which is based on the analysis of correlations. When using such an approach, one presumes that there is only one solution, which leads to the highest level of project success. Yet, researchers argue that project success is a multidimensional construct with different dimensions of success (Cecez-Kecmanovic et al., 2014; Jetu & Riedl, 2012). Each dimension can be of different importance in different projects. These insights indicate that there is a multitude of possible configurations for successful or unsuccessful projects and therefore an incongruence of IS project success as the phenomenon of interest and the analysis methods commonly used for its evaluation. Our interpretation of this issue in research is in line with previous efforts in general project success research (e.g. Verweij, 2015). Thus, we are the first to research IS project success in line with research methods established in the project research community (see Appendix A). This enables us to go beyond the identification of factors for project survival (Wagner, Newell, & Piccoli, 2010) to the evaluation of constellations of relative project success.

Therefore, we decided to adopt the configurational approach based on configurational theory for our research. The basic premise of this approach is that a configuration consists of a constellation of characteristics, which are conceptually distinct and commonly occur together (Meyer, Tsui, & Hinings, 1993). Generally, we view the different characteristics of an IS project as parts of a project's configuration (see Appendix B). Thus, we propose a remedy for the incongruence of research method and project success as the phenomenon of interest. We use the set-theoretic method of Qualitative Comparative Analysis (QCA) (Ragin, 1989; 2000), specifically, the fsQCA method, which is generally established in other fields such as

[2] The content in this section is based on Haake, P., Maedche, A., Müller, B., 2015. User Involvement in Enterprise System Implementation Projects – A Configurational Approach. 2015 OASIS Pre-ICIS Work. Fort Worth, TX, USA, December 12th, 2015. and Haake, P., Burgmaier, M., Eichhorn, K., Kaufmann, J., Schacht, S., Mueller, B., Maedche, A., 2017. Configurations of User Involvement and Participation in Relation to Information System Project Success. International Journal of Project Management, submitted.

political science (Schneider & Wagemann, 2012). This method allows for the analysis of equifinal solutions. Similar observations in the area of IS behavioral research have led Liu, Mezei, Kostakos, and Li (2017) to propose the application of fsQCA for modelling combinatorial complexities in that research area.

Many different characteristics of IS projects' can have a substantial effect on IS project success. Thus, a multitude of different configurations or characteristics can be related with a successful IS project. However, user involvement and participation (UIP) have been identified as some of the most important factors to ensure overall IS project success (The Standish Group International, 2013). In particular, Bano and Zowghi (2015) suggested to analyze the level and degree of UIP required to achieve project success in different project phases, as they did not find any such guideline in the literature. Furthermore, there is still a lack of knowledge about the appropiate timing for UIP, even though it has mostly been suggested that UIP is important in requirements analysis or during testing to positively influence project success (Bano & Zowghi, 2015). Inspired by this, we focus our research of factors of UIP related to project success. We measure project success in terms of end-users perceived usability, as UIP normally serves the purpose to improve the user interface and work processes of a system (The Standish Group International, 2013). The analysis of the appropiate point in time, the kind of UIP, users' involvement and motivation, and the types of involved users are our main research interests. Based on these insights, we propose the following research question: *How are different forms of user involvement and participation in IS implementation projects related with IS project success?*

We answer this research question with an analysis of multiple-case studies of the relationship of project success and different forms of UIP in 16 different IS implementation projects. The cases are completed IS projects with a user interface for commercial users. We employ a mixed methods research combining qualitative and quantitative research methods to answer the research questions (Venkatesh, Brown, & Bala, 2013), as such an approach is required to study the complex and multifaceted relationship between UIP and project success (Bano & Zowghi, 2015; Fiss, 2009). By answering this research question, we contribute to the IS project research by outlining and presenting additional evidence for the most effective point in time for end users' involvement and participation in an IS project. Furthermore, we provide one of the first studies with a configurational approach in the area of IS project research. We are able to show the applicability of a configurational approach and specifically fsQCA for IS project analysis. Our research also benefits practitioners because it gives them an indication to focus their resources on aspects of a project for which intensive UIP is crucial instead of using it in all phases of the project.

## Research Methodology

In this chapter, we present our approach of two analysis steps. First, we analyzed the individual cases. This ensured a thorough understanding of the cases as individual configurations, which is necessary for a successful QCA approach (Schneider & Wagemann, 2010). Second, we present our cross-case analysis approach based on the configurational theory.

**Data Collection**

While we gather data on the independent variables using semi-structured interviews with project members, we use an online survey among software users to measure the perceived product success based on usability. We selected cases with substantial differences in the aspects under investigation (Pettigrew, 1990). For instance, cases differed in type and degree of UIP as well as in the complexity of the tasks represented in the software concerned in the project. This ensure some generalizability of our research results. Furthermore, we needed to ensure the comparability of the projects. In general, we chose implementation projects of standard software and projects in which software was developed and implemented. Thereby, we considered implementation projects of completely new IS as well as projects of substitutions of an old IS. Moreover, it was a prerequisite that the considered software has a user interface and that business users work with it. Considering the context of the cases, we selected projects taking place in companies in Germany as well as in public organizations. Furthermore, we got the opportunity to conduct interviews in Columbia because of the contacts of one of the authors. Lastly, as different effects of the project configuration on project success are subject to our analysis, we made sure to gather users' evaluation in relation to the circumstances of the project and not to other factors that occurred afterwards. Therefore, we only selected IS which still were in the shakedown phase (Markus & Tanis, 2000). This phase "refers to the period from 'going live' until 'routine use' has been achieved and can typically last anywhere from 6 months to a year" (Sykes, Venkatesh, & Rai, 2011). Similarly, Häkkinen and Hilmola (2008) argue that the shakedown phase typically lasts up to twelve months while length and intensity of the phase can vary.

For each case, we conducted two semi-structured interviews: one with the IT project manager and one with a project member, ideally a user of the software. We chose this approach to obtain a certain breadth of opinions (Myers, 2009). We conducted semi-structured interviews (Myers, 2009). As recommended by Myers (2009) we created an interview guide before the interview series. This allowed us to structure the interviews and to ensure that we asked all necessary questions and collected all the information required for multi-case analysis. We asked interviewees questions about project characteristics, such as the introduced software and the conditions of the project, and the UIP characteristics of the case. On-site visits allowed us to conducted face-to-face interviews. We interviewed the project manager separately from the other project member to ensure that the two interviewees did not influence each other. If it was not possible to have a face-to-face interview, we conducted them either via phone or via video-call. We recorded and transcribed the interviews, if interviewees agreed. Otherwise, we took notes during the interviews to enable coding in a later stage.

We used an online-survey among users of the particular software for each of the cases to measure the level of perceived usability. We chose a web-based survey form as it requires less effort of the respondent than other survey forms (Dillman, Smyth, & Christian, 2014). Furthermore, it allowed o protect the privacy of respondents, which is important, as projects and their success are often highly contested issues in organizations. This and guaranteed anonymity ensured trust and leads to reduced subject apprehension (Elie-Dit-

Cosaque & Straub, 2011). We conducted a pre-test to identify and solve eventual understanding, technical or structural problems (Passmore, Dobbie, Parchman, & Tysinger, 2002).

We used the System Usability Score (SUS) developed by Brooke (1996) with a 5-Point-Likert-Scale to measure the usability of the software implemented in the particular projects because it is well-established and widely used in research and practice (Bangor, Kortum, & Miller, 2008; Tullis & Albert, 2013) (see Appendix C). We chose it for three reasons. First, it is flexible enough to evaluate a wide range of different interface technologies (Bangor et al., 2008) which is important to ensure that the survey works for all considered projects. Second, it is quick and easy to use for both participants and administrators (Bangor et al., 2008). Third, the result of the SUS is a single score that can be easily understood by many people and which is comparable to the results of other published studies and examined software systems (Bangor et al., 2008; Brooke, 2013). One researcher translated all statements into German, a second person translated them back into English, and a third person confirmed parity with the original statements. If this was not case, we revised the translations. The same process was executed for the Spanish survey.

**Data Analysis**

As suggested by Eisenhardt (1989), we employed a two-stage approach comprising a within-case analysis and a cross-case analysis to analyze the case study data. First, the within-case analysis is used to "become intimately familiar with each case as a stand-alone entity" (Eisenhardt, 1989, p. 540; Fiss, 2009, p. 424). This analysis includes detailed case study write-ups for each of the cases (Eisenhardt, 1989; Gersick, 1988). Second, we conducted a cross-case analysis with the fsQCA approach (Ragin, 2000) to find patterns across cases and thus to identify generalizable findings.

We analyzed the considered cases separately to gather detailed information about the projects. We used a coding strategy to reduce, organize, and classify the data (Myers, 2009). ATLAS.TI was our software for the coding and analysis process of qualitative data because it is widely used and well-established for qualitative analysis (Scientific Software Development GmbH, 2015). We followed three not consecutive coding steps: open coding, axial coding, and selective coding (Strauss & Corbin, 1998). When we analyzed the survey data, we compared the results of the online survey for the SUS with published averages of other studies. For instance, Sauro (2011) compared the results of 446 studies respectively more than 5,000 observations and states that the average SUS score is 68 (similiarly 67.6 for business to business applications) whereby the bottom third has a score up to 60 and the upper third a score higher than 72. You find a brief overview of the cases in Table 3 and an extended description in Appendix D.

After analyzing each case separately, we conducted a cross-case analysis using the fsQCA method. We use the work of Schneider and Wagemann (2010, 2012) as well as of Thiem and Duşa (2013) as guidelines for the application of fsQCA. The argument for choosing fsQCA is especially based on the different levels of intensity of user participation, which we identified in the theoretical basis of our research and in the possible

categorization of the outcome (Schneider & Wagemann, 2010). We use the software called fs/QCA, Version 3.0 (Ragin & Davey, 2016; Ragin, 2010) for the initial analysis and replicated our analysis with a QCA-package for R (Duşa, 2007, Thiem & Dusa, 2013). Furthermore, we also used the QCA-package for R in the data calibration process, which is necessary when using fsQCA. Generally, there are two different methods of calibration (Thiem & Dusa, 2013).

Table 3: Overview of the Selected Cases

| Case Name | Description | End Users | SUS | # of Responses |
|---|---|---|---|---|
| **UniPortal (E)** | Uniportal is a campus management system of a German university. Different user types or user groups, e.g. students, teachers, secretaries as well as class and room management coordinators use it. This case represents the project of the view of all end user groups except "students". | approx. 1,350 employees | 40 | 29 |
| **UniPortal (S)** | A campus management system of a German university with a focus on the user group "students". | approx. 12,000 students | 51 | 80 |
| **Construction ERP** | ERP system of a Colombian company active in the area of concrete formworks. | approx. 40 end-users | 73 | 33 |
| **Residential Soft** | An administration tool for residential complexes, which provides administrational functions for property owners and tenants, like booking common areas as well as paying residential bills, e.g. electricity bills. | approx. 1,500 end-users | 78 | 48 |
| **SkillSoft** | A testing and managing platform for IT skills of users. It is run by a company that provides this platform as a service to other companies. | approx. 5,000 end-users | 76 | 38 |
| **UniAlerts** | An early warning system used by universities to detect academic and financial problems of students and to start a support process. | approx. 15,000 students | 80 | 43 |
| **LabSales** | A sales force tool, which is specialized for pharmaceutical companies and used by several companies. | approx. 300 sales agents | 72 | 34 |
| **MGIS** | MGIS is a geographic information system for the purpose of land consolidation. A public authority implemented this to replace and comprehensively extend an existing solution that only had display functionalities. | approx. 750 users | 65 | 46 |
| **FGIS** | FGIS is a geographic information system for the forestal planning at the authority. In the considered project, a project team reworked an existing system. The software mainly serves the purpose of creation and administration forestal maps. | approx. 25 users | 68 | 12 |

| | | | | |
|---|---|---|---|---|
| **MIS** | The case is a major release of a software module of an IS for project managers in the area of land consolidation. The functionality includes project management and financial management functions. In the considered project, the project team reworked the module cost and financing, meaning that they changed about 50 percent of the functions of the software. | approx. 900 users | 57 | 108 |
| **CAD-WS** | The case company uses a computer-aided design (CAD) system for construction purposes and an Enterprise Resource Planning (ERP) system as an overarching data storage system. The project concerned the implementation and customization of a standard software for linking CAD and ERP, which allows users to create and access documents in the ERP-system. | approx. 750 users | 66 | 23 |
| **DMS** | The project DMS took place in the same company as CAD-WS. DMS is a data management system add-on to the ERP-system used by the organization. It is a standard software, which they extended to fit the purpose of the organization. | approx. 400 users | 54 | 11 |
| **Money** | The software Money was developed and implemented in a public bank. They started the project to substitute an old application. Money is a solution completely developed in-house that contains functions to calculate prepayment penalties. | approx. 100 users | 84 | 17 |
| **TicketReporting** | TicketRep is a reporting tool that is used by the first-level IT support in an insurance corporation to get information about malfunctions reported by users of different software systems with different helpdesk software. They introduced TicketRep to provide reporting functionalities across all helpdesk systems. The implemented software is a standard reporting system with some customizations. | approx. 100 users | 74 | 14 |
| **CorporateWiki** | In the case of CorporateWiki they chose a standard intranet software, customized, and implemented it in the large utility company EnergyServ. It was the goal to change the intranet from a pure information display to a social platform. The software would allow social collaboration among workers and easier provision of information. | approx. 180 users | 66 | 18 |
| **ChemLawTool** | New European chemical law REACH caused the development of ChemLawTool. REACH forces the case company ChemCompany to register their chemicals and manage them securely. ChemLawTool is a task management tool, which helps to create, assign and execute the tasks necessary to comply with REACH. | approx. 100 users | 63 | 21 |

The first method is direct assignment during which the fuzzy-set membership scores (ranging from 0 to 1) are directly defined by the researcher based on knowledge of the research domain. In our analysis, this is necessary for most of the information that we obtained via the interviews and document analysis. We used

the framework for the assessment of user participation, that we developed earlier based on Damodaran's (1996) forms of user participation, for the assessment of user participation across the different projects. Thus, it served as a qualitative anchor during this process of set calibration by direct assignment (Schneider & Wagemann, 2010).

As we examine different project types and approaches, we had to access whether the categorization of phases based on our framework had a good fit with cases underlying our analysis. We identified the three main phases for user participation from our model in all projects. Especially because of the restriction to use a reasonable number of conditions (Schneider & Wagemann, 2010), this number of phases was the appropriate level of detail in light of the available data. **Requirements analysis and design** are closely related and connected in most projects and thus are not clearly separable. User participation in the **development and customization phase** did take place in those cases when developers used agile methods. For instance, users participated by providing feedback on prototypes in intermittent user feedback cycles. Furthermore, we assessed the participation in the **implementation and testing phase**. This was user participation during training and adjustment efforts. We also judge if the user group participating in the project was **representative for all users** of the implemented IS. This condition of the overall project thus mirrors the challenge to select the right users and to let enough users participate in a project. We distinguished between groups that were 'not representative' and 'largely non-representative', meaning that for instance several departments were affected by the new software, but only a small number of users of one department participated, and groups being representative for the user group, meaning that a higher number of users of affected departments was included. 'Representative, few users' was assigned if the participating users indeed represented the whole user group from a functional point of view, but were only a very small share in respect of the whole user group. We also assessed the **user involvement** in the different projects based on users' perception of attributes of the IS. For instance, we evaluated whether users saw the software as a burden or as important and personally relevant. If it was obvious that users' attitude towards the system changed during the project, we assessed the particular state at the end of the project because it is most important when regarding project success and especially product success. We applied the direct assignment of fuzzy-set values to the assessment of UIP and the degree of user representation and user involvement and motivation based on the within-case analysis in the following way: 0 for no presence of the condition, 0.33 for user participation, which can be classified as informative or a small presence of a condition, 0.66 for consultative user participation and some presence of the condition, and 1 for participative user participation and full presence of a condition (see Table 4).

As a second calibration method, we used transformational assignment. In this approach, we make use of continuous functions to map base variable values to fuzzy values. Thus, we only provided minimal information. However, we had to define three thresholds, one for full exclusion, the crossover threshold, and one for full inclusion (Thiem & Dusa, 2013). While the full exclusion value defines the threshold of a condition for not being a member of a set (=0), the full inclusion value defines the threshold to be a full

member (=1). Moreover, the crossover threshold defines the boundary between a condition being a set member and not being a set member.

Table 4: Conditions and Outcome for the fsQCA

| **Name (Abbreviation)** | **Assignment Type** | **Fuzzy-Set Calibration** | | | | **Source** |
|---|---|---|---|---|---|---|
| | | **0** | **0.33** | **0.66** | **1** | |
| **Condition** | | | | | | |
| User Participation in Requirements Analysis (*UPR*) | Direct | None | Informative | Consultative | Participative | (Damodaran, 1996) |
| User Participation in Development/ Customization (*UPD*) | Direct | None | Informative | Consultative | Participative | (Damodaran, 1996) |
| User Participation in Implementation (*UPI*) | Direct | None | Informative | Consultative | Participative | (Damodaran, 1996) |
| Degree of User Representation (*DUR*) | Direct | Non-representative | Largely non-representative | Representative, few users | Representative | (Bano & Zowghi, 2015) |
| User Involvement (*UI*) | Direct | Software (SW) is seen as a burden | SW rather not important and personally relevant | SW rather important and personally relevant | SW important and personally relevant | (Barki & Hartwick, 1989) |
| **Outcome** | | | | | | |
| Usability (*SUS*) | Transform. | Full-exclusion threshold: 50 | | Crossover threshold: 62 | Full-inclusion threshold: 73 | (Bangor et al., 2008) |

We based our transformational assignment on a positive end-point concept, which implies that the set membership scores increase with increasing values of the base variable. We used transformational assignment for the calibration of the outcome of usability from the survey data in our study based on the calculation in R with the QCA package by Thiem and Dusa (2013). There are different calibration methods for transformational assignment. We use the piecewise logistic function, which is the standard function in the QCA package in R, as this method is most commonly used in research (Dul, 2016; Thiem, 2013). Moreover, Thiem and Dusa (2013) suggest using this function if there are no special theoretical or empirical reasons for using other methods. We set the full exclusion threshold to 50, the crossover threshold to 62, and the full inclusion threshold to 73 because Bangor et al. (2008) point out that SUS scores lower than 50 are unacceptable while 62 is the medium score and scores greater than 73 are considered to be good. We used

the values for system usability because its perception has been linked to matching the users' needs, especially on a functional level (Bano & Zowghi, 2015; Rivard & Lapointe, 2012). The raw data matrix containing the assessed conditions and outcome for all projects (Table 3) shows the results of the within-case analysis, whereas Table 5 contains all fuzzy-values on which we base the fsQCA.

Table 5: Overview of Data for Truth Table Minimization

| Case | UPR | UPD | UPI | DUR | UI | SUS |
|---|---|---|---|---|---|---|
| **UniPortal (E)** | 0.33 | 0.33 | 0.66 | 0.66 | 0.33 | 0 |
| **UniPortal (S)** | 0 | 0 | 0.66 | 0.66 | 0.33 | 0.04 |
| **Construction ERP** | 1 | 0 | 0.66 | 0.66 | 1 | 1 |
| **Residential Soft** | 0.66 | 0 | 0.66 | 0.66 | 0.66 | 1 |
| **SkillSoft** | 1 | 1 | 0.66 | 1 | 0.66 | 1 |
| **UniAlerts** | 1 | 1 | 0.66 | 0.66 | 1 | 1 |
| **LabSales** | 0.66 | 0 | 0.66 | 1 | 0.66 | 0.95 |
| **MGIS** | 0.33 | 0.66 | 0.66 | 1 | 0.66 | 0.63 |
| **FGIS** | 1 | 0 | 0.33 | 1 | 0.66 | 0.77 |
| **MIS** | 0 | 0.33 | 0.33 | 0.33 | 0 | 0.29 |
| **CAD-WS** | 0.33 | 0 | 0.33 | 0.33 | 0.66 | 0.68 |
| **DMS** | 0.33 | 0.33 | 0.66 | 0.66 | 0.33 | 0.17 |
| **MONEY** | 1 | 1 | 1 | 0.66 | 1 | 1 |
| **TicketRep** | 0.66 | 1 | 1 | 1 | 1 | 1 |
| **CorporateWiki** | 0.66 | 0.33 | 0.33 | 0.66 | 0.33 | 0.68 |
| **ChemLawTool** | 0.66 | 0 | 0.66 | 0.33 | 1 | 0.55 |

**Findings**

When conducting a cross-case analysis using fsQCA, it is the primary goal to identify necessary and sufficient conditions for the examined outcome (Schneider & Wagemann, 2012). A condition is necessary if it is present in all cases in which the outcome is present. In the case of fsQCA, where membership decisions are not binary, this means that the fuzzy value of a condition has to be greater or equal than the fuzzy value of the outcome, which can be assessed with a calculation of consistency. Cases that do not have the specifically considered outcome are thereby not relevant when testing for necessity (Ragin & Rihoux, 2009). A consistency value of 1 (Schneider & Wagemann, 2012), or at least higher than 0.9 (Ragin, 2006) can also indicate a necessary condition. We did not identify a necessary condition in this step of the analysis. Furthermore, we also included the automatically provided PRI (proportional reduction in inconsistency) score, to make sure that we did not identify evidence for a necessity relation between condition and the positive

as well as the negative outcome. We did not find an indication for this in our analysis. Subsequently, we conducted an analysis of the necessary conditions for the negated outcome. We did this in the same way as the analysis for the positive outcome. This test is essential, since a condition which is necessary for an outcome as well as for the negated outcome is a trivial condition (Schneider & Wagemann, 2012). We also did not identify such a condition.

We also conducted an analysis for the sufficient conditions. A condition is sufficient if it is part of the configuration of the considered outcome in any case, implying that there is no case among the considered ones where the condition is present, but not the outcome. For fsQCA, this means that a condition is sufficient for the outcome if its fuzzy-value is equal to or smaller than the fuzzy-value of the outcome. The sufficient conditions for the outcome are identified by the creation of a truth table (see Table 6) followed by using the enhanced Quine-McCluskey algorithm to minimize the Boolean output function (Thiem & Dusa, 2013).

Table 6: Truth Table for Usability

| UPR | UDP | UPI | DUR | UI | SUS | Consistency | PRI | Number | Case Name |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 1 | 1 | 1 | 0.885781 | 0.807086 | 3 | LabSales, Construction ERP; ResidentialSoft |
| 1 | 1 | 1 | 1 | 1 | 1 | 0.876263 | 0.843949 | 4 | SkillSoft, Uni-Alerts; Money; TicketRep. |
| 1 | 0 | 0 | 1 | 1 | 1 | 0.86612 | 0.743456 | 1 | FGIS |
| 1 | 0 | 0 | 1 | 0 | 1 | 0.836667 | 0.689873 | 1 | CorporateWiki |
| 1 | 0 | 1 | 0 | 1 | 0 | 0.774436 | 0.571429 | 1 | ChemLawTool |
| 0 | 1 | 1 | 1 | 1 | 0 | 0.738693 | 0.539823 | 1 | MGIS |
| 0 | 0 | 0 | 0 | 1 | 0 | 0.706767 | 0.469388 | 1 | CAD-WS |
| 0 | 0 | 0 | 0 | 0 | 0 | 0.560886 | 0.242038 | 1 | MIS |
| 0 | 0 | 1 | 1 | 0 | 0 | 0.546366 | 0.264228 | 3 | DMS, Uni-Portal (S,E) |

We also conducted this analysis for the negative outcome to make sure that there are not contradictory paths in comparison to the positive outcome (Schneider & Wagemann, 2012). The required levels of consistency and subsequently coverage determine the inclusion of a configuration. A choice of the appropriate level of consistency and coverage for a particular analysis should be based on the characteristics of the data and the specific research project (Schneider & Wagemann, 2010). We identified a gap in the distribution of consistency scores between the different cases, which we used as an indicator for the threshold (Ragin & Rihoux, 2009). Hence, we used a minimum consistency value of 0.8 for analyzing sufficiency, which is above the suggested minimal threshold of 0.75 (Ragin & Rihoux, 2009; Schneider & Wagemann, 2012). Furthermore, the high PRI scores indicated a substantial difference between consistency scores for high

usability and low usability (Schneider & Wagemann, 2012). A closer analysis of the cases covered by the configurations also supported the cut-off point.

The application of the Quine-McCluskey algorithm in the aforementioned software solutions generates complex, parsimonious and intermediate solutions (see Table 7). The complex solution is the default option (Thiem & Dusa, 2013), without the inclusion of logical remainders (Ragin & Rihoux, 2009). Logical remainders are configurations not appearing in any of the underlying cases. The parsimonious solution is based on the inclusion of logical remainders into the minimization process without any prior assessment by an analyst as to whether a sufficiency relation is plausible or not (Thiem & Dusa, 2013). The intermediate solution is a solution based on the minimization process based on logical remainders which are consistent with the underlying knowledge of cases and theory (Ragin & Rihoux, 2009, Thiem & Dusa, 2013). This means for our analysis that we indicate that a prominence of all user participation efforts, a higher degree of degree of end user representation, and higher user involvement will be part of configurations with a higher level of usability. We focus on this solution for our analysis because of the theoretical underpinnings of the minimization process (Ragin & Rihoux, 2009).

Table 7: Truth Table Minimization Results

| Type of Solution | Minimized Configuration | Consistency | Cov.r | Cov.u | Case Name |
|---|---|---|---|---|---|
| **Complex** | UPR*~UPD*~UPI*DUR | 0.88 | 0.32 | 0.06 | FGIS (0.67,0.77), CorporateWiki (0.66,0.68) |
| | UPR*UPI*DUR*UI | 0.93 | 0.60 | 0.33 | ConstructionERP (0.66,1), ResidentialSoft (0.66,1), SkillSoft (0.66,1), UniAlerts (0.66,1), LabSales (0.66,0.95), Money (0.66,1), TicketRep (0.66,1). |
| **Parsimonious/ Intermediate** | UPR*DUR | 0.91 | 0.70 | 0.70 | SkillSoft (1,1), FGIS (1,0.77), ConstructionERP (0.66,1), ResidentialSoft (0.66,1), UniAlerts (0.66,1), LabSales (0.66,0.95), Money (0.66,1), TicketRep (0.66,1), CorporateWiki (0.66,0.68) |

In our particular case, the results for the intermediate and the parsimonious solution are identical, which indicates that logical remainders did not have a particular influence on the results of the minimization process. However, we begin our presentation of results with the explanation of the complex solutions. There

are two complex solutions, which are associated with a high level of usability. The first complex solution *UPR*~UPD*~UPI*DUR* has a rather low raw coverage (Cov.r) and unique coverage (Cov.u). The low raw and unique coverage indicate that this complex solution explains only a small share of the membership values (Ragin, 2000). Only the cases FGIS and CorporateWiki have a large overlap with this solution. However, the cases of FGIS and CorporateWiki have both very particular characteristics. They are rather specialized solutions for specialized user groups in the respective organizations. In both cases, there was enough user participation of the right users early in the project. Thus, additional efforts were not necessary.

The other complex solution *UPR*UPI*DUR*UI* has a higher degree of raw and unique coverage and therefore a greater overlap with altogether seven cases. Thus, this solution explains a larger share of the outcome. This solution suggests that user participation in the requirements and implementation phase with the appropriate users will be associated with a certain level of user involvement. This is a link to previous research on the relationship of UIP, which stated that participation will spur involvement (Hartwick & Barki, 1994). The identical parsimonious and intermediate solution *UPR*DUR* suggest that only the combination of the conditions of early user participation during the requirements phase conducted with the appropriate users is causally relevant for project success in terms of usability. Besides its high level of consistency, this solution covers many different cases and therefore provides a good explanation for a large share of the outcome. Furthermore, this result indicates that user participation as a condition of IS project success is inseparable from the assessment of the appropriate users for the participatory practice. The projects with a membership in this solution all have some form of consultative or participative user participation in the requirements analysis phase.

We compared our results to the findings in previous research on the relationship of UIP and IS project success that we outlined in section 2.1.1. First, we did not find outright support for the necessity of the condition of user participation in the requirements analysis phase without an additional condition. However, user participation in the requirements analysis phase is part of all solutions terms of the fsQCA. It is therefore a causally relevant condition only in combination with the condition to involve the appropriate users. The combination of conditions is not sufficient for the outcome because of the membership scores of the case of FGIS. For this case, the fuzzy set membership of the combination of conditions is higher than the membership in the outcome of high usability. However, for a condition to be sufficient for the outcome, the membership of each case in the condition must be equal to or smaller than its membership in the outcome (Schneider & Wagemann, 2012). With regard to the impact of user training and other efforts after implementation, we also did not identify evidence for the sufficiency of user participation in the implementation phase for project success. Apparently, efforts later in the project are not likely to have enough impact to ensure a successful project from end users' point of view. However, it is part of a complex solution in combination with the presence of user participation in the phase of requirements analysis, the appropriate degree of user representation, and user involvement. As this combination of conditions is sufficient for the positive outcome, user participation in the implementation phase is part of a sufficient solution. Finally, the results of the fsQCA underline that UIP is more effective when the participants represent a large share of

the affected users. This reaffirms previous research results (Damodaran, 1996; Markus & Mao, 2004). In sum, project success is very likely for the majority of the cases when the appropriate users participate and this takes place in the phase of requirements analysis.

**Discussion**

Our analysis of multiple cases contributes to research with an improvement in the level of detail of the understanding and empirical backing for the notion that user participation and involvement is especially beneficial in the requirements analysis phase (Bano & Zowghi, 2015). Thus, our fsQCA provides additional empirical evidence on this finding. Furthermore, a higher level of user participation without participation of the appropriate user group (mainly end users) will not result in a significant improvement in the outcome. This finding can also be linked to previous research, which indicated that ineffective management of the participation and involving possibly the wrong users could also have adversarial effects on project success (Bano & Zowghi, 2015; Howcroft & Wilson, 2003a; Lynch & Gregor, 2004). As an implication, this could mean the participation of actual end users and not of their managers or power users, who are not representative for the majority of the user group. The results are an indication (Schneider & Wagemann, 2012) and an empirical typology, which can guide future research into the relationship of user participation and project success. The results of our analysis also cast doubt on the net effect of user participation in development as well as testing. However, a qualification of this assessment is necessary, as the lack of participation in the development phase can be due to the lack of prominence of truly agile development/customization approaches in most projects. Nonetheless, our results reinforce the notion that the participation of users in the development phase is much more prone to complications, therefore costly, and less effective than user participation in the requirements analysis phase. The low coverage of the complex solution, which encompasses user participation during development, indicates this.

Our results confirm the generally positive evaluation of the relationship of UIP with IS project success. Furthermore, we add to the body of knowledge on the subject with the empirical typologies (i.e. configurations) analyzed in the paper. We also add to the research domain by providing an analysis of the intertwined conditions of user participation in the requirements phase and the appropriate degree of user representation. This is a new insight, which advances the research for IS project success, and gives an indication for the appropriate phase for user participation. Thereby, we add to research to determine the appropriate forms of user participation in different project phases (Bano & Zowghi, 2015). We also explain part of the relationship of UIP and the success of IS implementation projects.

However, there are also limitations for the interpretation of the results of our multiple case study. Generally, UIP is problematic because users do not know what they need (Nielsen, 2001). Howcroft and Wilson have warned about the conflicts emerging through the participation of different stakeholders (2003b). Besides these more general points on the subject of user participation, the number of cases that we were able to analyze and their particular nature influenced the analysis. Furthermore, we used a limited number of conditions for the analysis. Only a larger number of cases can help to reduce these limitations. A larger number

of cases would allow introducing more conditions in the QCA, or a different focus of a reanalysis of the available data set with a different theoretical motivation. A different theoretical perspective could, as aforementioned, include the condition of project complexity as it has already been established that the degree of user participation and involvement can be related to the complexity of the project (Harris & Weistroffer, 2009). In our analysis, we could only use the number of end users and some information about the tasks and features of the implemented IS as a proxy for this condition. We did not opt to do this because of the focus of our research on UIP and the limited number of conditions that we could analyze given the number of cases (Schneider & Wagemann, 2010). Thus, the results of our analysis generally only hold true for the types of cases that we examined (Schneider & Wagemann, 2010). Another possible limitation is a response bias in survey answers for individuals who have made a negative experience with the implemented software. We used the interviews in the organizations in order to corroborate and challenge our survey-based findings as remedy against biased results.

Our analysis of the cases also has several practical implications. Project managers should make sure that they focus their attention on user participation in the phase of user requirements analysis. In particular, they should make sure that actual end users of the IS participate. This should help to increase the perceived usability of the software and thereby increase the productivity of end users. Our results do not indicate that user participation in the other phases of a project is not worthwhile. However, it shows that this participation will be less effective, if users have not participated early on. The key insight for practitioners is therefore to involve representative end users of the IS and listen to them in the early days of a project. Then, user involvement and motivation of these users are very likely to be associated with the situation in and around the project and therefore assure project success. Perceived project success in terms of usability is also very likely in such a situation.

**Conclusion**

We conducted a multiple-case study and highlighted the effect of UIP in the requirements phase on IS project success. We are able to show that the participation of the appropriate users in the requirements analysis phase is a key condition for IS project success. In addition, we are able to show that a higher level of user participation will not result in a significant improvement in the outcome, if users participate that cannot contribute as much as true end-users can. The parsimonious solution of our configurational analysis of all cases is an example for a unidirectional set-relationship because user participation in the requirements phase without the right users is not particularly valuable or maybe just a waste of time of all parties involved.

# 4 Empirical Studies on the IS Post-Implementation Phase

In this chapter, we are going to present our research focusing on the IS post-implementation phase. In this phase, we did not investigate the origins of use behaviors based on the development of the IS project, but the actual user behavior and its antecedents on the level of the individual end user. Based on the theoretical foundations that we presented earlier these antecendents are learning, adaptation, and workarounds as a special form of adaptation. In the first study, we present our conceptual analysis of the relationship of learning and effective use in section 4.1. The second study, presented in section 4.2 is a case study in which we investigate the relationship of workarounds and effective use. In section 4.3., we present our initial proposition for an empirical study for the investigation of the relationship of user adaptation in the form of adaptive system use (ASU) and effective use. This entails the replication of Sun's (2012) orginal study on ASU and the operationalization of the measures for EU. This chapter therefore includes our more detailed investigation of the nature and measurement of the concept of effective use (EU).

## 4.1 Analyzing the Effect of Learning on the Effective Use of Enterprise Systems[1]

It is intuitive to expect that learning has a positive effect on EU because users who have learned the system's structures and how to use it to carry out their tasks can use it more effectively and efficiently in their jobs. However, we argue that it has not been completely clarified when and how users engage in learning to improve their level of EU. We propose that the learning actions suggested by Burton-Jones and Grange (2013) are affected by context-oriented forms of learning. To capture the complexity of learning, we develop three constructs: (1) learning via training, (2) self-learning, and (3) learning via social interaction. For example, users might learn how to navigate the user interface (i.e., surface structure) in a training session and later, during their experimentation with the system, learn how to leverage its representations to improve their ability to take IAs. As illustrated in Figure 7, our research model integrates the proposed learning constructs into the EU framework and extends the work of Burton-Jones and Grange (2013). In this section, we explain this model and formulate five hypotheses, which address the effect of the identified learning forms on three learning actions, which in turn influence the EU dimensions.

As mentioned before, Burton-Jones and Grange (2013) propose a hierarchical structure for EU in which the lower-level dimension is necessary but not sufficient for the higher-level dimension. To reflect this hierarchy, two relationships have been developed. First, TI directly influences RF since a user naturally needs to interact

[1] The content of this section is from the following paper: Gnewuch, U., Haake, P., Mueller, B., Maedche, A., 2016. The Effect of Learning on the Effective Use of Enterprise Systems. Proc. Int. Conf. Inf. Syst. 2016, December 11-14, 2016, Dublin.

unimpededly with a system to improve her/his ability to obtain faithful representations. Second, RF has a direct effect on IA, as users cannot take IAs without obtaining faithful representations. Furthermore, the learning actions and their relationships with EU dimensions have been developed by Burton-Jones and Grange (2013). Learning the system, which includes learning its physical structure, surface structure and representations, is hypothesized to improve a user's TI with the system because knowledge of the surface structure (e.g., user interface) will help a user to interact with it. However, there is no link between learning the system and other EU dimensions. To improve their ability to obtain RF, users need learn the fidelity of the system's representations, that is, to learn to assess if a representation faithfully reflects the domain. Thus, learning fidelity is proposed to have a moderating effect on the relationship between TI and RF. Similarly, learning to leverage representations moderates the relationship between RF and IA because users who have learned to leverage a system's representations will be better positioned to take IAs.

**Learning via Training**

Burton-Jones and Grange (Burton-Jones & Grange, 2013) argue that users need to learn the system (i.e., its physical structure, surface structure, and representations) to improve their TI with it. Normally, newly hired employees receive a general technology education or already possess knowledge on the underlying physical structure (consisting of computers, keyboards, monitors, etc.). However, training courses also support the development of general technology knowledge and skills (Gripenberg, 2011). Training programs help users to become familiar with a system's user interface (e.g., menus, forms, buttons) and to learn how to navigate it (Lauterbach et al., 2014; Robey et al., 2002). Furthermore, training imparts users with basic knowledge on how to do their tasks (Yamauchi & Swanson, 2010), which provides an insight into the system's representations (i.e., the combination of the deep structure and corresponding data). As explained above, training comprises all formal activities before the implementation of a new ES to educate users about how to use it (Sykes, 2015). Moreover, organizations often provide additional training materials (Sasidharan et al., 2012). Therefore, we define learning via training as the extent to which users learn from their participation in formal training activities. Users need basic training and a minimum level of IT skills to use the available technology and to get an initial understanding of the system's functionality (Gao, Liu, Feng, & Hu, 2014). Training provides basic functional knowledge which is usually sufficient to build confidence in using the system in the future (Gao et al., 2014; Léger et al., 2011). The implementation of a new system is usually accompanied by the introduction of new business processes which are first explained during training (Robey et al., 2002). This also facilitates the users' understanding of how the system represents these implemented processes. Thus, we argue that:

*$H_1$: Learning via training improves a user's ability to learn the system (i.e., its physical structure, surface structure and representations).*

While there is general support in IS literature for the assumption that learning via training has a positive effect on learning the system, there is little or no evidence of a significant influence on a user's ability to learn the

fidelity of its representations or how to leverage them. Although researchers recently suggested more innovative training approaches, such as collaborative technology-mediated training (Gupta & Bostrom, 2013) or business simulation training (Léger et al., 2011), even "the best training programs have difficulty anticipating all the complexities of actual on-the-job use" (Sasidharan et al., 2012). Moreover, training cases are often rigid and do not allow for individual exploration of the system (Lauterbach et al., 2014). Gallivan et al. (2005) even suggest that training "may be neither a necessary, nor a sufficient, condition for successful IT usage" (p. 178) because users explore the system on their own or together with their peers. Particularly in integrated applications, such as ESs, it is important for users to learn how they can effectively coordinate their interactions with other users (Sharma & Yetton, 2007). In summary, we argue that during training, users learn the components of a system and how to perform basic tasks, but their level of EU will be rather low, as they have not learned the RF or how to leverage representations. Users cannot achieve a high level of EU merely by attending training sessions. Thus, we do not hypothesize relations between learning via training and the other two learning actions. Nevertheless, we will test for these relationships and adapt our research model if we find evidence for a greater effect of learning via training.

**Self-Learning**

Self-learning includes all activities users undertake to learn independently how to use a system effectively. It has been observed that, users explore a system's features or additionally provided materials after the roll-out of a new system (Barki et al., 2007; Liang et al., 2015; Spitler, 2005). Moreover, users experiment with unknown features (Spitler, 2005; Tennant et al., 2015; Yamauchi & Swanson, 2010) or discover new ways of exploiting the system by trial and error (Beaudry & Pinsonneault, 2005). While users carry out their work and gain valuable experience in using the system, they also engage in learning-by-doing (Ryu et al., 2005; Torkzadeh et al., 2011). The benefits of experiential learning (Kolb, 1984) are widely recognized in psychology. Therefore, we define self-learning as the extent to which users learn from their own efforts. Burton-Jones and Grange (2013) postulate that users need to learn the fidelity of the system's representations which is facilitated by learning its representations and domain. Even though training might provide users with an initial insight into the representations and domain of a system, we argue that a significant amount of learning takes place when users engage in self-learning. When users use a system in their day-to-day tasks, experiment with it or explore new features, they gain valuable experience. Not only do these activities help them to improve their knowledge on representations and domain, they also foster an understanding of the business logic implemented as the system's deep structure. Particularly, learning fidelity is difficult without applying the system to actual business problems because training cases cannot replace actual work experience (Lauterbach et al., 2014; Sasidharan et al., 2012). On-the-job usage, however, provides experience of how the system reacts in real life business situations and which typical problems or errors can occur. This helps users to determine if a particular representation faithfully reflects the domain (e.g., if a customer's phone number in a CRM system is the correct one for this customer). Therefore, we propose that:

*$H_{2a}$: Self-learning improves a user's ability to learn fidelity towards representations.*

Burton-Jones and Grange (Burton-Jones & Grange, 2013) further point out that learning to leverage representations will raise a user's level of EU by improving the ability to take IA. We hypothesize that self-learning significantly contributes to learning to leverage representations because the experience gained through on-the-job usage (i.e., learning-by-doing) or experimentation with a system enables users to make better decisions. Moreover, researchers have found that self-learning activities, such as exploration, increase the use of a system in terms of breadth and depth (Liang et al., 2015; Liu, Feng, Hu, & Huang, 2011). Even though breadth and depth of use do not imply EU, we argue that when a user has explored new or previously unknown functions, s/he can establish a better foundation for taking IA by leveraging what s/he has learned through exploring the system. Furthermore, users can combine several self-learning activities. For example, a user watches a video tutorial or reads about a feature in the documentation while experimenting with this functionality in the system or performing her/his day-to-day tasks. Thereby, s/he can immediately see the result of her/his actions, understand and react to any problems that may arise and, ultimately, learn new or better ways of doing things in the future. Additionally, users can avoid taking ill-informed actions, which lead to additional effort for correcting errors or poor decisions (Burton-Jones & Grange, 2013). In sum, we argue that:

*$H_{2b}$: Self-learning improves a user's ability to learn to leverage representations.*

**Learning via Social Interaction**

Learning via social interaction captures the social embeddedness of learning processes in the workplace. During their work, employees frequently interact with their colleagues and help each other in performing their tasks using the company's ES (Bruque et al., 2009; Gao et al., 2014; Sasidharan et al., 2012). This provides many opportunities for learning from others (e.g., asking peers for help) and for learning together with others (e.g., collaborative problem solving) (Deng & Chi, 2012; Gripenberg, 2011). Therefore, we define learning via social interaction as the extent to which users learn from and together with others in the workplace. To improve their ability to obtain RF, users need to learn the domain as well as representations and their fidelity (Burton-Jones & Grange, 2013). Sykes (2015) states that peers provide valuable domain knowledge which can lead to a deeper understanding of the system's domain. Particularly due to the complexity and integration of best practice business processes in ESs, users need more domain knowledge to operate an ES and therefore have to rely on their coworkers' knowledge (Sykes et al., 2009). Additionally, IT support staff possess general knowledge on the company's applications (e.g., on its deep structure and representations) (Beaudry & Pinsonneault, 2005; Sykes, 2015). Furthermore, interaction with peers and support staff also allows users to learn if representations faithfully reflect the domain (Boudreau, 2003) or to clarify certain system behavior (Yamauchi & Swanson, 2010). This timely support not only helps them to complete a task successfully, but may also facilitate determining the faithfulness of a representation in the future. Thus, we argue that:

*$H_{3a}$: Learning via social interaction improves a user's ability to learn fidelity towards representations.*

Furthermore, Burton-Jones and Grange (2013) emphasize that knowledge of how to leverage the obtained representations is necessary to take IAs. We argue that a large amount of this learning occurs via social interaction. According to Nan (2011), employees learn from their top performing peers through social learning. Since EU enhances performance (Burton-Jones & Grange, 2013), it seems likely that those colleagues exhibit a high level of EU resulting from their knowledge on how to leverage the system's representations to take IAs. Employees who still struggle with effectively using the system can learn from these peers by adopting their practices (Nan, 2011). Moreover, Lauterbach et al. (2014) observed that users interact with peers or superiors to solve problems in their immediate work performance. "Being able to question a co-located peer in the middle of having trouble" (Yamauchi & Swanson, 2010) is an effective way to learn how to use the system and to avoid taking ill-informed actions. Thus, we hypothesize that:

*$H_{3b}$: Learning via social interaction improves a user's ability to learn to leverage representations.*

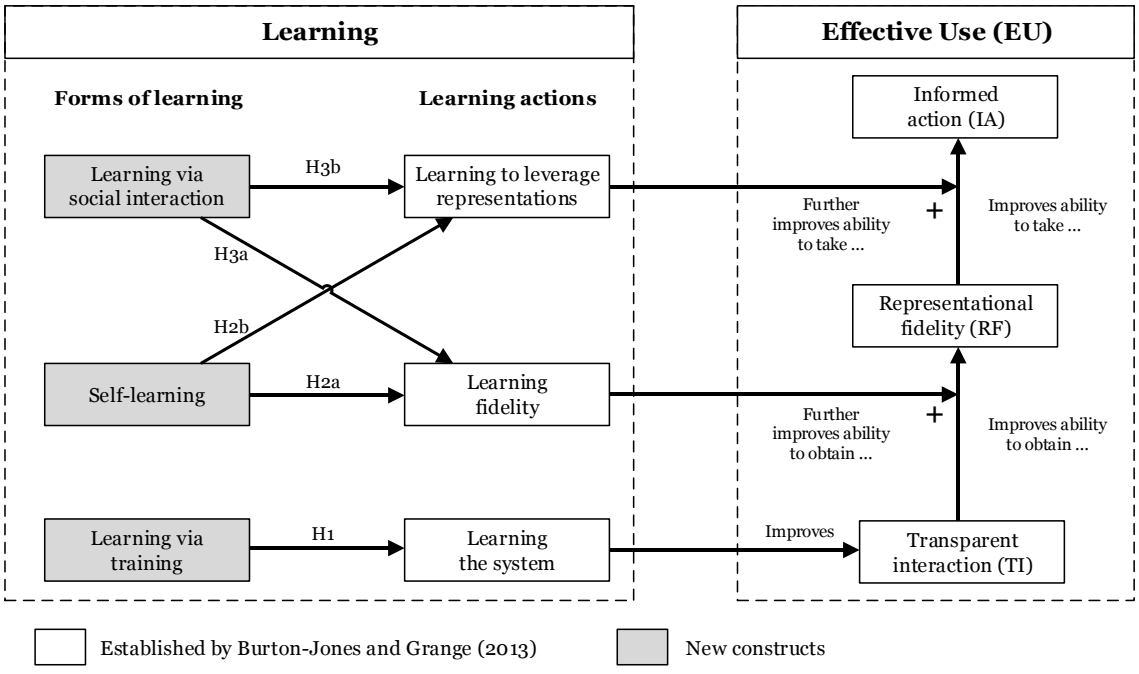



Figure 7: Forms of Learning and the Construct of Effective Use

While we introduce the conceptualization of the relationship of learning and effective use, we focus our further research on the investigation of the adaptation actions that are informed by learning. These are driven by users consolidated knowledge, which allows them to work around a system, whenever the features of a system lack fit with the specific application domain, or they can be focused on adapting the system in use. These forms of adaptations are already a result of learning. Since this thesis is focused on the organizational and individual means that lead to effective use of an IS, we decided to address these adaptations within the systems and workarounds as forms of adaptations first. Furthermore, we decided that the prerequisite of learning for informed adaptation that is an antecedent of any educated adaptation (Burton-Jones & Grange, 2013), which is

likely to improve the effective use of an information system, should be addressed in another future research effort. In the following section, we are going to present our study into the effect of workarounds on effective use. Subsequently, we conceptualize the relationship of user adaptation in the form of adaptive system use (ASU) and effective use.

## 4.2 Explaining the Influence of Workarounds on Effective Use – the Case of a Supply Chain Management System[2]

Managers are eager to understand how the benefits of IS, such as increased performance, integration of business processes and cost savings can be realized. Since IS are highly-complex information systems (IS), which implement a variety of industry best practices, they are rather inflexible and often difficult to use to perform company-specific tasks (Devadoss & Pan, 2007). As a result, projects introducing IS are often found to be most troubled in the post go-live phase (Markus, 2004; Markus & Tanis, 2000). In these, the key challenge to IS success shifts away from adoption and diffusion – issues that have been shown to be problematic in the IS context (Gallivan, 2001) – and more towards the question of how users use a system for their tasks. This ties in closely with efforts to go beyond shallow concepts of usage per se (Barki et al., 2007; Burton-Jones & Straub, 2006; Elie-Dit-Cosaque & Straub, 2011) in favor of deeper engagements with how a system is used to both effectively and efficiently achieve relevant outcomes. As Burton-Jones and Grange (2013) argue, organizations can realize the benefits from their IT-related investments only if such effective and efficient use is achieved.

However, due to the standardized nature of IS and their resultant imperfect fit to any one specific business setting, users frequently need to work around perceived shortcomings of such systems in order to successfully do their work (e.g. Boudreau & Robey, 2005). These workarounds are defined as individual or group level, goal-driven adaptation behaviors for overcoming the imperfections of an IS, which are preventing users to achieve personal or organizational goals (Alter, 2014). Workarounds are commonplace in many organizations and either individual employees or user groups employ them to do their job. In some cases, employees are encouraged and supported in their use of workarounds to overcome misfits of implemented standard software (Alter, 2014). Furthermore, Goh et al. (2011) indicate that workarounds are usually designed to support routine tasks rather than altering the business process. However, users' desire to save time or effort can lead to the adoption of a workaround regardless of system imperfections (Vassilakopoulou et al. 2012). Few prior studies explore how and why workarounds can influence use. Instead, most prior research only offers empirical evidence of workaround development and usage without providing comprehensive theoretical explanations (Alter, 2014; Yang et al., 2012). Examining this research gap with a new

[2] Li, Y., Haake, P., Mueller, B., 2017. Explaining the Influence of Workarounds on Effective Use: The Case of a Supply Chain Management System. ECIS 2017 25th Eur. Conf. Inf. Syst. Guimarães, Port. June 5th-10th 2017.

perspective on the effective use of IS through workarounds, will help organizations to use IS more effectively and allow managers to sponsor those workarounds that actually alleviate problems in use.

In this paper, we present a longitudinal case study in a globally operating chemical company (CeCo). The company deploys an IS for demand planning, which is the illustrative context for this case study. This advanced supply chain management (SCM) system supports decision making processes via optimized business data management in the supply chain (Moss & Atre, 2003). The implemented SCM system is flawed in the eyes of many users, but its use is mandated by the company's global management based on the rationale that only the integrated, company-wide use of a SCM system can improve forecast accuracy. Employees at CeCo have developed several workarounds to enhance their ability to use the system effectively and efficiently. Our analysis of this case contributes to the understanding how these workarounds help employees at CeCo to deal with an otherwise cumbersome SCM system. Through our analysis and theorization, we contribute to research by expanding the concept of effective use with an improved understanding of workarounds and their effect on effective use of IS, such as SCM systems. Based on this study, we answer the following research question: *How and why do workarounds influence the effective use of an IS in the post-implementation phase?*

**Research Methodology**

We follow a case study approach and conduct an interpretive case study on the basis of the seven principles for interpretive field research developed by Klein and Myers (1999) as the key research method for refining the effective use theory. Interpretive case studies can not only generate insights on the phenomenon, but also the comprehension of the complex context (Keutel, Bjoern, & Richter, 2014). We chose an interpretive research approach to develop an extension of effective use theory because we are examining how individuals in organizations make sense of an IS and their use context and then find a collaborative approach to deal with the impediments to effective use. In turn, they are able to have an impact on their context through effective use of the IS. Interpretive case studies require a close interaction between researchers and the research entities (Bygstad & Munkvold, 2011; Klein & Myers, 1999). Hence, one of the researchers worked in the case company for nine months to generate a better understanding about the complex environments, the employed workarounds, and effective use of the standardized SCM system.

**Case Description**

CeCo (alias) is one division of a large chemical company in Central Europe. For CeCo, basic chemical products are a huge part the product portfolio. Market competition is rather intense for basic chemical products and accurate planning is especially vital for CeCo because it allows more precise inventory control and production that is more efficient. It is very demanding to generate accurate demand forecasts for basic chemical products because the product portfolio covers a wide range of different products and a volatile market. Moreover, CeCo has to align the demand for the markets in three continents.

Therefore, CeCo invested into its Supply Chain Management (SCM) system, which is a large-scale IS for managing the planning process. In terms of demand planning, major functionalities offered by SCM are used through a planning process that can be summarized in two stages. In the first stage, the data is transferred in a top-down manner. The global key users maintain master data and the system generates corresponding forecasts on a monthly basis. In order to improve the data for forecasting, global key users are responsible for updating the master data on the product and customer portfolio in the system, segmenting products, ruling out the outlier data, selecting forecast strategies, etc. Forecasts are subsequently distributed to local sales representatives. Sales representatives directly contact customers to discuss the forecast and subsequently upload the expected sales volume for the next three to six months. In the second stage, forecast data is transferred bottom-up. After local sales representatives upload their forecasts, regional planners gather forecast data and present it in a sales and operation planning meeting. In the final step, agreed forecast numbers are allocated to each factory for detailed production planning.

Although this process is supposedly smooth and SCM is supposed to align with the whole planning process, problems occurred during use of the system. For instance, it is not feasible for key users to effectively group customers and products because of the huge data volume and complicated market context. Consequently, SCM cannot facilitate users to generate more accurate demand forecasts as it was expected. Therefore, the users at CeCo cannot use SCM to attain the goals of their work systems. Originally, it had been the organizational goal of SCM use to increase the demand forecast accuracy. In response to increasing competition, CeCo is searching for solutions to optimize demand planning and the company is dedicated to enhance the effective use of SCM for the goal of more accurate company-wide planning. After a pre-study, it was evident that the customization of SCM requires a great amount of change management and would take at least one year. Hence, it was decided that the company attempts to adapt existing workarounds and create new ones to improve the overall effective use of its standardized SCM system. The condoned workarounds do not substitute but compliment functionalities of SCM. As aforementioned, one author worked as an embedded researcher in CeCo's central IT support during this phase. He worked collaboratively with the employees there to identify current workarounds and to facilitate the demand planning process. This gave him immediate access and allowed him to interact directly with subjects during the data collection process.

**Data Collection**

For data collection we also followed the approach suggested by Klein and Myers (1999) who state that units of analysis can be at more than one level when subunits need to be focused on during the research. We identify the work systems around SCM as the main unit of analysis, with individual groups of users and their workarounds as relevant subunits within. We define work systems as a combination of business units (BUs) and regions. CeCo is a global multi-national company, which has three BUs and has separate branches in **Europe (EUR)**, **Asia-Pacific (AP)**, and **North America (NA)**. These different BUs produce substantially different products and are situated within different geographic regions and business contexts. All work systems use SCM as their default system, whereas work systems improvise workarounds for fulfilling the local requirements. Table 8 contains an overview of the analyzed work systems.

Table 8: Location of Work Systems at CeCo

| | **BU1** | **BU2** | **BU3** |
|---|---|---|---|
| **Europe** | EUR1 | EUR2 | EUR3 |
| **Asia-Pacific** | AP1 | - | - |
| **North America** | - | NA2 | NA3 |

The selected work systems do not cause any obvious bias for data collection, because all three BUs and all three regions are covered. We chose to conduct interviews (int) with key users, who have more solid knowledge about SCM and are expected to have more coping resources, as well as end users, who are likely to have limited IS-related knowledge and may face different problems when using SCM. We did take field notes based on observations or the discussion with users (Wolcott, 2005).

Table 9: Overview of Interviews at CeCo

| **Interview** | **Interviewees** | | **Experience of interviewees in the field** | **Work Systems** |
|---|---|---|---|---|
| **int 1/ int 6 / int 7** | 2 Key users | Global IT support | High knowledge and experience | EUR1, EUR2, EUR3 |
| **int 2** | Key user | Planner | High knowledge and experience | NA2, NA3 |
| **int 3** | End user | Planner | Low knowledge, average experience | EUR3 |
| **int 4 / int 10** | End user | Sales representative | Low knowledge, average experience | EUR3 |
| **int 5 / int 11** | Key user | Planner | Average knowledge and experience | AP1 |
| **int 8 / int 9** | 2 End users | Sales representative | Low knowledge, average experience | EUR3 |

We followed the guidance from Kvale and Brinkmann (2009) for designing interviews and arranged interviews in two rounds. In particular, the second round of interviews was conducted to cover any unexplained conflicts among data from the first round of interviews (Glaser & Strauss., 2010). We conducted eleven interviews with eight people in two rounds. The average length of the interviews was around 35 minutes. Interview guidelines are available from the authors upon request. Moreover, users showed and explained their workarounds to the embedded researcher. The interviewees had at least five years of experience in their job and in the firm. The interviewed key users are solution or project owners, while the end-users have an in-depth knowledge of the business processes in their area. We present the information about each interview in Table 9.

**Data Analysis**

In our data analysis, we followed an inductive strategy and used the grounded theory method (Corbin & Strauss, 2015) for analyzing data and for identifying the set of categories that allow an extension of effective use theory. The grounded theory method is a widely accepted approach for interpretivist research (Eriksson

& Kovalainen, 2008) and is suitable for an explorative case study (Myers, 2013). We used semi-structured interviews, which fit the philosophical paradigm of interpretivism (Kvale & Brinkmann, 2009). Glaser and Strauss (2010) recommend multiple rounds of interviews because data collection and analysis should be conducted iteratively when following a grounded theory approach. Hence, before conducting the second round of interviews, we transcribed, coded, and analyzed the first round of interviews.

After transcription, we followed the two-steps coding process suggested by Glaser and Strauss (2010). First, starting with line-by-line analysis, we applied open coding for the first as well as the second round of interviews. The identified concepts were summarized into categories at a higher level, making sure that they sufficiently described the story of the case (Locke, 2001). Theoretical saturation was reached by constantly comparing the quotes and checking the transcripts (Glaser & Strauss., 2010). Second, we employed axial coding following Corbin and Strauss (2015), who propose a conditional/consequential matrix as a new tool for organizing concepts. During the analysis of the first round of interviews, we identified the conditions of the globally rolled out SCM, which impaired the execution of tasks on the level of regional work systems. For instance, planners often do not have direct access to all necessary information on screen in SCM because data necessary for the planning process is gathered at different system levels within SCM. In the second round of interviews, our questions aimed at discovering how users make sense of the different sources of information and how they link information in the SCM with workarounds. During the analysis of the first round of interviews, it became also evident that users' difficulties with learning the deep structure of the SCM system might result in the usage of workarounds. Thus, in our second round of interviews, we build our interview questions on the basis of Santhanam, Seligman, and Kang (2007) and Bagayogo et al. (2014), who distinguish IT related knowledge into know-what, know-how and know-why. Our subsequent analysis of the interviews with open coding followed by further deriving the conditional/consequential matrix showed what was learned and the implemented workarounds that were used to be able to execute the given tasks in the business environment or to maintain given routines.

**Findings**

When working with SCM, users often experience situations in which their interaction with the system is impeded. However, the underlying reasons for the impediment are often beyond the users' control. Consequently, they conceive **workarounds (wk)** that help them overcome the system's impediments. As aforementioned, they have gathered the knowledge about possible solutions in various situations and developed a bricolage of knowledge on systems and tasks. They use this knowledge to implement the workarounds with tools that they have control over in order to achieve the goals of their work system. As in our case, management and IT departments can also promote this process. Engaging with our data carefully, we observe that when a formal request of customizing SCM cannot be approved in a timely manner or it requires too much effort (thus effectively eliminating the chance for an individual user to engage with the problem in her/his personal context her/himself), users resort to developing workarounds. A key user shared his experience of how exhausting the customizations process can be: *"Sometimes it does not make sense to customize SCM […]. […] in the next version of SCM, this customization will not work any longer. Then*

*you have to make another customization […]"* (int 2). Consequently, users tend to search for more feasible solutions outside the system. We present the seven identified workarounds in the following three sections (see also Table 10).

## Workarounds for Adaptation of Surface Structure

Workarounds for the adaptation of the surface structure, that is, the user interface of the SCM, are often necessary because it is cumbersome for users to access the desired data in SCM. Thus, they cannot interact with the system in a transparent fashion. For example, in Europe (EUR) some necessary data is not displayed directly in SCM. Therefore, users have to compare the data, once obtained elsewhere, with the data from SCM: *"We get all business data, including invoice data, open orders, from [another system]. I compare [that data] with the demand forecast [which I get from SCM] in the Excel file"* (int 4, **wk 1**). This quote shows how users need to leverage another system to obtain the data and then go through the often difficult process of comparing the data against the data in SCM. In a second, even more common example, useful data is contained in separate interfaces within one system. It is very cumbersome for users to switch between different interfaces for checking the links between data. A sales representative in Europe explains this in the following way: *"[in the interface of our planning book,] we have the planning numbers at customer/article level. The volume of what we can sell every month is on customer group level. […]You don't have the link anymore"* (int 4).To overcome this problem, the users created a workaround to compare data from the SCM: It is easier for users to generate an overview of the data by downloading data from SCM and displaying it in an Excel file. The user further illustrates this: *"[creating the Excel file] is the only way that you can have the overview and you can know about the numbers"* (int 4, **wk 1**). In effect, the Excel-based solution of wk 1 thus allows users to interact with the system more transparently, improving the effective use of the SCM.

Furthermore, users deploy Excel-based workarounds to design interfaces that present only necessary data. Even though users can select data relevant for their tasks from SCM's interface, the generated reports often provide unnecessarily detailed data. One planner described this in the following way: *"[The report from] SCM provides very detailed data […], [but a planner] only needs three or four [columns from the SCM report] for planning"* (int 3, **wk 2**). As a result, users need to spend extra time and energy to locate the required data. To address this issue, planners adopt an Excel-based workaround that only contains necessary data in the interface. As explained by that planner: *"So we [download all the data from SCM and] create a pivot table [in Excel to show only the necessary data]"* (int 3, **wk 2**). The planner from Asia (AP1) illustrates the explanation of this solution, while sharing that he is also experiencing this problem: *"SCM offers a lot of detailed information. […] We manually generate an Excel sheet to show data [, which is relevant for our region]"* (int 11, **wk 3**). In terms of effective use, such workarounds help to improve **transparent interaction (TI)** by allowing end-users to use an adapted interface of the system.

## Workarounds for Adaptation of Surface Structure and Representations

Another group of workarounds that we identified in the case organization does not only allow increasing the transparent interaction with the user interface, but also the representations of data in the SCM. The first aspect of a lack of transparent interaction is illustrated by a North American (NA) planner who explained that SCM is not intuitive enough for end users to obtain desired data: *"SCM is not user friendly for the sales representatives [who are] the end users"* (int 2). Consequently, this planner shares that he *"[…] extract[s] data out of SCM, and make[s] [an Excel file], which is more user friendly for sales representatives"* (int 2, **wk 4**). With the help of this workaround (**wk 4**), sales representatives do not need to go into SCM to check data while conducting their tasks. Instead, users can obtain all required data directly from the Excel workaround, which is more intuitive to use. Consequently, *"sales representatives can [use Excel to] check which customers have not put the order yet"*, and *"planners can communicate [data] with sales representatives"* (int 2, **wk 4**). This first aspect of the workaround helps sales representatives to have a more transparent access to data in SCM, just likes the aforementioned workarounds Again, such an increase in transparent interaction has a generally positive overall effect on the users' level of effective use of the data in SCM. Sales representatives can make use of more current planning data and they can use it when talking to a customer about a delivery date. However, the use of this workaround (**wk4**) goes beyond simply allowing better access to SCM data. The North American key user also leverages this workaround (**wk 4**) to allow sales representatives to correct or modify data in the Excel file directly and return any modifications made by the planning department to the sales representatives. The process for forecasting data ends when the key user uploads the data back to SCM and ensures that the data in his Excel workaround and in SCM are consistent. Similarly, **wk 4** offers a way for sales representatives (end users) to access some master data in SCM (over which they would normally have no control) through the Excel file. Thus, sales representatives can suggest changes to the master data: *"Sales representatives [can check the data in Excel and] say which customers were left out, or what location of a customer is no longer used […]"*. Subsequently, the key users can *"modify the data in the [Excel] sheet and maintain SCM accordingly"* (int 2, **wk 4**). In relation to the concept of effective use, **wk 4** therefore shows that these users do not just circumvent current surface structure to improve transparent interaction. **Wk4** also enables sales representatives to have a more direct influence on the system's representations, thus positively influencing the **representational fidelity (RF)**.

We identified another workaround with this combined effect in Europe (EUR). This particular workaround helps to deal with the search function in SCM, which is perceived as very inconvenient. It leads to a heavy workload for users when they are trying to locate and maintain master data. As explained by one global key user in Europe: *"[If I use the default search function from SCM], it takes me a long time to get that data out of the system […]"* (int 6). For this reason, the key users hired an external software company to develop an Access-based workaround, which provides more functional navigation of the interface. Therefore, *"it is easy and comfortable [...] to use the nice filter and sort function [in Access] to find relevant master data"* (int 6, **wk 5**). Compared to the default search function in SCM, which offers very limited possibility to

narrow down and filter master data, users can take advantage of the extra functionalities from Access to more easily and quickly find the desired data in a large database. Primarily, this has a positive impact on users' ability to interact with the system in a transparent fashion by improving the interface for the user. Similar to wk 4, though, we see that **wk 5** also has an impact on the representational fidelity. In the current process of managing master data, key users are first informed by the business functions about what data should be changed via email, and they change the respective data in SCM accordingly. However, the SCM key user for Europe explains that *"data in emails is not always correct"* and *"if I just upload the data without doing a double check, I might change something that should not be changed"* (int 6). As a consequence of an imbalance between manpower and the volume of master data, it is very stressful and time consuming for global key users to maintain the master data. In order to maintain master data more effectively and efficiently, key users leverage the Access-based workaround (**wk 5**) to reduce the difficulties of searching data and updating data considerably. Furthermore, key users also use this workaround to involve end users in correcting the master data. One key user explained that it is effective for end users to use this workaround to correct master data because *"[with this workaround] end users do not need to deal with the complex [logic of] tables; […] If they enter a new entry in one table, data will be updated in the related tables"* (int 5, **wk 5**). Another key user added that *"[with the drop-down function in Access], [end users] are not able to change the wrong data, because they cannot change customers who are not linked to [them]. So the quality of master data will be improved automatically"* (int 6, **wk 5**). This workaround illustrates that users can design a collective solution to involve more actors into the task for correcting the data in the system. While adding to **wk 5**'s positive effect on transparent interaction, this will also help to improve the quality of the representations users work with, thus improving representational fidelity.

Furthermore, we detected a third workaround that provided the functionality to adapt the surface structure as well as improve the representations of data. We observed that it is very difficult to clean up and maintain the data in the location-mapping table, which is a special master data table in SCM. It connects SCM to an underlying enterprise resource planning (ERP) system. However, if location data are changed manually in ERP, an inconsistency can arise between these two systems. Subsequently, key users need to change the data in SCM manually. However, there is no one-to-one relationship between the data in the two systems, and key users have no clue how to make a correct change based on SCM's information. As a result, key users tend to leave the inconsistency in the system. Unless *"planers complain something is missing, or [a] wrong simulation location [is included], [then] we update location mapping"* (int 6). In order to improve the key users' overview of the data, a workaround (**wk 6**) was established to load data from both SCM and ERP into a special Access database. In this tool, key users receive information which location data needs to be updated to address the data inconsistency. One key user stated that this workaround *"reduces the workload and leads to more accurate data […]"* (int 7, **wk 6**). Like **wk 4** and **5, wk 6** can also be seen to have a dual effect. First, it allows key users to interact with the system in a more transparent fashion, which, in turn, helps to improve representations in the system, and it improves representational fidelity.

## Workaround that enables Informed Action based on Adapted Representations

Finally, we observe a workaround (**wk7**) in relation to the generally dramatically inaccurate forecast numbers in SCM. The severity of the issue is illustrated by a quote from a sales representative: *"statistic forecasting is really a disaster"* (int 9). **Wk7** allows adapting representations in order to improve forecast numbers, which enables better-informed action. This is necessary because the default forecast model in SCM cannot capture typical demand patterns in CeCo's industry: *"We know that the big part of business is done between January and June, and [demand in] July and August is always very low. However, statistic forecast cannot show [this pattern]"* (int 8). After a thorough investigation, key users in Europe figured out that the default forecast model in SCM cannot effectively predict time-series data. Therefore, the accuracy of forecast numbers is always low. In response, key users in Europe collectively work around this issue by using the software of R-studio in **wk7**. In particular, key users download the historical data from SCM and use

Table 10: Identified Workarounds

| *wk* | Technology | Work System | Type of Workaround | Effective Use |
|---|---|---|---|---|
| ***wk 1*** | Excel | EUR3 | Adaptation of surface structure | TI |
| ***wk 2*** | Excel | EUR3 | Adaptation of surface structure | TI |
| ***wk 3*** | Excel | AP1 | Adaptation of surface structure | TI |
| ***wk 4*** | Excel | NA2 / NA3 | Adaptation of surface structure and representations | TI, RF |
| ***wk 5*** | Access | EUR1 / EUR2 / EUR3 | Adaptation of surface structure and representations | TI, RF |
| ***wk 6*** | Access | EUR3 / NA2 / NA3 | Adaptation of surface structure and representations | TI, RF |
| ***wk 7*** | R-studio | EUR3 | Adaptation of representations / enable informed action | RF, IA |

a more advanced forecast model, which was built in R-studio according to their requirements by central IT support (**wk 7**). R-Studio is then used to calculate the forecast for the next 6 to 12 months. Subsequently, the forecast data is uploaded back into SCM. Now users can have a more precise reference concerning historical demand patterns. Looking at this workaround's impact on effective use, we see that key users are leveraging **wk 7** to adapt representations by looping them through a different system (R-studio). Once these numbers are back in SCM, this does not only improve the level of representational fidelity in the respective representations among end users, but also improve end users' ability to leverage that data in their work; thus, improving their ability to achieve **informed action (IA)**.

**Discussion**

All workarounds presented above relate to end users' attempts to make their routine use of SCM more effective, the key aspect of our research question. In the following, we explain the effects of workarounds on effective IS use. We propose that workarounds are an outcome of users' sensemaking when leveraging a system for a specific task within a work system. Users improvise when discrepancies occur and adapt their IS use for better performance. A workaround is very likely to enhance the effective use of the formal standard system when the workaround is designed in line with the goal shared in the work system. In such a case it complements the use of main IS such as SCM. As shown above, workarounds positively influence effective use and its sub-constructs of transparent interaction, representational fidelity, and informed action (Burton-Jones & Grange, 2013). In terms of transparent interaction, when using a workaround in a separate system, users can redefine surface structures such that they can access the principal system's (SCM in our case) representations more easily (**wk 1-6**). These workarounds are adaptations of the surface structure to improve the user's ability to obtain transparent interaction (see Figure 8). Beyond the improvement of transparent interaction alone, a number of the observed workarounds had a ripple effect on representational fidelity as well (Burton-Jones & Grange, 2013). Especially **wk 4-6** helped users to engage with the system's representations in some way, ultimately improving the overall level of representational fidelity. This effect is constituted by allowing users to adapt representations more easily, thanks to an increase in transparent interaction, thus improving the quality of the representations they ultimately work with. These workarounds lead to a changed surface structure as well as adapted and thereby improved representations (Figure 8, Table 10). **Wk 7** also helps to improve representational fidelity, however in a way that is not primarily connected to SCM's surface structures, but rather its deep structures (i.e., functionality of the forecasting algorithm). Beyond this, **wk 7** also improves the ability to take informed action, as the new statistical forecasting abilities obtained through the workaround allow end users to more accurately predict and plan their sales (e.g., through taking into account typical seasonal deviations in their industry's sales patterns, a functionality that SCM does not offer).

Integrating our observations from the case and our conceptual abstraction of the workarounds' impact on effective use, Figure 8 offers a conceptual synthesis of our results. Workarounds to adapt the surface structure improve the ability to obtain transparent interaction with a system. In turn, a higher level of transparent interaction improves a SCM user's ability to obtain representational fidelity. As described above, some workarounds for adapting the surface structure can (in part) be used to improve the representational fidelity of SCM for the end user as well. A higher level of representational fidelity improves a SCM user's ability to take informed action. Furthermore, we also identified a workaround that helps to improve representational fidelity and the ability to take informed action directly. We illustrate the overlap of the different type of workarounds in Figure 8.

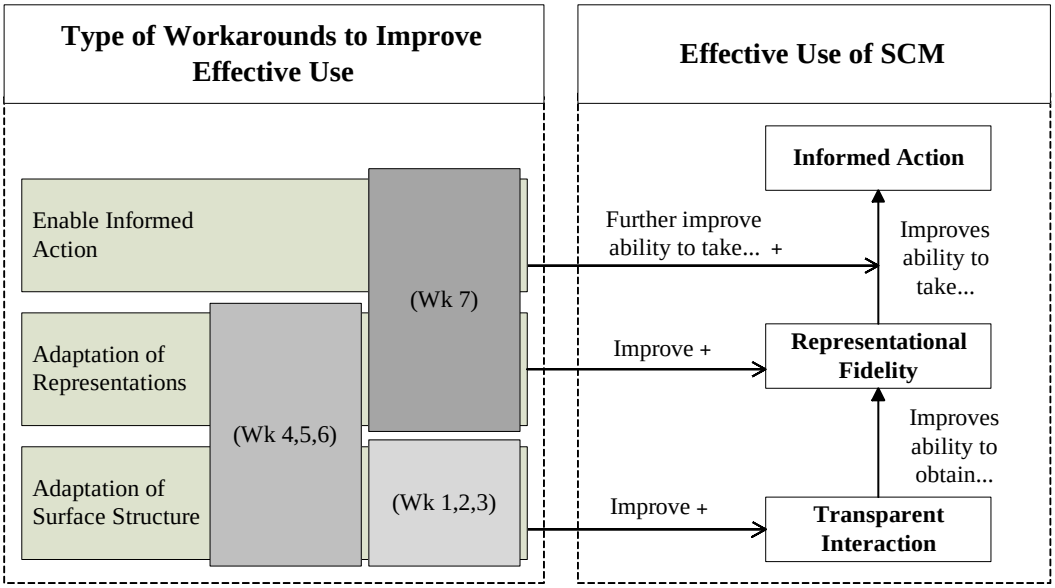



Figure 8: Workarounds and Effective Use

Beyond this conceptual integration, we believe that our observations also provide an opportunity to critique some of the underlying arguments in the effective use conceptualization proposed by Burton-Jones and Grange (2013). While they argue that workarounds generally reflect uneducated adaptations, much of the positive effects we observe seem to suggest that users develop workarounds that are educated adaptations in their own right. For instance, **wk 4** allows end users to enter more accurate data in SCM and thereby to use SCM more effectively thanks to the workaround. Thus, workarounds can positively influence the effective use of an SCM system. We explained this in our rich description of the relationship of workarounds and effective use of an IS on an organizational level. This is the first part of the contribution of our study. We also extend the theory of effective use with a positive theoretical perspective on how workarounds can lead to an efficient and effective use of an IS in an organization, thus recasting workarounds as adaptation acts in their own right. Understanding workarounds in supporting systems as potentially beneficial for the effective use of a principal system also opens up the discussion on effective use as proposed by Burton-Jones and Grange (2013) to the increasing emphasis on the feature level (e.g., Sun, 2012; Benlian, 2015). For example, Sun (2012) suggests that users generally build a bricolage of features from different systems to achieve a particular goal, rather than looking at a principal system in isolation. Logically then, adaptations in the sense of Burton-Jones and Grange (2013) must not necessarily occur in the surface structures of that principal system directly (SCM in our case), but could also manifest in other systems (Excel and Access in our case). Rather than jeopardizing effective use of SCM by reducing transparent interaction with the principal system directly, such adaptations seem to improve users' ability to effectively use SCM overall. Again, this emphasizes the nature of the workarounds we conceptualize here as rather skillful and educated adaptations that allow users to achieve or improve effective use of a system that would otherwise impose on the ability to achieve users' business goals.

**Conclusion**

Based on an explorative case study at CeCo, we expanding the theory of effective use. We explain how and why workarounds can have an impact on the effective use of an IS (an SCM system in our case). In this, we particularly discuss how the various workarounds we identify in our case impact the sub-constructs of effective use proposed by Burton-Jones and Grange (2013), that is, transparent interaction, representational fidelity, and informed action. We show that users conceived most of the workarounds we identified (**wk 1-6**) in order to improve their transparent interaction with the system. However, a number of these workarounds (**wk 4-6**) also have a ripple effect that allows users to leverage their improved transparent interaction to adapt the system's representations. While many of these workarounds will only have an indirect effect on informed action, we also identify a workaround (**wk 7**) that directly supports users' ability to leverage the system's representations and, thus, the ability to take informed action.

To enable a better interpretation of our findings, we advise the reader of our work's limitations: First, as discussed by Burton-Jones and Grange (2013), ineffective use often stems from feelings of lost control or frustration. In our work, here, however, we did not account for these factors and future research in this domain could include this, especially in light of to the relevance of emotional and affective responses (Beaudry & Pinsonneault, 2010). Second, a more extensive longitudinal case study might be necessary to explore more fully how workarounds are triggered, built, optimized, and – eventually – abandoned. Such research may involve the investigation of the role of the individual abilities and knowledge in the origin and development of workarounds. This was not within the scope of our current research because we focused on workarounds that are already in use. Furthermore, our work is constrained by the access to the case site and the timing of the overall project. Third, we suggest that the effective use theory needs to be extended and elaborated further. Our proposed concepts can only provide explanations for the specific SCM context. To be generalizable to IS overall, more process-oriented systems than the SCM need to be studied (Grubljesic & Jaklic, 2015).

Nonetheless, our work and proposed model contribute to research in the following ways. First, our work picks up the nascent stream of research on effective use. In particular, we show how users work around a SCM system by leveraging other systems while maintaining some level of integration with the principal system, thus improving the SCM's effective use overall. Such an integration is important to maintain the key benefits usually associated with the introduction of an IS (such as SCM) – that is, the integration of data across a company's multiple vertical and horizontal layers (Devadoss & Pan, 2007; Markus & Tanis, 2000; Staehr et al., 2012). Second, our work offers opportunities to not only consider workarounds as uneducated adaptations (Burton-Jones & Grange, 2013), but to think of them as rich, informed, and purposeful attempts to improve the effective use of an information system. We explicated the characteristics of workarounds and argued that workarounds are beyond good or bad per se (Su, 2013), but that some of them have the potential to positively impact effective use. Future research should improve our ability to differentiate between functional and dysfunctional workarounds from an effective use perspective. Studies like Haag, Eckhardt, and Bozoyan (2015) also suggest that users who work around specific aspects of an IS make

more effective use of the IS overall. This supports our reasoning that workarounds are enabling rather than constraining users' ability to use an information system effectively.

Beyond these conceptual implications, we also see a set of practical contributions that can arise from our work. First and foremost, we clarify why workarounds of SCM occur and explicate their impact on effective use. It is often necessary to use customization to enhance end users' performance (Grabski, Leech, & Schmidt, 2011) or their outright ability to use a system at all. But customization can be costly (Gattiker & Goodhue, 2005; Malaurent & Avison, 2016) for all kinds of IS. Hence, leveraging readily available systems to build functional workarounds is a potential solution for organizations to enable their employees to interact with an IS more effectively. As such, systems like Excel or Access might best not be seen as unwanted diversions, but should be explored more purposefully to see how they can help end users to use a company's core systems more effectively.

Whenever the system is very flexible and allows individual users to adjust, the user adaptation can take place within the confines of the functionality of the system or mean the adjustment of user to the systems characteristics. Exploring this aspect of user adaptation was the goal of our research into the specific relationship of user adaptation and effective use, which we present in the following section.

## 4.3 Exploring the Relationship of User Adaptation and Effective Use[3]

The research presented in this section largely relates to the theoretical background on user adaptation and effective use (Burton-Jones & Grange, 2013), which we outline in section 2.3.2. There we present the concept of adaptive system use (ASU), which describes the user adaptation of features in use (FIU) initiated by triggers of user adaptation. Still, the existing conceptualizations of system use (e.g., frequency, variety of system functionalities, or duration) do not sufficiently explain the relationship between system use and the realization of expected outcomes and have been identified as being too simplistic (Sun, 2012). A deeper understanding of users' reasoning and motivation to adapt and the consequences of adaptation for their ability to perform their jobs effectively could potentially lead to a better understanding of users' needs for working effectively. Therefore, the aforementioned black box of user adaptation needs to be opened further to improve the conceptualization of user adaptation (Benbasat & Barki, 2007; Burton-Jones & Straub, 2006; Straub & Burton-Jones, 2007) and to assess the effects of the adaptation process in detail. Specifically, we aim to analyze the effect of user adaptation in the form of ASU on effective use (EU). Thereby we extend the nomological net of EU with a model of the effect of individual user adaptation on the EU of an IS on the level of FIU. This approach is based on the insight that a higher level of technology integration into work systems can be achieved by a

[3] This is in part based on the following paper: Haake, P., Lauterbach, J., Mueller, B., Maedche, A., 2015. The Effect of User Adaptation on the Effective Use of Enterprise Systems. ICIS 2015 Proc. 36th Int. Conf. Inf. Syst. Fort Worth, United States, December 13-16, 2015.

higher degree of adaptation (Beaudry & Pinsonneault, 2001; Cooper & Zmud, 1990; Leonard-Barton, 1988). This higher degree of integration can in turn be related to higher performance of the individual users (Beaudry & Pinsonneault, 2001). When triggers cause user adaptation, users are most likely to adapt to a changed or new system over time due to learning and adaptation of the features relevant for the tasks. Beaudry and Pinsonneault (2005) suggest that there is a reciprocal relationship between actual usage and EU. These would be constituted as loops of appraisal of the changes and subsequent adaptation and explains an individuals' ability to adapt his/her own work (Burton-Jones & Grange, 2013), for example by adapting the FIU to fulfill a task. There is a need for empirical evaluation of the concept of EU and for the evaluation of the effect of ASU on EU, when user adaptation has been triggered. Hence, we pose the following research question: *What is the effect of adaptive system use on effective use?*

Previous research has shown that the initial phase of appraisal efforts in the adoption phase can be strongly supported by top management's commitment, as it can influence beliefs about usefulness and ease of use (Beaudry & Pinsonneault, 2005; Lewis, Agarwal, & Sambamurthy, 2003). We assume that during the post-implementation phase users' personal capabilities and behaviors are more important as they experience the system in their personal use. This notion is reinforced by recent findings on the IT feature level which indicate that individual user's capability to broaden and deepen the use of IT features decreases over time (Benlian, 2015). Users in later stages in the adaptation process increasingly make use of stable subsets of features to complete their tasks. Moreover, growth in features-in-use (FIU) leads to the perception of increased immediate performance and of objective performance as well (Benlian, 2015). The assessment of use of a system from the perspective of particular users is commonly based on FIU (Orlikowski, 2000; Sun & Zhang, 2008). The features of a system are its functional building blocks. On a feature level, system use can be defined as the use of features of a system by an individual user to perform a task (Burton-Jones & Straub, 2006; Sun & Zhang, 2008). Hence, we adopt a FIU perspective for the analysis of the relationship of ASU and EU. Exploring this relationship involves a replication of Sun's paper (2012). We will not state all hypotheses presented by Sun (2012). The presented research model shows only one full adaptation episode as it represents an extension of the existing ASU research model by Sun (2012). It is important to emphasize that several adaptation episodes might occur in sequence and are started by a trigger (novel situation, discrepancy, deliberate initiative) every time. A new adaptation will also lead to a new perception of EU. However, the perception of EU is a dependent variable in second order to ASU and not a trigger, which initiates another adaptation episode. The whole research model thus represents a generic model for one adaptation cycle that occurs at different points in time.

Users perform these ASU behaviors to a varying degree (Sun, 2012). Users generally perform adaptation behaviors on their individual level to regain their efficiency and effectiveness in their job or at least piece of mind (Beaudry & Pinsonneault, 2005). While EU of an ES has generally been conceptualized on a system level (Burton-Jones & Grange, 2013), it can be adapted to a feature level. Previous research has identified the differing effectiveness of IS application based on different patterns in FIU of individual users (Jasperson et al., 2005). However, Jasperson et al. (2005) stress the importance of the feature level because the feature level is the level of use that is relevant to different user groups and determines the effectiveness and efficiency of

their daily system use, despite changing forms of system use over time (Jasperson et al., 2005). Users of IS are experts on the features of the system that they need to use for their specific functional jobs. Hence, the feature based concept of information systems has a good fit with the proposition of our research on individual adaptation (cf. Veiga et al. 2014). Moreover, ASU only concerns the FIU that are specific to an individual and can thus be related to his/her EU of the system (Sun, 2012). EU as a concept is case and context specific (Veiga et al., 2014). Thus, the focus is on the adaptation of representations on the feature level via ASU. The adaptations of features are not always beneficial for EU of these features. However, individuals often choose to work with inefficient features because the suit their personal preferences (Sun, 2012) and therefore might lead to the measured perceived EU of a feature. Thus, we concluded that ASU mediates the relationship between the triggers and EU (see Figure 9).

*$H_1$: Adaptive system use will mediate the relationship of the triggers with effective system use.*

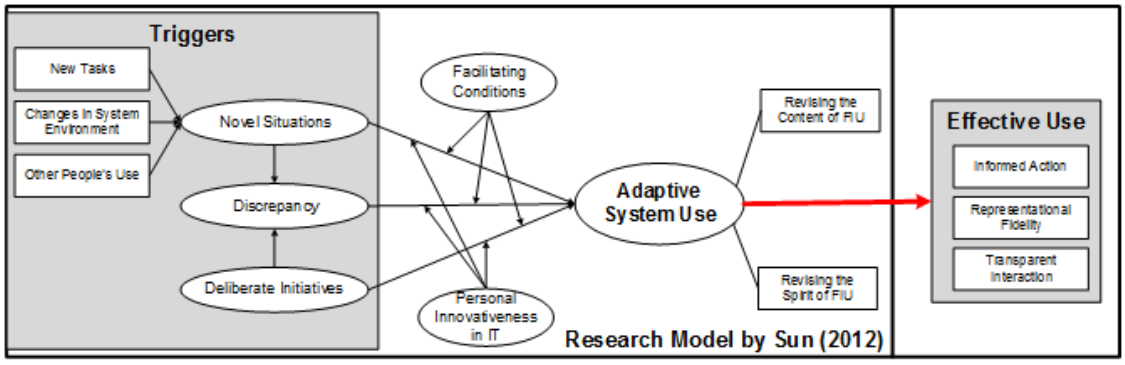



Figure 9: Proposed Relationship of Adaptive System Use and Effective Use

An analysis of the relationship of ASU and EU required the replication of ASU and the operationalization of a measure for EU. Hence, we first present the replication of EU and then our research on an initial operationalization of EU. This with done with the same data collection effort and basic research design. However, we present this in two separate sections, as we first had to answer the preliminary questions, whether it was possible to replicate ASU and whether we could develop a stable measure for EU. Therefore, we present the replication of the ASU study by Sun (2012) in the following section. Subsequently, we present the initial operationalization effort and then reexamine the initial hypothesis presented above.

### 4.3.1 Adaptive System Use Revisited – A Methodological Replication[4]

User adaptation of information systems (IS) is a continuous process in the post-implementation phase. Each interaction of a user with an IS presents the opportunity to revise prevalent use behavior. For instance, an employee might have never used the “track changes”-function in Microsoft (MS) Word and begins to do

[4] The content of this section is based on Haake, P., Schacht, S., Maedche, A., 2017 Adaptive System Use Revisited – A Methodological Replica-tion. AIS Transactions on Replication Research (TRR), resubmitted after first review.

so, whenever someone shares a document for the purpose of collaborative work on a single document. Sun (2012) motivates his research on user adaptation in post-implementation IS use along these lines. Surprisingly, Sun identified only little research on user adaptation to IS (2012), particularly for the post-implementation stage of IS implementations. Thus, Sun (2012) developed the concept, research model, and measures for Adaptive System Use (ASU) on the basis of Louis and Sutton's (1991) theoretical underpinnings of the understanding of how people switch between automatic and active thinking. His study is focused on a user's revision process for specific features of an IS. An evaluation with 253 office workers largely supported his hypotheses. In this article, we report our methodological replication of his work in a slightly altered context. Thus, we aim to extend the external validity of Sun's (2012) model, which we present in section 2.3.2., by replicating it under these adapted circumstances. We contribute to research with an extension of the body of knowledge on ASU by identifying some indication for its robustness. Before presenting our results, we describe the applied research methodology, and the data analysis.

**Research Methodology**

We applied the research methodology used by Sun (2012). Thus, we also conducted an online survey comprising the items measuring ASU, its triggers, and the moderating factors of personal innovativeness in IT (PIIT) and facilitating conditions (FCOND). Appendix E provides an overview of the measures that we applied in our replication study. However, from a methodological perspective, our research is different in several aspects: **First**, Sun (2012) conducted the online survey in the USA whereas we chose participants from the UK. The national cultures of the UK and the USA are similar yet different, therefore, our replication study took place in an altered national culture context (Hofstede, 2011a; 2011b). **Second**, we focused our investigation explicitly on the use of MS Excel rather than the entire MS Office suite. This allowed us to select panelists who stated that they have a good or very good command of the MS Excel features. We assumed that only these users would have a sufficient system use experience to recall their specific adaptation behavior and educated adaptations. In addition, we also replicated the situating task (Sun, 2012), with a special focus on adaptations of MS Excel. We considered only the participants who reported such an incident in our data analysis.

**Data Collection**

For our replication study, we collected data by employing a panel service provider to reach a sufficient number of knowledgeable MS Excel users. We are aware that an application of research panels can result in panel effects. In his work, Dennis (2001) examined commonly mentioned panel effects in more detail. Dennis (2001) noticed that he could "not detect a serious undercurrent of negative panel effects" (Dennis, 2001, p. 36). We ensured the comprehensibility of the items with respect to the language by using respondents from the UK. Before data collection, we provided the panel provider with a set of criteria describing the targeted respondents to reduce the effect of 'professional panelists'. In particular, we focused on potential respondents that can be classified as knowledge workers (Drucker, 1999) and asked the panel provider to balance the set of data with regard to respondents' gender. The overall set of respondents also covers

multiple industries and different educational as well as socio-economic backgrounds to balance the panelists' demographics.

As aforementioned, we decided to collect data from knowledge workers who are experienced in using MS Excel, which was tested via a filter in the survey. It has been indicated that MS Excel is the most welcomed among identified workarounds (Eckerson & Sherman, 2008) and the toughest system to replace (Robey et al., 2002). Consequently, we selected MS Excel as the information system of interest in our study. Thus, our panel is somewhat different to the one used by Sun (2012), as we extend the circle of participants by including knowledge workers in different roles and positions from all kinds of industries into the group of potential survey participants and because we are focusing solely on MS Excel. Furthermore, we conducted the survey with a panel from the UK instead of the USA because national culture can also influence the perception and use of IS (Leidner & Kayworth, 2006). Table 11 highlights the differences of our study to the work of Sun (2012).

Table 11: Characteristics of Panel Study

| | **Replication Study** | **Sun (2012)** |
|---|---|---|
| **Type of respondents** | Knowledge workers from all industries | Employed Administrative staff |
| **Respondent residence** | UK | USA |
| **Researched Information System** | Microsoft Excel | Microsoft Office Suite |
| **Experience with respective software** | high | no information |

**Data Analysis and Results**

For the analysis of our data set, we used the Partial Least Squares (PLS) method as described by Urbach and Ahlemann (2010) and Hair, Hult, Ringle, and Sarstedt (2013). Sun (2012) also used PLS. We used SmartPLS 3.2.5 to run the PLS for the data analysis to assess the measurement and the structural model. After the completion of data collection, we first controlled for the appropriateness of our data by comparing completion times for the surveys and by screening descriptive statistics. Table 12 provides an overview of the descriptive statistics for the data collection and includes Sun's (2012) results.

In total, the panel service provider invited 3,230 panelists to participate in our study. Due to our filter mechanisms, 2,346 participants were screened out, meaning that they either had no or limited experience with MS Excel, could not describe a case of adapting Excel to their needs (situating task depicted in Appendix E), were not employed in an organization, or the gender-related ratio needed to be balanced. From the remaining 884 participants, 111 did not answer at all, and 337 did not answer the questionnaire completely. Thus, we removed them from our overall data set.

Table 12: Descriptive Statistics of Panel Data

| | Replication Study | Sun (2012) |
|---|---|---|
| **Number of invitations / participants/ valid data sets** | 3,230/ 436/ 281 | 1,500/ 282/ 253 |
| **Number of female participants** | 151 (53.7%) | 180 (71%) |
| **Number of male participants** | 130 (46.3%) | 73 (29%) |
| **Average age** | 42.23 years | 37.73 years |

Finally, we checked our quality criteria to receive the final data set. We had to remove more than 150 out of 436 completed responses from the panel data set on the grounds of quality issues. For the removal of invalid responses, we followed a two-step approach. First, as we used Questback[5] as software for online surveys, we were able to calculate a quality measure based on the median response times of all participants. We decided to remove all responses (107 responses) with a quality value smaller than 0.25, meaning that the participants' response times were 50% lower than the average of all participants. In a second step, we considered the items that were reversely coded in our survey. The usage of reverse coded items also enabled the detection of low quality responses. Frequently, researchers suggest to use reverse coded items to identify (inter alia insufficient cognitive ability, impaired response accuracy, or actual measurement of a different construct) careless responses (Magazine et al. 1996, p. 247). If respondents answered significantly different on two items that are reversely coded to each other but referred to the same construct, it can be the case that they were careless in their answers. This implies a lower quality of their answers. Again, we removed 48 completed questionnaires based on the analysis of reverse coded items (resulting in 281 valid responses).

**Measurement Model**

After data collection and cleansing, we validated the measurement model of ASU with respect to its reliability, convergent validity, and discriminant validity. In a first step, we assessed the measurement model's outer loadings. We observed outer loadings between 0.86 and 0.93 (> 0.708) for the reflective constructs of discrepancy (DP) and deliberate initiative (DI). Except for PIIT2 (which was reversely coded; outer loading = 0.312) and FCOND3 (which was also deleted by Sun (2012) in his study), we also had outer loadings between 0.705 and 0.986 for the indicator of our two potential moderators: FCOND and PIIT. Thus, we deleted PIIT2 and FCOND3 to ensure acceptable indicator reliability. As indicated in Table 13, the composite reliabilities (CR) and average variances extracted (AVE) are very similar to Sun's (2012) results. More specifically, the values of CR and AVE exceed the suggested thresholds of 0.7 and respectively 0.5. Thus, the measurement model fulfills the quality criteria of internal consistency reliability and convergent validity (Hair et al., 2013). The criterion of discriminant validity is also fulfilled, as the AVE's square roots are larger than the correlations among the single constructs (see Table 13).

[5] https://www.questback.com/ (Accessed on March 31st, 2017)

Table 13: CR, AVE, and Correlations of First-Order Constructs

| | Construct | No. of Items | Mean* | | Std.Dev. | | CR | | AVE | | Square Roots of AVEs and Correlations** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 1. | ASU (trying new features) | 4 | 5.59 | 5.58 | 1.54 | 1.45 | .90 | .93 | .70 | .76 | .83 | | | | | | | | | | |
| 2. | ASU (feature substituting) | 3 | 4.26 | 4.58 | 1.73 | 1.91 | .89 | .91 | .74 | .79 | .36 | .86 | | | | | | | | | |
| 3. | ASU (feature combining) | 4 | 4.37 | 4.57 | 1.88 | 1.79 | .89 | .90 | .68 | .71 | .47 | .62 | .82 | | | | | | | | |
| 4. | ASU (feature repurposing) | 6 | 3.00 | 3.53 | 1.78 | 1.89 | .95 | .94 | .77 | .73 | .04 | .32 | .36 | .88 | | | | | | | |
| 5. | Triggers (new task) | 1 | 4.42 | 3.96 | 1.70 | 1.80 | 1.0 | 1.0 | 1.0 | 1.0 | .26 | .19 | .29 | .08 | 1.0 | | | | | | |
| 6. | Triggers (other people's use) | 3 | 4.14 | 4.16 | 2.03 | 1.94 | .89 | .88 | .73 | .70 | .05 | .23 | .25 | .22 | .12 | .85 | | | | | |
| 7. | Triggers (changes in system environment) | 4 | 3.19 | 3.74 | 1.82 | 1.92 | .86 | .91 | .61 | .72 | .16 | .42 | .38 | .54 | .13 | .37 | .78 | | | | |
| 8. | Triggers (discrepancy) | 2 | 3.43 | 4.06 | 1.87 | 1.79 | .93 | .96 | .86 | .92 | .09 | .25 | .19 | .49 | .05 | .30 | .43 | .93 | | | |
| 9. | Triggers (deliberate initiative) | 2 | 3.27 | 3.54 | 1.91 | 1.88 | .87 | .89 | .77 | .80 | .01 | .14 | .17 | .34 | .13 | .38 | .41 | .36 | .88 | | |
| 10. | Facilitating conditions | 2 | 4.73 | 4.61 | 1.64 | 1.78 | .86 | .90 | .76 | .82 | .29 | .15 | .22 | -.05 | .17 | -.11 | -.03 | -.22 | -.09 | .87 | |
| 11. | Personal innovativeness in IT | 3 | 4.36 | 4.63 | 1.85 | 1.71 | .92 | .92 | .80 | .74 | .30 | .26 | .31 | .16 | .11 | .03 | .12 | -.03 | .01 | .40 | .89 |

CR: Composite Reliability AVE: Average Variance Extracted

* The mean is the average of the item scores; sclaes ranged from 1 (strongly disagree) to 7 (strongly agree)

** The diagonal elements (shaded in grey) are the square roots of the variance shared between the constructs and their measurements (AVE); off-diagonal elements are the correlations among constructs

Numbers in grey are the results of Sun's (2012) work

**Structural Model**

Like Sun (2012), we used the latent variable scores for the three formative indicators of the novel situation (NS) construct and the two formative indicators of the ASU construct. In total, we added six single-indicator interaction terms representing the two moderating effects on each of the relationships between the triggers and ASU. These single-indicator interaction terms were directly linked to the dependent variable ASU. After bootstrapping, we were able to assess the relative importance of the formative indicators. The results including the comparison to Sun's (2012) work are summarized in Table 14. All in all, we verified Sun's (2012) results with slight differences. In contrast to Sun (2012), our data indicate a significant contribution of others use (OU) to form a novel situation. Thereby, we followed Sun's call to replicate the analysis of OU's effect on novel situation. We could not identify an effect of new tasks (NT) on novel situation.

Table 14: Variance Inflation Factors and Beta Coefficients of Formative Indicators

| | VIF | b-value | | t-value | | p-value | |
|---|---|---|---|---|---|---|---|
| Revising content of FIU | 1.139 | 0.402 | 0.59 | 2.631 | 5.68 | 0.009 | <0.001 |
| Revising spirit of FIU | 1.139 | 0.770 | 0.52 | 5.916 | 4.75 | <0.001 | <0.001 |
| New tasks | 1.023 | 0.159 | 0.65 | 1.669 | 4.39 | 0.096 | <0.001 |
| Changes in system environment | 1.165 | 0.870 | 0.57 | 15.425 | 3.89 | <0.001 | <0.001 |
| Others use | 1.161 | 0.189 | -0.11 | 2.150 | 0.56 | 0.032 | NA |

NA: not avaible
VIF: Variance Inflation Factor
Numbers in grey represent Sun's (2012) results

Thus, current results on the formative indicators of novel situation are inconclusive and require further analysis. As all VIF values are smaller than 3.3, there are no issues with multicollinearity (Diamantopoulos & Winkelhofer, 2001) of ASU and NS. As highlighted in Table 15, our data confirm Sun's results (2012) with regard to the direct effects of the three triggers on ASU. Similar to Sun (2012), we could not identify a direct effect of deliberate initiatives (DI) on ASU. We could not support any of Sun's hypotheses, when we added the aforementioned moderators. In other words, we could not observe any interaction or multi-

group moderation effects of PIIT and FCOND. These results are also confirmed by the small effect size that results when the moderators are included in the model.

Table 15: Results of Structural Model ASU

| | **Effects Only** | | **Direct Effects + Moderating Effect** | |
|---|---|---|---|---|
| **a. Dependent Variable: ASU** | | | | |
| $R^2$ | 0.46 | 0.47 | 0.48 | 0.50 |
| $\Delta R^2$ | | | 0.02 ($f^2 = 0.04$) | 0.03 ($f^2 = 0.06$) |
| Novel Situation (NS) | 0.46*** | 0.23** | 0.47*** | 0.24** |
| Discrepancy (DP) | 0.27*** | 0.31** | 0.27*** | 0.26** |
| Deliberative Initiative (DI) | -0.01 (n.s.) | 0.04 (n.s.) | -0.03 (n.s.) | 0.08 (n.s.) |
| Facilitating Conditions (FCOND) | 0.09 (n.s.) | 0.28** | 0.10 (n.s.) | 0.30** |
| Personal Innovativeness in IT | 0.23*** | 0.23** | 0.23*** | 0.24** |
| NS × FCOND | | | -0.04 (n.s.) | 0.09 (n.s.) |
| DP × FCOND | | | -0.05 (n.s.) | -0.13 (n.s.) |
| DI × FCOND | | | 0.01 (n.s.) | -0.03 (n.s.) |
| NS × PIIT | | | -0.06 (n.s.) | 0.14* |
| DP × PIIT | | | -0.07 (n.s.) | -0.03 (n.s.) |
| DI × PIIT | | | 0.06 (n.s.) | -0.14* |
| | | | | |
| **b. Dependent Variable: Discrepancy** | | | | |
| $R^2$ | 0.23 | 0.32 | 0.22 | 0.32 |
| Novel Situation (NS) | 0.35*** | 0.41** | 0.35*** | 0.41** |
| Deliberative Initiative (DI) | 0.20*** | 0.23** | 0.20*** | 0.23** |

n.s.: not significant *p<0.05 ** p<0.01 *** p < 0.001
Effect size ($f^2$) is calculated by the formula as presented by Sun (2012); Numbers in grey represent the Sun's (2012) results

In addition, we conducted a Sobel test (Hayes, 2013) to verify the mediation effect of discrepancy (DP). First, we tested the mediating effect of DP on the relationship between NS and ASU. In the absence of DP, we identified a significant total effect of NS on ASU (see Table 15). Introducing DP as mediator, the direct influence of NS on ASU remains significant. As the 95 percent confidence interval (CI of 0.327 to 0.423) does not contain zero, we can conclude that DP has a partial mediation effect on the relationship between NS and ASU. Second, we identified a full mediation effect of DP on the relationship between DI and ASU, as there is a non-significant relationship between DI and ASU (see Table 15) and the confidence interval (CI of 0.269 to 0.370) also does not contain zero. Like Sun (2012), we conducted a cluster analysis to identify heterogeneous triggering conditions and to examine behavioral patterns of ASU under these conditions. Since our results are similar to Sun's (2012), we present these findings in Appendix E.

**Discussion**

The present study replicates the work of Sun (2012), who conceptualized ASU and developed measures for the related constructs and triggers of ASU. Generally speaking, our data confirm his research results in our slightly altered context (see also Table 16).

Table 16: Summary of Hypothesis Testing ASU

| **Hypotheses** | **Supported?** | Sun (2012) |
|---|---|---|
| H1: Novel Situations → ASU | Y | Y |
| H2: Discrepancies → ASU | Y | Y |
| H3: Deliberate initiatives → ASU | N | N |
| H4: Novel situations → Discrepancies | Y | Y |
| H5: Deliberate initiatives → Discrepancies | Y | Y |
| H6: Facilitating Conditions moderate the impact of (6a) novel situations, (6b) discrepancies, and (6c) deliberate initiatives, on ASU. | N | N |
| H7: Personal Innovativeness of IT use positively moderates the impact of (7a) novel situations and (7b) discrepancies, and negatively moderates the impact of (7c) deliberate initiatives, on ASU. | N | Partially. PIIT did not moderate the relation-ship between discre-pancies and ASU. |

Our replication demonstrates the applicability of Sun's (2012) items for the three triggers of NS, DI, and DP as well as ASU. Our data set confirms all relationships of the triggers to ASU and the mediating effect of DP. However, we have different results with regard to the impact of OU and NT based on our data. While Sun (2012) indicated a significant effect of NT and a non-significant effect of OU on NS, we observed opposite results. We assume that the variations in results can be related to the slight differences between the contexts of the two studies. In a context where several tools can be applied (such as the use of the whole MS Office suite (Sun, 2012), new tasks could have a significant effect on the perception of novel situations because different solutions can be employed to deal with the new tasks. They might not have a particular effect when looking at the use of a specific software solution such as MS Excel. Spreadsheet software has been designed for the solution of rather specific kinds of problems, which share similar characteristics. Furthermore, we selected a panel of proficient users of MS Excel, who have the ability to make use of the features of the software and might be expert users in their organization. It could be the case that because of their level of specialization these knowledge workers experience a much smaller number of new tasks than general administrative staff members, who were the respondents in Sun's (2012) study. However, OU can be important for the user types that are included in our survey because expert users are likely to benefit from an exchange of best practices with colleagues. These kinds of benefits of exchange between users might not be so important in purely administrative settings as covered by Sun's (2012) research, were many clerks or office assistants might tend to work on their own. In addition, we could not support any hypotheses with regard to the moderators presented by Sun (2012). We tested for the moderating effect of PIIT and FCOND because we wanted to explore whether the theoretically well-grounded argument for the

moderating effect of these two factors would hold in a slightly altered setting (see Table 15). It became evident that this was not the case.

Sun (2012) identified a positive moderation of PIIT for the relationship between NS and ASU as well as a negative moderation of PIIT for the relation between DI and ASU. However, even those two moderating effects could not be identified based on our data set. We assume that this is due to the characteristics of MS Excel and the experience of the user types, which were the respondents for our replication study. The explanation for the lack of a positive moderating effect for the relationship of NS and ASU can also be linked to the work environment of the respondents. As aforementioned, the respondents in our panel are likely to be more specialized users because they perceived themselves as experienced users of MS Excel. This might mean that they had fewer opportunities to perceive their own user behavior to be particularly innovative, since they were much more familiar with the technology at their disposal. They have fewer opportunities to experiment and explore something new, as it is suggested by the items for PIIT: Hence, not innovativeness but knowledge and the kind of learning approach of individuals is likely to be a more appropriate moderator for this relationship. Authors of future replication studies should therefore consider including constructs of system knowledge and individual learning behavior as potential moderators.

A negative moderation of the relationship between DI and ASU by PIIT as identified by Sun (2012) would mean a resistance to change because of demands of others (Sun, 2012). The absence of such a moderating effect in our study can also be explained with the likely nature of the predominant work environment of our panelists compared to those used by Sun (2012). Expert users are likely to work in more autonomous functions then general administrative staff, which is much more likely to be in a situation where the execution of a job can be judged by a larger number of people or very detailed processes and protocols for the execution of tasks exist. These conditions are probably not the usual work environment of our panelists, who are likely to conduct specialized tasks, which require their specific knowledge of MS Excel. It could also be the case that these differences in the observations are rooted in different working cultures of the UK and the USA. As we cannot provide conclusive results for the differences between our and Sun's (2012) observations, more replications of the ASU model in varying contexts and with differing software artifacts are warranted as only our slight adaptation already produced significantly different results. Additional replications would further increase the generalizability of the ASU model and its triggers.

As we replicated Sun's work (2012), our research has similar limitations. A first limitation stems from the application of a panel for data collection. However, as discussed previously, we invested substantial effort in mitigating issues related to the application of a panel service provider. Another limitation stems from our decision for MS Excel as the system of interest, since the system allows a great degree of freedom for the end user. Regarding this, our study does not differ significantly from Sun's (2012) original study. Further research on software artifacts, which have more restrictions for adaptation (e.g. ERP, CRM systems) would address this current research gap. In addition, our study was conducted at one single point of time. Similar to Sun (2012), we suggest the analysis of multiple feedback loops in future longitudinal studies.

**Conclusion**

ASU can be successfully replicated under similar conditions. Our research is a first step towards understanding ASU in more detail. Further replications to identify other potential moderators and to reassert the applicability of ASU in different contexts are necessary. Thus, we were able to show that the first part of the research model (see Figure 9) could be successfully replicated. To evaluate the relationship of ASU and EU, we also needed to operationalize the construct of effective use. We present our research effort on this in the following section.

### 4.3.2 Operationalization and Measurement of the Concept of Effective Use[6]

In this initial operationalization, we analyze the relationship of the different components of EU, which are transparent interaction (TI), representational fidelity (RF), and informed action (IA) (Burton-Jones & Grange, 2013). Although Burton-Jones and Grange (2013) discuss the concept of EU and the possible relationships of its sub-constructs, the concept is not yet operationalized. Operationalization and resultant measurement is, however, a crucial prerequisite to test and expand theories on effective use. We used measures for the constructs of TI, RF, and IA, which were developed in a previous dissertation project (Lauterbach, 2015). Furthermore, we reanalyzed the data from this thesis for presentation as a pre-study of another case company. This enables us to seek an answer for the following research question: *What is the real relationship of transparent interaction, representational fidelity, and informed action as sub-constructs of effective use?*

**Hypotheses**

Burton-Jones and Grange (2013) "are extending representation theory beyond its traditional use" (p. 638). Initially, only the internal view of representation theory was studied (Wand & Weber, 1990, 1995; Weber, 1987). This decision was originally taken because they were only concerned with studying an IS as an object in its own right without a link to the organization in which it is implemented (Wand &Weber, 1995; Burton-Jones & Grange, 2013). Burton-Jones and Grange (2013) extended that view by applying representation theory to the external view of an IS. This includes the study of a surface and physical structures of an IS and the difference between people's perception and objective reality. Moreover, they noted that their extension of representational theory is compatible with the theory of the studied artifacts, such as the IS. The theory of affordances (Gibson, 1977) was cited as the most prominent theory of artifacts. It has been suggested that representation theory and the theory of affordances can be integrated (Burton-Jones & Grange, 2013). An affordance can be defined as what an artifact offers someone (Hartson, 2003). Hartson (2003) identified four different types of affordances. First, *sensory* affordances are those that allow the user to sense, see of feel.

[6] Parts of this section were accepted to the Pre-ICIS SIGADIT Workshop 2016, Dublin. Only the abstract was published. The paper won the workshop's Best Paper Award. This section is also part of a recent submission to the Information & Management Journal: Haake, P., Schacht, S., Lauterbach, J., Gnewuch, U., Koegel, C., Mueller, B., Maedche, A., 2017. Operationalization and Measurement of the Concept of Effective Use. Information & Management, submitted.

Second, *physica*l are those affordances which enable users to do something physically. Third, *cognitive* are those that make it possible that a user thinks or knows something. Fourth, *functional* are those that enable a user to accomplish a goal. Affordances are can be nested with each other because an individual needs to be able to sense and physically interact with a system to make use of an artifact's cognitive and functional affordances (Hartson, 2003). Burton-Jones and Grange (2013) suggested that this concept also applies to IS. If a user wants to obtain a representation from an information system she needs to have access to them through a IS's sensory surface and physical structure (Burton-Jones & Grange, 2013). Furthermore, Burton-Jones and Grange (2013) explain it is assumed, based on the link between affordance and representation theory, that users aim to obtain representations of the real world from an IS to cognitively understand the domain and thereupon function in it. Users often have to conduct an action based on the information that they obtain. This is achieved in the best way if the representations that they obtain from the IS are *faithful* (Dennis, 1996). Thus, users need to have a way of dealing with the systems that provide information and have trust in the representation of the real world that the system presents. We suggest that TI, as the unimpeded access to the representations in a system, enables faithful representations via improved access to representations (cf. Burton-Jones & Grange, 2013). For instance, if accountants can understand the output options of an IS very clearly, she has greater trust in the output. Hence, we derived the following hypothesis (see also Figure 10).

*$H_1$: Transparent interaction has a positive effect on the representational fidelity of an information system.*

Second, we will assess whether representational fidelity has a positive effect on informed action. As aforementioned, a user that is becoming acquainted with a system is likely to focus on the representations of the system. This involves dealing with the surface structure and physical structure, and also a system's deep structures and the tokens that populate this structure (Burton-Jones & Grange, 2013). A focus on the deep structure and the tokens is also beneficial when someone studies the fidelity of learning to use an IS. Burton-Jones and Grange (2013) stated initially that representational fidelity is a necessary, but not a sufficient condition for informed action. However, when representational fidelity would be coupled with the appropriate knowledge to take advantage of the available data, then it can be expected that individuals take informed actions. On the other hand, individuals will tend to take actions, which seem to be ill informed (Burton-Jones & Grange, 2013), if not enough knowledge about the meaning of the representations is available. For example, if accountants clearly understand and trust the accuracy of a report, they can derive a more detailed picture of an organization. Thus, we derive the following hypothesis (see also Figure 10).

*$H_2$: Representational fidelity has a positive effect on an end-user's ability to execute informed action.*

Third, one could argue, that a good access to a system's representations would enable informed action. However, the unimpeded access to representations can only facilitate informed action if those representations faithfully reflect the represented domain to begin with. This means that TI is a necessary condition and representational fidelity is a sufficient condition for informed action. For instance, accountants are not able to produce a required report if the IS does not provide trustworthy data to them and even more so, if they do not have

unimpeded access to it. On the contrary, if the system provides trustworthy representations, TI is the cornerstone for it. Based on the aforementioned insights, we derived the following hypothesis:

*$H_3$: Representational fidelity fully mediates the relationship between transparent interaction and informed action.*

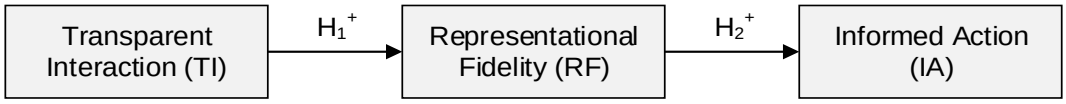



Figure 10: Research Model Effective Use (based on Burton-Jones & Grange, 2013)

It has been argued that IS are inherently malleable (Brooks, 1995, p. 185). Thus, users can overcome issues with the system by adapting the representations of the system. Adapting surface structures and physical structures of an IS will improve a user's access to representations when done in an educated way (Burton-Jones & Grange, 2013). Such adaptations are often feasible and desirable because of the inherent malleability of IS. Furthermore, users are most likely to learn how fallible a representation is and adapt the system if they perceive a deviation (Burton-Jones & Grange, 2013). It is important to emphasize that several adaptation and learning episodes for increasing effective use might occur over time. The whole research model thus represents a generic model for use in general that occurs at different points in time. This means that user might have several attempts at increasing the TI with a system by making informed adaptation to a systems surface or physical structure. Each adaptation was likely to be based on previous knowledge and use and represents a fresh opportunity to learn for the user. This, in turn, is believed to increase the fidelity of the representations for the user and subsequently allows informed action. When actions are evaluated and users realize that their actions have been ill informed, users are likely to go back to adaptations of surface and physical structure to increase representational fidelity again.

**Research Methodology**

For the conceptualization and operationalization of effective use (EU) we followed the approach as described by Fowler (2014) and MacKenzie et al. (2011). This approach can be roughly sub-divided into two steps. First, a set of items is developed that fits EU's sub-constructs best. Having a reasonable set, the items need to be validated in a second step. To support our conceptualization, we selected a case company that performs an enterprise system implementation project. In doing so, we were able to develop not only theoretically but also practically grounded items. For the development of the items, the case company supported us in formulating the items as comprehensible as possible. Later, we used the items to collect data within the case company in order to validate our set of items. In the following subsections, we describe in detail our case company, the development of the items, and their validation.

**Case Site**

In a first wave, we collected data at BANK, a global bank with roots in central Europe that performed a multiyear enterprise system implementation program. The implementation program dealt with the replacement of the custom-built core-banking system and surrounding systems in front and middle offices with a standard software solution. The implementation followed a phased approach where the system was rolled out in several releases. At the center of our initial investigation was BANK's credit service unit (for reasons of simplicity we will refer to BANK when talking about BANK's credit service unit in the following). Here, a new Loan Management System (LMS) was implemented. LMS is a solution specific to the banking industry. It is provided by one of the world's leading software vendors and it is an industry-specific, customizable standard software package that integrates information and business processes (e.g., across various units within BANK's credit service unit and branch employees) and its implementation comes with considerable scope, complexity, and risks (Devadoss & Pan, 2007; Markus & Tanis, 2000). Service employees were faced with the implementation of the standard software LMS as part of the replacement of the whole core-banking system. The old system used to manage loans had been in place for over thirty years and had to be replaced due to technical and regulatory requirements. Early in 2013, project activities for the LMS implementation at BANK started with requirements analysis and definition followed by configuration and implementation activities and testing until November. From September onwards, change management activities (mainly trainings) were performed in BANK until December 2013. Trainings were done for all employees, starting with a one-day basic training. This was followed by self-trainings with a training-system and pre-defined training cases until December 2013. Our study was executed in this context. Prior to conducting the survey, we leveraged our presence in the field to support the development of the instrument. Developing and pre-testing the instrument was partially done in situ, that is, with actual BANK employees to ensure fit and contextuality of the instrument. Due to our presence in the field we were able to collect qualitative data where and whenever possible. Together with the quantitative results, we used the insights from this qualitative inquiry to triangulate and explain our findings (Venkatesh et al., 2013).

**Item Development**

Based on thorough literature work and the conceptualization of the constructs of the model, we developed a pool of new questionnaire items (i.e., questions to capture the concepts in a survey) (MacKenzie et al., 2011) for transparent interaction (TI), representational fidelity (RF), and informed action (IA). Here, we used hints from literature and from our case company that we collected in a previous qualitative study (Lauterbach et al., 2014) to examine keywords that could be used to develop the items. Then, we discussed the questions with several researchers and with potential respondents at BANK to ensure face validity. Based on the results obtained in these discussions we revised or deleted questions that were too complex or not comprehensible (Hoehle & Venkatesh, 2015; MacKenzie et al., 2011). As a next step, we started to ensure content validity by using a card sorting technique (Davis, 1989; Moore & Benbasat, 1991) for assessing the coverage of the domain of the constructs. Here, we specifically followed the approach suggested by Anderson and Gerbing (1991). The approach suggests providing skilled raters with matrixes that show

the concepts as one dimension and the respective questions as another dimension. The rater is then asked to assign the questions to the respective concept. Along with the rating matrixes, we also provided further explanations through definitions of the concepts.

From the ratings, we calculated both the Proportion of Substantive Agreement (PSA) and the Coefficient of Substantive Validity (CSV) (Anderson & Gerbing, 1991). The minimal cut-off value for good survey questions is 0.60, which suggests that more than 60% of all raters have assigned the question to the correct concept (Anderson & Gerbing, 1991). In this step, we drew on students of an enterprise systems master course. The selection of respondents is supported by MacKenzie et al. (2011) who suggests that the raters should have sufficient intellectual capacities to perform the card sorting exercise. We exercised this step of our instrument development in two waves out of a sample of 108 students with a total set of 30 newly developed questions for the three constructs of our model. In a first wave, 55 students performed the card sorting exercise. A second wave consisted of 53 responses. After the first wave, we refined the wording of concept definitions and questions and added several new questions. Based on the second wave we had 19 questions that fulfilled the 0.6 cut-off criterion for PSA of which seven also fulfill the cut-off for CSV. Based on these quality criteria, we decided to drop 9 items (resulting in 21 items) for purposes of further research. As not all of the remaining items fulfilled the quality criteria of PSA and CSV, we analyzed the items critically and discussed the results with other researchers in our research group before deciding to keep them and go forward with the instrument development process. Our three reasons for this decision are the following: First, as recommended in literature, we aimed to have approximately four to six items per sub-construct (Hair, Black, Babin, Anderson, & Tatham, 2006) in the final measure. Second, the three dimensions of effective use are conceptually complex and potentially interrelated, which may confuse raters (PSA<0.6) or cause raters to also choose a similar concept for an item belonging to another dimension of effective use (CSV<0.5). Third, RF includes formative items, which might have added complexity to the sorting process. Although researchers like Helm (2005) demonstrated that it is possible to receive values of PSA and CSV above the suggested cut-off value of 0.6 for formative constructs, it might be the case that the raters in our study, were confused by the formative items and therefore, had difficulties in assigning the item to the corresponding construct. For all items, we kept detailed records of revision history and pre-test performance which factor into our overall assessment of our proposed measurement model's quality.

As a next step, we performed a content validity check with three researchers. During that process, we performed a back-translation (Brislin, 1970; Brislin, 1986) as the questions were needed in German to conduct the item validation within our case company. In an attempt to reduce the number of items and burden for respondents (Hoehle & Venkatesh, 2015), we again dropped three items (resulting in 18) that were highly similar to each other. In addition, we realized that four out of the remaining six items for RF were conceptualized as formative, while the other two are reflective items. The formative items refer to the content's quality, i.e. the faithfulness of the reflection of the real world domain by data in the system, while the reflective items refer to an individual's trust in the presented content. Finally, we performed a pre-test of the survey with six researchers. After this pre-test, we made minor changes in wording to the items. The

resulting pool of items provided a sufficiently large number and quality of questions to perform the next step in developing the instrument and testing the model.

**Data Collection**

For the validation of our items, we collected data from two sources: our case company and a panel. In doing so, we prepared two online surveys, whereas one applies the German items for the case company and the other one applies the English items for data collection from an international panel. We decided to conduct the survey in our case company first, as we expected to get only a medium sample size of responses (no more than 100 responses) as BANK's credit service unit has approximately 350 employees that can be invited to participate the survey. In doing so, we were able – if necessary – to adapt the survey for the panel study which is related with high monetary costs. For both studies were distributed an online survey to employees of BANK and the panelists by using Questback – a software for online surveys.

To prevent or at least consider possible biases, we employed ex ante and ex post techniques to reduce the threats to validity from the common-method bias. Ex ante to our study, we triangulated the process of item operationalization by gathering qualitative data in form of feedback from BANK's employees and quantitative data on the quality of our items in form of the card sorting method conducted with 108 students. In order to prevent common method bias, we designed the survey in a way that we purely collected data on the endogenous variables and thus, employed only respondents for the various sub-constructs of the dependent variable EU (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

We performed the first wave of data collection in December 2014 with all employees at BANK (across all affected business units) that were affected by the implementation of LMS (total 344 employees). Participation in the survey was voluntarily and came on top of employees' regular work. Participants were requested to indicate their level of agreement with each item on a 7-point Likert scale (1 [strongly disagree] to 7 [strongly agree]). From these employees 63 valid responses were collected after quality control (response rate 18.3%). We found that non-response bias was not an issue because the sample demographics well represented the "average workforce" at BANK with regard to gender age, and organizational tenure (see Table 17). Non-response was due to voluntariness of the survey as well as the high operational pressure on all employees during the shakedown phase. Thus, the matching demographic profile as well as our data collection over a relatively short time (2 weeks) without official reminders alleviates concerns about response bias (Hoehle & Venkatesh, 2015; Sykes, 2015).

In the second wave, we conducted the data collection by employing an international service provider for online surveys and panels in order to receive a larger sample size than in our case company. Furthermore, the employment of a panel provider enabled us to collect data from a sample being as heterogeneous as possible from multiple organizational contexts. In doing so, we also get some insights with regard to data's generalizability. We are aware, that one might argue that an application of web-based research panels can result in panel effects. In his work, Dennis (2001) examined two commonly mentioned panel effects in

more detail: First, often it is argued that panels create "professional respondents", which are answering the questions differently than they would do when not being part of a panel. With the words of Dennis, "panelists' self-reported attitudes and behaviors are changed over time by their regular participation in surveys (2001, p. 34). Second, researchers often criticize the selection bias resulting by the selection of web-based panels. At best, the overall group of participants of a panel reflect the average population. However, it is often argued that only a specific group of people is interested in being part of a panel. Thus, Dennis (2001) also studies whether there is a selection bias due to the employment of a panel provider. For both examined panel effects, Dennis (2001) noticed that he did "not detected a serious undercurrent of negative panel effects. By taking proper precautions, researchers can enjoy the benefits of online panels and minimize these potential problems" (Dennis, 2001, p. 36). As we also employed our case company for data collection, we triangulate the data and thus, took some first precautions to prevent negative panel effects. However, in addition we provided the panel provider with a set of criteria describing the targeted respondents before starting the data collection. In particular, the survey aimed to focus on potential respondents that can be classified as knowledge workers whose main power are their knowledge and experiences, rather than physical power (Drucker, 1999). In addition, we declared that the overall set of respondents should cover multiple industries and different educational as well as socio-economic backgrounds in order to balance the demographics of the respondents. As we collected nearly as much data from women than from men in our case company, we particularly asked the panel provider to balance the set of data with regard to respondents' gender. In addition, we purposefully selected a panel provider whose respondents come from the United Kingdom to ensure not only high validity of our item set, but also comprehensibility with respect to the language. In order to adapt the survey to an appropriate information system being known for as many respondents as possible, we decided to collect data from knowledge workers who are experienced in using MS Excel. It has been indicated that among identified workarounds MS Excel is the most welcomed (Eckerson & Sherman, 2008) and the toughest system to be replaced (Robey et al., 2002). As our study aims to conceptualize and operationalize the sub-constructs of EU, we relied on respondents that are regularly using an information system and thus, are experienced in its use. Consequently, we selected Microsoft's Excel as information system of interest in our study. In order to receive only responses of highly experienced Excel users, we additionally implemented a filter ensuring that respondents are knowledge workers employed in an organization and have high experiences in using Excel. As in our case study, we also focused on the post-adoption phase. Thus, we also included a filter where the respondents had to describe a situation in which they had to adapt their use of MS Excel in past. Except of adapting the information system of interest to the survey and including the filter mechanism, we did not make any changes on the items and the overall survey employed in the first wave of data collection.

**Data Analysis**

For the analysis of our data sets, we used Partial Least Squares Structural Equation Modelling (PLS-SEM) as described by Urbach and Ahlemann (2010) as well as Hair et al. (2013). We selected PLS-SEM due to three main reasons: First, it does not require a specific type of data distribution. As we conducted the item

validation in our case company and by employing a panel service provider, we were initially not sure whether both data sets demonstrate similar data distributions. Second, as we did not expect to get more than 100 responses from our case company, we needed an approach that is feasible for even small data sets. For reasons of comparability, we then also employed PLS-SEM for the larger data set collected in the panel. Third, the sub-construct of RF contains reflective, but also formative items. Consequently, PLS-SEM is most appropriate for the analysis of our data (Hair et al., 2013) and therefore, for the validation of our item sets. For the data analysis, we used SmartPLS 3.2.0 to run the PLS to algorithm and assess the measurement and structural model.

**Results**

In the following, we discuss the results of both data collection methods. In doing so, we compare the data collected in BANK and within the panel in order to demonstrate the similarity and thus, the validity of our items as well as the hierarchical structure between the three sub-constructs of effective use (EU) namely transparent interaction (TI), representational fidelity (RF), and informed action (IA).

**Descriptive Statistics**

After the completion of both data collections, we first screened the appropriateness of our data by comparing completion times for the surveys as well as by the screening descriptive statistics. Table 17 provides an overview of the descriptive statistics for both data collections.

Table 17: Descriptive Statistics of BANK and Panel Data

| | **BANK data** | **Panel data** |
|---|---|---|
| **Number of invitations / participants/ valid data sets** | 344/ 65/ 64 | 3,230/ 436/ 281 |
| | | |
| **Number of female participants** | 34 (53.1%) | 151 (53.7%) |
| **Number of male participants** | 30 (46.9%) | 130 (46.3%) |
| **Average age** | 36.66 years | 42.23 years |

From the data of our BANK case, we removed one "unengaged respondent" from the sample based on an analysis of standard deviation. On the contrary, we had to filter many participants from the panel data set. In total, the panel service provider invited 3,230 panelists to participate our survey. Due to our filter mechanisms 2,346 participants were screened out, meaning that they either had no or limited experience with MS Excel, they could not describe a case of adapting Excel to their needs, they were not employed in an organization, or the gender-related ratio needed to be balanced. From the remaining 884 participants, 111 did not answer and 337 did not complete the questionnaire. Thus, they were also removed from our overall data set. Finally, we checked our quality criteria in order to receive the final data set. In doing so, we again had to remove more than 150 0ut of 436 completed responses from the panel data set, as the data did not fit our quality criteria. For the removing of invalid responses, we followed a two-step approach. First, as

we used Questback as software for online surveys, we were able to calculate a quality measure based on the median response times of all participants. We decided to remove all responses that have a quality value smaller than 0.25, which means that the participant's response times were 50% lower than the average of all participants. Considering the median response times, we therefore removed 107 completed questionnaires (329 remaining questionnaires). In a second step, we considered the items that we reversely coded in our survey. In addition, to consider response times, the usage of reverse coded items also enables the detection of low quality responses. Frequently, researchers suggest to use reverse coded items to identify (inter alia insufficient cognitive ability, impaired response accuracy, or actual measurement of a different construct) careless responses (Magazine et al., 1996, p. 247). When respondents answered significantly different on two items that were reversely coded to each other but referred to the same construct, it can be the case that they were careless in their answers and thus, the quality of their overall answers can be doubted. By analyzing the reverse coded items, we therefore again had to remove 48 completed questionnaires (resulting in 281 valid responses) to ensure high quality of our research results.

**Measurement Model Assessment**

As a next step, we assessed our measurement model as shown in Figure 11 and performed several tests to evaluate its validity and reliability (MacKenzie et al., 2011). We needed to resolve the Multiple Indicators and Multiple Causes (MIMIC) modeling of RF's items. As stated above, we identified four items that are formatively modeled as they cover the dimensions of content's quality and two items that were reflective modeled as they refer to individual's trust into the presented content. For the resolving, we followed the approach as described by Barki et al. (2007) (referring to Diamantopoulos and Winkelhofer (2001)).

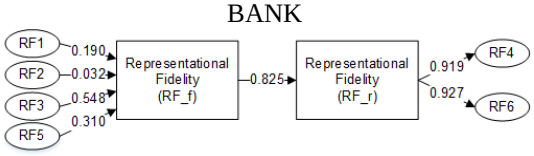
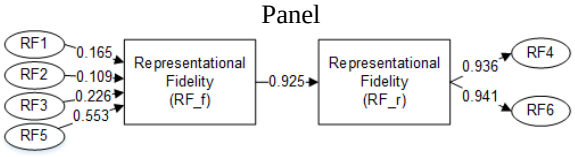
| BANK | Panel |
|---|---|
|  |  |
| VIF (RF1) = 2.575 VIF (RF3) = 5.032<br>VIF (RF2) = 5.139 VIF (RF5) = 5.875 | VIF (RF1) = 6.512 VIF (RF3) = 5.585<br>VIF (RF2) = 8.759 VIF (RF5) = 4.309 |
| t-value = 21.141 (p-value < 0.001) | t-value = 71.821 (p-value < 0.001) |

Figure 11: Assessment of Formative Measurements for BANK and Panel Data Set

Before resolving the MIMIC model, we had to ensure that the formative indicators fulfill all quality criteria and thus we had to assess the measurement model for the formative indicators. As depicted in Figure 11, the path coefficients between the formative and reflective modeled constructs of RF are for both data sets (collected at BANK and within the panel) greater than the suggested threshold of 0.8 (Hair et al., 2013). Thus, the path coefficients support the formative constructs' convergent validity. As high correlations between two formative measures are problematic from a methodological and an interpretational perspective, we also assessed the multicollinearity by calculating the variance inflation factor (VIF) (Hair et al., 2013).

Researchers suggest a threshold of a VIF smaller than ten indicating that multicollinearity is not problematic (Urbach & Ahlemann, 2010). The VIFs of both data sets do not exceed this threshold. Finally, we conducted a bootstrap algorithm in order to assess the significance and relevance of our formative indicators. The t-values of the all the outer loadings range between 13.30 and 79.79 for the BANK data set and between 33.17 and 172.40 for the Panel data set. The paths between the formative and reflective constructs are also significant at a 0.001 level (see Figure 11). Thus, all formative indicators are significant at a 0.001 level. Consequently, the formative indicators fulfill all quality criteria enabling us to resolve the MIMIC model by following the descriptions of Barki et al (2007). In doing so, we conducted the PLS algorithm in SmartPLS for RF modeling the formative and reflective measures in two separate constructs (as done in Figure 11). By using the latent variable scores of the two constructs as new measures, we were able to model RF as a reflective construct consisting of two measures. In the following, the measure resulting from the formative indicators is referred to as RF_f and the measure based on the reflective indicators is referred to as RF_r. Both measures are modeled as reflective indicators of the RF construct. Consequently, all items of the resulting measurement model are now modeled as reflective indicators enabling us to assess the measurement model as described by Hair et al. (2013) and MacKenzie et al. (2011).

Table 18: Results of the Assessment of the Measurement Model

| Latent Variable | Indicators | Outer Loadings | | Composite Reliability | | Cronbach's Alpha | | AVE | |
|---|---|---|---|---|---|---|---|---|---|
| | | BANK | Panel | BANK | Panel | BANK | Panel | BANK | Panel |
| TI | TI1 | 0.883 | 0.815 | 0.912 | 0.920 | 0.887 | 0.895 | 0.636 | 0.657 |
| | TI2 | 0.761 | 0.863 | | | | | | |
| | TI3 | 0.884 | 0.830 | | | | | | |
| | TI4 | 0.821 | 0.731 | | | | | | |
| | TI5 | 0.607 | 0.779 | | | | | | |
| | TI6 | 0.797 | 0.837 | | | | | | |
| RF | RF_f | 0.956 | 0.982 | 0.954 | 0.981 | 0.904 | 0.961 | 0.912 | 0.962 |
| | RF_r | 0.954 | 0.980 | | | | | | |
| IA | IA1 | 0.917 | 0.884 | 0.962<br>0.944[1] | 0.964<br>0.936[1] | 0.952<br>0.911[1] | 0.955<br>0.898[1] | 0.808<br>0.850[1] | 0.816<br>0.831[1] |
| | IA2 | 0.903 | 0.924 | | | | | | |
| | IA3 | 0.894 | 0.934 | | | | | | |
| | IA4 | 0.901 | 0.908 | | | | | | |
| | IA5 | 0.902 | 0.888 | | | | | | |
| | IA6 | 0.877 | 0.883 | | | | | | |
| Suggested Threshold | | > 0.708 | | 0.6 – 0.95 (for exploratory research) | | | | > 0.5 | |

[1] values after removing of IA2, IA4, and IA6

For the assessment of the measurement model, we first tested the model for indicator reliability. Table 18 summarizes the results and demonstrates that nearly all outer loadings of both data sets are higher than the suggested threshold of 0.708. Only TI5 of the BANK data does not reach the threshold. Since our research has an exploratory character and TI5 of the Panel study did not come below the threshold, we decided to keep the indicator in the measurement model. Thus, we can conclude that the indicators of each construct

have much in common and therefore reflect the according construct. While the outer loadings enable the assessment of the measurement model on an indicator level, the average variance extracted (AVE) criterion enables the assessment of the model's convergent validity on a construct level. As indicated in Table 18, all AVE values are higher than 0.5 and thus, the particular "construct explains more than a half of the variance of its indicators" (Hair et al., 2013; p. 103).

Both, composite reliability and Cronbach's alpha enabled us to assess the models internal consistency reliability. For both measures, literature suggests thresholds between 0.7 and 0.95 respectively. However, for exploratory research values between 0.6 and 0.7 are also acceptable. Values above 0.95 indicate that items are semantically redundant (Hair et al., 2013). Considering the values summarized in Table 18, especially the composite reliability and Cronbach's alpha values of informed action (IA) seem to be critical. We, therefore, carefully scanned the individual items and decided to remove IA2, IA4 and IA6 from the measurement model, as each of them bore resemblance to one of the remaining items. In doing so, we reached acceptable values for composite reliability and Cronbach's alpha smaller than 0.95.

Finally, we assessed the discriminant validity criterion, which demonstrates that a construct is truly distinct from the other constructs. In doing so, we considered the Fornell-Larcker criterion, where AVE's square root for each construct should be higher than 0.5 and in all cases higher than the variance shared with all other constructs (Fornell & Larcker, 1981). Table 19 demonstrates that the Fornell-Larcker criterion is fulfilled and thus, the measurement model fulfils the criterion of discriminant validity.

Table 19: Fornell-Larcker Criterion Analysis

| BANK | | | | | Panel | | | |
|---|---|---|---|---|---|---|---|---|
| | IA | RF | TI | | | IA | RF | TI |
| IA | **0.922** | | | | IA | **0.911** | | |
| RF | 0.770 | **0.955** | | | RF | 0.768 | **0.981** | |
| TI | 0.707 | 0.735 | **0.798** | | TI | 0.491 | 0.570 | **0.811** |

**Structural Model Assessment**

In addition to their operationalization, we are also interested in the relationships between the three sub-constructs of effective use (EU). Thus, we assessed the structural model in the next step. Again, we followed the suggestions of Hair et al. (2013). Figure 12 summarizes the path coefficients, the significance levels of paths, the explained variances ($R^2$), and the effect sizes ($f^2$) for the structural model. As indicated, there is a significant relationship between TI and RF as well as RF and IA for both data sets. As hypothesized by us (and by Burton-Jones and Grange (2013)), our data also demonstrate that RF fully mediates the relationship between TI and IA. Consequently, our operationalization of items and the hierarchical structure between the sub-constructs of EU could demonstrate the validity of the assumptions and hypothesis formulated on the EU construct. In addition, our data also indicate that approximately 60% of variances in IA can be explained by RF, which can be considered as a substantial effect. Considering the effect sizes of the

paths, this observation is confirmed. While the effect sizes of RF on IA ($f^2$ = 0.374 / 0.866) and the effect sizes of TI on RF ($f^2$ = 1.176 / 0.482) can be considered as strong effects, the effect size of TI on IA ($f^2$ = 0.118 / 0.010) can be considered as moderate respectively weak (Urbach & Ahlemann, 2010). However, for the effect sizes the data sets show different results. Thus, more studies are required in order to come to a conclusion with regard to the hierarchical structure of the three sub-constructs TI, RF, and IA.

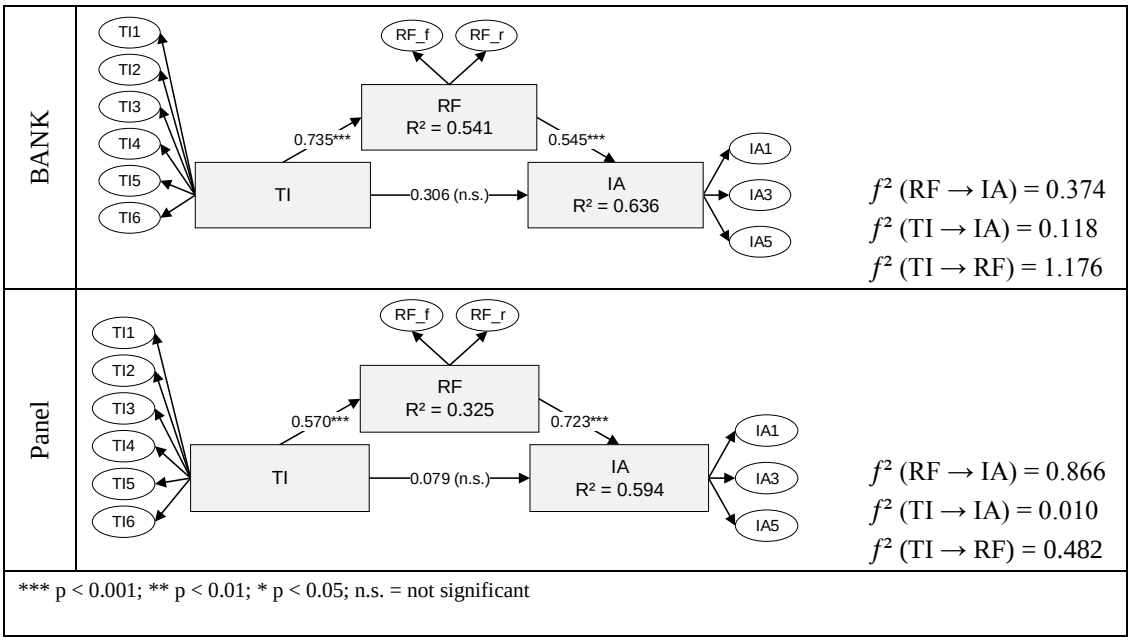



Figure 12: Assessment of the Structural Model Alternative Effective Use Measurement

Summarizing, all our hypotheses H1 to H3 are confirmed by our research results. Consequently, we can argue that the conceptual theory of Burton-Jones and Grange (Burton-Jones & Grange, 2013) on the concept of EU and the hierarchical relationship between TI, RF, and IA are also confirmed by our findings. The basis of our findings are the items, which we developed for TI, RF, and IA by following the established approach of McKenzie et al. (2011) (see Table 20).

**Evaluation of the Relationship of Adaptive System Use and Effective Use**

We used these items to test the presented hypothesis that ASU will mediate the relationship of the triggers of ASU with EU. This would also allow us to evaluate the effect of ASU on EU. We had collected the necessary data for the evaluation of this relationship only in the Panel data collection effort. Hence, we used this data set as the basis for our evaluation. Our analysis revealed that the data did not support the hypothesized relationship of ASU and EU. This became evident when we began to evaluate the relationship between ASU and EU. The variance explained in EU based on this operationalization was very low ($R^2$ = 0.002). Furthermore, the path coefficient of the relationship was low and not significant (β = 0.050, n.s.). We therefore refrained from analyzing this relationship further and focused on reassessing our measure for effective use. In our additional efforts, we focused on EU because we had been able replicate ASU successfully. This involved a

reassessment of the design of the items and the evaluation of the conceptual understanding of EU in writing in comparison to the understanding of raters, when rating the items or of respondents when answering the survey. In the following section, we are going to present the effort to develop and test another, enhanced version of the items for EU.

Table 20: Measurement Items of Effective Use's Sub-Constructs

| ID | Item | Measurement in Study |
|---|---|---|
| TI1 | I find *system* very cumbersome to use. | reflective |
| TI2 | When using *system* interface it requires a lot of (mental) effort. | reflective |
| TI3 | Overall, I believe that *system* is easy to use. | Reflective, reverse coded |
| TI4 | I would imagine that most people would learn to use *system* very quickly. | Reflective, reverse coded |
| TI5 | When using it I find it difficult to obtain the content that I need because of *system's* interface. | reflective |
| TI6 | I find the system unnecessarily complex. | reflective |
| RF1 | When I use *system*, I find that the content (data, report information etc.) it provides me was sufficiently correct. | formative |
| RF2 | When I use *system*, I find that the content (data, report information etc.) it provides me was sufficiently complete. | formative |
| RF3 | When I use *system*, I find that the content (data, report information etc.) it provides me was sufficiently meaningful. | formative |
| RF4 | When I use *system*, I am confident that the content the system provides is a correct representation of the business case (e.g. loan contract data) at hand. | reflective |
| RF5 | When I use *system*, I find that the content (data, report information etc.) it provides me was sufficiently clear. | formative |
| RF6 | When I use *system*, I find that I can rely on it to process the data I entered correctly. | reflective |
| IA1 | I use *system* because it supports me in successfully performing my work. | reflective |
| IA2 | I act upon the information that is provided by *system* because it helps me to effectively perform my work. | reflective |
| IA3 | When I obtain information from *system* I can act upon it to effectively perform my task (e.g., complete my process). | reflective |
| IA4 | *System* is the adequate system to effectively do my work (finish my work in time and quality). | reflective |
| IA5 | I can leverage *system's* functionality to effectively perform my work. | reflective |
| IA6 | I leverage *system's* functionality to successfully perform my tasks/processes. | reflective |

### 4.3.3 An Enhanced Operationalization of Effective Use[7]

Our research effort to operationalize the measures for EU as presented so far was successful. However, the mix of reflective and formative measures, and concern raised by item raters, respondents, and other researchers motivated us to improve on this initial effort. While developing the measures for EU, we experienced several challenges. EU introduces a much higher level of abstraction to the IS use concept. While this represents a significant contribution to the understanding of the underlying mechanisms of EU, it makes the operationalization of EU much more demanding. The operationalization of an abstract phenomenon is a challenging mental procedure (Recker, 2013), particularly for complex, multidimensional concepts such as EU. Due to the complex and abstract nature of EU, many people involved in the research process (e.g., content validity raters or survey participants) seemed to have had difficulties in understanding elements of the theory such as the concept of representation. Hence, the goal of developing a generalizable EU theory is ever more challenging and research should always aim to contextualize to enable respondents to relate to the questions (Burton-Jones & Grange, 2013). Despite including this aspect in our operationalization efforts, we encountered many raters and respondents, who perceived the questions relating to the sub-dimensions TI and RF as system properties or tried to understand them that way.

This is contrary to Burton-Jones' and Grange's (2013) conceptualization of TI, RF, and IA as assessments of use (i.e., as behaviors), not as properties of the system or the user. Burton-Jones and Grange (2013) explicitly state the differences between the EU dimensions and existing constructs such as perceived ease of use (Davis, 1989) or information quality (DeLone & McLean, 1992):

> *"Although our constructs bear some similarity to TAM constructs, there are several differences (e.g., our constructs reflect observable behaviors rather than user perceptions). More importantly, TAM explains IT acceptance whereas our theory explains what people need to do to use systems more effectively and increase their performance."* (Burton-Jones & Grange, 2013, p. 652)

> *"Representational fidelity is not the same as information quality. For example, one difference is that information quality is a property of a system whereas our concept of representational fidelity is a property of use."* (Burton-Jones & Grange, 2013, p. 652)

While Burton-Jones and Grange (2013) clearly demonstrate why the EU dimensions are behaviors and how they differ from perceptions of system properties on a conceptual level, this distinction is less clear when it comes to operationalizing and measuring these constructs and in the interaction with respondents. Furthermore, operationalizations of richer concepts of IS use in previous IS research have generally measured

[7] Parts of this section were accepted to the Pre-ICIS SIGADIT Workshop 2016, Dublin. Only the abstract was published. The Paper won the workshop's Best Paper Award. This section is also part of a recent submission to the Information & Management Journal: Haake, P., Schacht, S., Lauterbach, J., Gnewuch, U., Koegel, C., Mueller, B., Maedche, A., 2017. Operationalization and Measurement of the Concept of Effective Use. Information & Management, submitted.

usage behavior based on perceptions, such as perceptions of using a particular feature of a system (e.g., deep structure use):

- *"*When I use Excel, I use features that help me analyze the data." (McKnight, Carter, Thatcher, & Clay, 2011, p. 22)
- "I use the "feedback" feature to provide input to others on their work." (Sykes & Venkatesh, forthcoming, p. 57)

This raises the question of whether the EU dimensions – although they are behaviors on a conceptual level – can be empirically measured based on perceptions that represent the product of a user's behavior (i.e., the results of a user's interaction with the system). Consider as an example the concept of RF which constitutes the extent to which a user is obtaining faithful representations from a system (Burton-Jones & Grange, 2013). Most likely, a user's perception of the quality of the system's representations is determined by his/her own ability to obtain faithful representations from it. For example, users who state that the system provides incorrect information reveal their inability to obtain correct information from the system. As a result, their perception of the system can be used as a proxy measure for RF. In addition to that, this approach provides benefits from a practical standpoint since it is arguably much easier for someone to grasp the perceived quality of the system's representations than to go through the thought process whether his/her interaction with the system results in the obtainment of accurate representations. While Burton-Jones and Grange (2013) have illustrated that EU and its sub-dimensions differ significantly from established measures, the comparison of measures and the insights from the item development process raise the much broader question of whether the operationalization of core EU constructs results in reconceptualizations of other concepts that represent system properties (e.g., TAM constructs).

To better illustrate this conjecture, Table 21 provides a comparison of the definitions of EU sub-dimensions with existing measures for other constructs. This provides initial evidence for the assumption that the EU dimensions can be linked to the perception of system properties, at least on an empirical level. Furthermore, we included an exploratory factor analysis (EFA) with SPSS Version 22 to test the initial measurement models for unidimensionality (Urbach & Ahlemann, 2010). We performed an EFA based on principle-component-analysis (PCA) because it is deemed the appropriate approach for exploratory research (Pett, Lackey, & Sullivan, 2003). Furthermore, we selected extraction based on eigenvalue >1 and promax rotation (kappa = 4), as recommended for human behavior research (Costello & Osborne, 2005). For the panel data set, all items converged in their corresponding construct. For BANK, several items did not converge in their corresponding construct (see the results of the final EFA in Appendix F). This added to our perception that we should reevaluate and, when necessary, adapt our initial operationalization. Beyond the points that we have already mentioned, we also wanted to address low loadings on some items (e.g. TI5), the high Cronbach's alpha for IA and the formative nature of some of the RF items (RF1-3; RF5) to allow for a more convenient measurement.

Table 21: Similarity of Effective Use Measures with Other Constructs

| Construct | Definition | Measures for Related Constructs |
|---|---|---|
| Transparent interaction | During interaction with the system, the extent to which a user is accessing the system's representations unimpeded by the system's surface and physical structures | Perceived ease of use (PEOU) (Davis, 1989, p. 340):<br>*I find it easy to get the system to do what I want it to do.* |
| Representational fidelity | During interaction with the system, the extent to which a user is obtaining representations that faithfully reflect the domain that the systems represents. | Information quality (InfQ) (Sasidharan et al., 2012, p. 674):<br>*The system provides the precise information that I need.*<br>*The system provides output that is exactly what I need.* |

**Item Development**

Thus, we decided to start another item development and data collection effort to investigate whether the EU-sub-dimensions are similar to measures of perceived system characteristics and to improve the individual items. We developed completely reflective measures to reduce the complexity of the measurement, following the suggestions of current research (Hair, Hult, Ringle, & Sarstedt, 2014; MacKenzie et al., 2011). According to Hair et al. (2014), reflective measures represent the consequences of an underlying construct. To understand the consequences in more detail, we operationalized the items in the role of embedded researchers and altered item versions between contextualization and generalization, while testing the items with end users. For our pre-study, we conducted embedded research in a buildings material company (BMC) in Central Europe that is currently setting up customer service centers and the accompanying call-center system. One of the authors was an embedded researcher at BMC for half a year, while he got to know the company and developed the items (see Table 22). Thus, we incorporated the lessons learned from the previous operationalization effort to develop a reduced number of focused and pre-tested items. Nevertheless, we again developed the new set of measures by generally following procedures suggested in IS literature (MacKenzie et al., 2011), as we did for the previous item set (see Appendix G).

We selected a Multi-Channel-Fashion-Retailer (MCFR) as the case site for our study, which has eleven different brick-and-mortar stores as well as a sizeable online shop. 525 personnel of full-time and part-time shop assistants as well as sales managers work in the different stores. The shops assistants routinely use a shop-assistant system (SAS) in their jobs. SAS is a software installed on desktop PCs, which can be found across all branches of MCFR. In addition, the desktop PCs are equipped with a scanner for product codes. The SAS provides a wide array of features, which support the shop assistants and their first-level management. The SAS allows accessing the firm's intranet, which works like a wiki-system and includes all rules and regulations relevant for employees. This ranges from human resources topics, information about the features and the use of software, to specific sales-information and company policies towards customers. Furthermore, it includes a direct link to the web-shop of the company, which is understood as a different sales outlet (i.e. separate prices etc.). The core features of the system are designed to support the shop assistants

in their direct contact with the customers and allow them to deal with stock levels, loyalty card information, specific service offerings, and complaints management. Additional features designed to support the processes in the sales organization can also be found in the key index tab of the SAS. Thus, it is evident that SAS provides a wide array of features with very different purposes. However, the features need to be used effectively by shop assistants to take informed action for customers or for internal processes.

Table 22: New Effective Use Measures

| Construct | ID | Item |
|---|---|---|
| Transparent interaction | TI1 | The system is difficult to work with. (reverse) |
| | TI2 | The system is easy to navigate. |
| | TI3 | The system allows easy access to its [content]. |
| | TI4 | I can successfully interact with the system. |
| | TI5 | The system facilitates the access to its [content]. |
| Representational fidelity | RF1 | The system's content is dependable. |
| | RF2 | I trust the system's representation of the content. |
| | RF3 | The system correctly reflects the real business object (e.g. customer, level of stock, services). |
| | RF4 | I am confident that the system provides a correct representation of its [data]. |
| | RF5 | I do not have to crosscheck the data in the system. |
| Informed action | IA1 | The system's content allows me to make better decisions in my job. |
| | IA2 | I act upon information in the system because they help me to do a better job. |
| | IA3 | Information drawn from the system's content allow me to avoid making mistakes. |
| | IA4 | I can leverage the system's content to avoid acting on false information. (dropped) |
| | IA5 | The system's [content] allows me to correctly execute [my tasks]. |

**Data Collection**

We measured all items using a seven-point Likert scale (1=strongly disagree ... 7=strongly agree). Before we started the data collection, the embedded researcher at the Multi-Channel-Fashion-Retailer (MCFR) discussed the survey design and the contextualization of the items with several other employees at the firm. S/He discussed the items and survey design mainly with the main trainer for SAS and with the responsible IT-department employee. Furthermore, s/he also discussed the contextualization of the items with a select group of two department heads, one deputy department, and the employees from the works council. For this purpose, we had to translate the items into German. We controlled the accuracy of this translation by having another person directly translating the German version back into English and a third independent person evaluating whether the items have the same meaning. Subsequently, we conducted several pre-tests of sections of the survey with end-users of SAS on the shop floor. All the people that we contacted provided feedback on the items and the survey structure, which we used to further iteratively develop the survey instrument. Based on their feedback, we removed and redesigned several items and modified the instructions to reduce complexity and make the survey easier to understand.

It became evident that shop assistants as well as all other sales personnel understood IA based on the definition by Burton-Jones and Grange (2013) as all behaviors that followed from system use and enabled them to provide a service to a customer in a better way. They believed that their ability to obtain IA is influenced by their perceived TI and RF of the system. We added some controls for individual factors that could influence the ability to use a system and therefore added controls for prior IS use frequency (Wilson, Mao, & Lankton, 2010) and individual use experience (Kim & Malhotra, 2005). Furthermore, we added the controls of perceived ease of use (PEOU) (Davis, 1989; Venkatesh & Davis, 2000) and information quality (InfQ) (Rai, Lang, & Welker, 2002; Sasidharan et al., 2012) to enable the cross-validation as outlined above (see Appendix H). We collected 169 responses overall. 22 respondents did not answer the complete survey and we therefore removed their answers. Subsequently, we checked several quality criteria to receive our final data set. We had to remove another 32 responses based on quality issues. For the removal of invalid responses, we followed again a two-step approach. First, we used the implemented quality measure in the online survey software Questback[8]. We again decided to remove all responses (17 responses) with a quality value smaller than 0.25. Second, we considered the reversely coded item in our survey and removed 15 completed questionnaires based on the analysis of the reversely coded item (resulting in 115 valid responses; effective response rate: 22%). Table 23 provides an overview of the descriptive statistics for the data collection. Appendix I shows that this sample is representative for the employees at MCRF.

Table 23: Descriptive Statistics of New EU Data Set

| Statistic | Values |
|---|---|
| Number of participants/ valid data sets | 169 / 115 |
| Number of female participants | 81 (70%) |
| Number of male participants | 34 (30%) |

**Data Analysis and Results**

This time we also performed the quantitative data analysis with a partial least squares structural equation modeling (PLS-SEM) approach, using SmartPLS 3.2.6 (Ringle, Wende, & Becker, 2015) and again followed the recommendations by Urbach and Ahlemann (2010) and Hair, Hult, Ringle, and Sarstedt (2014). We conducted and exploratory factor analysis (EFA) with SPSS Version 22 with the same settings as in our previous effort. With the exception of IA6 and InfQ4/5, all items converged in their corresponding construct (see the results of the final EFA in Appendix J). While Smart PLS is the appropriate analysis tool for our explorative research, there is unfortunately no global measure for the goodness-of-fit of the different models that can be used (Hair et al., 2014). Hence, we evaluated both models separately.

Table 24 shows satisfactory values for CA and CR (> 0.7) (Nunnally & Bernstein, 1994). CA values range from 0.82 to 0.92, whereas CR values range from 0.88 to 0.94. Table 25 also shows satisfactory values for CA and CR (> 0.7) (Nunnally & Bernstein, 1994). CA values range from 0.82 to 0.89, whereas CR values

[8] https://www.questback.com/ (Accessed on June 20th, 2017)

range from 0.88 to 0.92. Appendix J shows that almost all reflective items load highly on their parent constructs (> 0.708) (Chin, 1998). However, the loadings for IA5 (0.638), as well as the loadings for TI4 (0.694) do not load highly on their construct. However, these values are still larger than the suggested threshold of 0.6 (Gerbing & Anderson, 1988) for exploratory research as long as the primary loading is on the correct factor (Gefen & Straub, 2005). Therefore, we included these items in our further analysis.

Table 24: Results for Reflective Measurement Model (Effective Use New Operationalization)

| Constructs | CA | CR | AVE | TI | RF | IA |
|---|---|---|---|---|---|---|
| TI | 0.83 | 0.88 | 0.59 | **0.80** | | |
| RF | 0.92 | 0.94 | 0.75 | 0.41 | **0.87** | |
| IA | 0.82 | 0.88 | 0.65 | 0.39 | 0.25 | **0.77** |

As Table 24 shows, AVE values are above the suggested threshold value of 0.5 for all constructs (Fornell & Larcker, 1981). We measured the lowest AVE value for TI (0.59). For the alternative model, Table 25 also shows AVE values above the suggested threshold value of 0.5 for all constructs (Fornell & Larcker, 1981). IA has the lowest AVE value (0.65). We assessed discriminant validity based on the Fornell-Larcker-Criterion (Fornell & Larcker, 1981) (Table 24/25) and item cross-loadings. Therefore, we can confirm the validity of the reflective measurement model. Item loadings in Appendix J illustrate that all items loaded higher on their designated construct than on any other construct. All cross-loadings were lower than 0.7 with a gap of at least 0.1 between cross- and primary loading (Gefen & Straub, 2005).

Table 25: Results for Reflective Measurement Model (Effective Use New Alternative Operationalization)

| Constructs | CA | CR | AVE | PEOU | InfQ | IA |
|---|---|---|---|---|---|---|
| PEOU | 0.87 | 0.91 | 0.59 | **0.85** | | |
| InfQ | 0.89 | 0.92 | 0.75 | 0.50 | **0.87** | |
| IA | 0.82 | 0.88 | 0.65 | 0.40 | 0.45 | **0.80** |

Finally, we employed Harman's single factor test to assess the common method bias (Podsakoff et al., 2003). After we had loaded all variables in an EFA, we examined the unrotated solution. If a single factor emerges from an unrotated factor solution or one general factor accounts for the majority of the covariance in the variables, there might be risk of a common method bias (Podsakoff et al., 2003). However, this was not the case in our study, which means that common method bias is not an issue in this study.

Subsequently, we assessed the structural model (Figure 13). The variance explained in the original EU model is 6.2% for RF and 26.0% for IA. Variance explained in the alternative model is 17.2% for InfQ and 13.9% for IA. This indicates that both research models have some level of explanatory power (Chin, 1998). However, the explanatory power for IA in the original model is higher than the explanatory power in the

alternative model, concerning a linear regression. We used the bootstrapping procedure with 5000 resamples to determine the direction and significance of the paths (β) within the structural model. As illustrated in Figure 13, TI (β = 0.250, p ≤ 0.01) positively affects RF and positively affects IA (β = 0.309, p ≤ 0.001). RF positively affects IA (β = 0.336, p ≤ 0.01). The relationships in the alternative model are of the following nature: PEOU (β = 0.502, p ≤ 0.001) positively affects InfQ and positively affects IA (β = 0.235, p ≤ 0.05). InfQ positively affects IA (β = 0.335, p ≤ 0.01). In contrast to the model for the original operationalization above, we observe for our new adapted operationalization of the original EU model as well as for the alternative EU model based on PEOU and InfQ that the relationship between TI and IA is significant, with and without the potentially mediating variables (Hair et al., 2014) of RF and InfQ. In the case of the original model, there is a significant effect of TI on IA (b= 0.402, p < 0.001) without RF in the model.

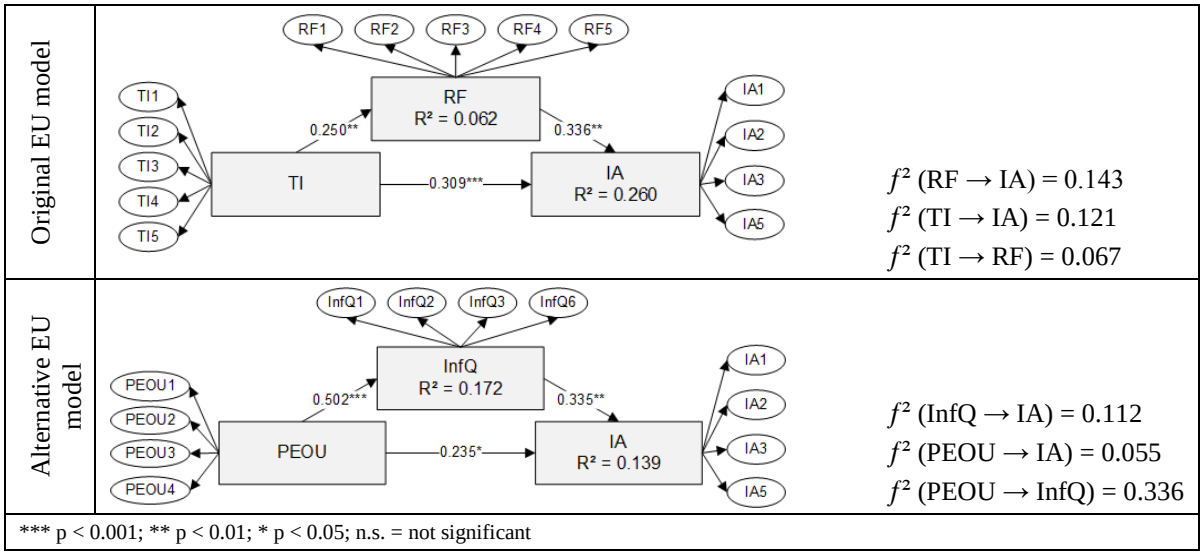



Figure 13: Comparative Assessment of the Structural Model for New and Alternative Measurement of Effective Use

When we introduce RF as a mediator in the model, TI still has a significant direct influence on IA (b= 0.309, p < 0.001). However, RF also has a mediating effect of 0.09 with a 95% confidence interval of 0.02 to 0.17 altogether indicating partial mediation. For the alternative model, there is a significant effect of PEOU on IA (b= 0.407, p < 0.001) without RF in the model. When we introduce InfQ as a mediator in the alternative EU model, PEOU still has a significant direct influence on IA (b= 0.235, p < 0.05). However, RF also has a mediating effect of 0.17 with a 95% confidence interval of 0.06 to 0.31 altogether also indicating partial mediation. Hence, we can accept H1 and H2 for both models, while we have to reject H3 for both models as well. Nonetheless, in both models RF and InfQ, respectively, partially but not fully mediate the relationship.

We evaluated the effect size based on Cohen's f² (Cohen, 1988). A small effect has an f² of about 0.02, a medium effect of about 0.15, and a large effect of about 0.35 (Cohen, 1988). The effect of TI on RF is small (f² = 0.067), while the effect of RF on IA is rather medium (f² = 0.143). The effect of TI on IA is also medium-sized (f² = 0.121). The results of the evaluation of the alternative model of EU show an effect of

PEOU on InfQ is almost large ($f^2 = 0.336$), while the effect of PEOU on IA is rather small ($f^2 = 0.055$). However, the effect of InfQ on IA is rather medium-sized ($f^2 = 0.112$). Additionally, we evaluate the models' capabilities of predicting dependent variables with a blindfolding procedure (7 cases). The $Q^2$ values are 0.144 for IA and 0.042 for RF in the case of the original EU model, indicating sufficient predictive relevance (Hair, Ringle, & Sarstedt, 2011). For the alternative EU model, we obtain $Q^2$ values of 0.139 for IA and 0.172 for InfQ, indicating sufficient predictive relevance (Hair et al., 2011).

**Conclusion**

Drawing on the recent conceptualization of EU (Burton-Jones & Grange, 2013), we initially developed a first measurement instrument (see Table 20) and conducted an empirical test to advance our understanding of individuals' effective use in an enterprise system implementation (post-adoption) context (at BANK) and in general (within a panel). However, we felt compelled to challenge our initial results in light of the feedback that we received from respondents and other researchers during the data collection effort. Consequently, we conducted another item development (see Table 22; see Appendix G) and data collection effort with these issues in mind and tried to operationalize the measurement model in response to the feedback that we received from respondents in the organizations where we collected the data.

Moreover, we also evaluated possible issues with alternative measures that Burton-Jones and Grange (2013) had identified themselves. The results for the two different measurement models are similar. The important difference in results between our first and the second operationalization is that RF and InfQ do not fully mediate the relationship between TI and IA or PEOU and IA, respectively. Instead, there is a partial mediation, which still backs the initial conceptualization of EU by Burton-Jones and Grange (2013). However, we are able to show that a similar relationship with IA also exists for the measures of PEOU and InfQ. Due to the explorative nature of our research and our use of Smart PLS, we cannot provide an evaluation of the global goodness-of-fit of the two different models. In future research, at greater stage of maturity of the measurement instrument for EU, this should be done with research methods that allow for the measurement of global goodness-of-fit (i.e. CB-SEM). Nonetheless, the higher explained variance for IA in the original model indicates that generally the original constructs of TI and RF explain more of the variance of IA than the constructs of PEOU and InfQ in the alternative model. This result changes when we introduce IA4 in the alternative model where it would not need to be dropped based on the results of the EFA (see Appendix J). We have still dropped it for the sake of comparison. Furthermore, when conducting an EFA with all items for the original and the adapted model, it becomes evident that most items of PEOU and TI in its current versions converge in the same factor (see Appendix J). This indicates that the unidimensionality of the items for TI still needs to be improved. However, we can also show that this problem does not seem to be as prevalent for RF as we might have expected given our experiences during the item development process. In sum, our initial efforts presented in this paper indicate that further analysis and evaluation of measures of effective use are necessary to conclude that effective use needs to be measured as the combination of TI, RF, and IA.

The two different operationalizations of EU are the key contributions of our work. For the initial version, we leveraged the conceptualization of EU by Burton-Jones and Grange (2013). We then developed an operationalization with all new items for measuring the model. For that purpose, we followed a thorough process as suggested by MacKenzie et al. (2011). To our knowledge, these are the first instruments to measure this conceptualization of EU and thus adds to the literature of adoption and use of IT that calls for measures of richer IT use concepts (Burton-Jones & Gallivan, 2007; Burton-Jones & Grange, 2013; Goodhue, 2007). As such, the work we present here affords other researchers to draw on both versions of our instruments should they choose to engage with EU and its sub-constructs in their empirical work, thus making the concept amenable to empirically based theory testing, extension, and elaboration. Furthermore, future researchers should test both operationalizations and determine the most appropriate operationalization of EU. This might involve additional conceptualizing work with regard to the challenges that we have identified. Future research can explore whether EU sub-dimensions should be linked to perception of system properties on an empirical level. We strongly believe that the development of relevant items is a contribution in its own right. Conceptually speaking, theoretical constructs are always specified and defined by two things: (1) through the nomological network they belong to and the reciprocal conceptual relationships with surrounding constructs (Suddaby, 2010), and (2) and more importantly for our work, through the observables used to measure them (Bacharach, 1989; Kaplan, 1964). We thus suggest that our operationalizations extend the conceptualizations of transparent interaction (TI), representational fidelity (RF), informed action (IA), and EU by providing definitions of corresponding observables. Our work is one of the first actual empirical employments of Burton-Jones' and Grange's (2013) EU concept. Even though the results of our measurement development are certainly not conclusive evidence for the EU model, we propose that our results bear the potential to advance our understanding of individuals' use of enterprise systems – and IS in general.

From a practitioner's perspective, organizations are confronted with a more than ever demanding business environment and therefore always strive for higher efficiency in their operations. Ineffective use of the enterprise system after its implementation can undermine these goals. In this context, it is our steadfast belief that after further verifying research work the items we suggest can be employed by managers to better understand what the key drivers and potential impediments of TI, RF, and IA are in practice in their attempt to improve the EU of systems they implement. This is not just true for a static perspective on constructs and their constituents, but also for the more dynamic aspect of the steps necessary to ensure EU. This, in turn, can contribute to practitioners' quest to more quickly and fully leverage the investments into new technology we alluded to in this paper's introduction. In the longer term, this can have wide-ranging practical implications. One example we see in this is the rethinking of training programs that accompany technology introductions. These might focus less on systems and systems' features, and more on what truly matters to individuals to get these systems to work for them and worked by them such that these individuals are able to complete their tasks more effectively and efficiently. Similarly, our insights may come to inform future enterprise systems' design, for example in how user interfaces are designed and developed. Of

course, this does point towards the need to further explore and elaborate our operationalizations and the underlying conceptualizations in an effort to ensure that they truly represent relevant drivers of EU.

In order to appropriately evaluate these implications, it is important to adequately reflect on a set of important limitations. *First*, we initially focused on the EU of enterprise systems. We believe that the conceptualization of EU by Burton-Jones and Grange (2013) has a good fit with enterprise systems, particularly in the context of our data collection at BANK and MCRF. Nonetheless, our initial results are bound to this substantive context and our insights and conceptualizations should be further tested and validated in other contexts to enhance their summative validity (Lee & Baskerville, 2003; Lee & Hubona, 2009). We partially mitigate this limitation by conducting our second data collection effort with a panel. The respondents in this effort had various backgrounds and use contexts and, based on our panel provider, were somewhat representative for knowledge workers in the UK. Furthermore, we used the broadly used tool Excel as the reference for data collection to indicate the generalizability of our developed measures for TI, RF, and IA. Thus, while the collection of data on the LMS and Excel is not directly comparable in terms of context, the similarity of the nature of results is an indicator for the nature of our developed measures. *Second*, it is important to recall that our initial conceptualization is temporally bound to the shakedown phase (Markus & Tanis, 2000). We referred to this context for the selection of panel respondents. While disruptions, shock, and negative reactions are at peak during the shakedown phase (Bala & Venkatesh, 2013; Markus & Tanis, 2000; Morris, Venkatesh, & Davis, 2002), this predestines the shakedown phase for studying the emergence of EU's antecedents. To mitigate this aspect, we studied EU at MCRF outside the shakedown phase because the system had been implemented more than a decade before our data collection. *Third*, actually measuring EU needs further attention by researchers. In our studies, we focused on perceptions as a measure of EU. While this is perhaps a needed first step, that needs to be tested and developed further, especially with an evaluation of our measures, we suggest that future research should develop ideas for objective measures (e.g., based on documented user data such as log files).

# 5 Discussion

This thesis investigates how organizations and individuals can increase the efficiency and effectiveness of their use of IS. The analysis is focused on two important phases of the implementation or renewal of an IS. First, we addressed the influence of differing perceptions of success in IS projects and the user involvement and participation during an IS project as important influencing factors. Second, we addressed the influencing factors in the post-implementation phase, when a system has been implemented and is in regular use. In this phase, we conceptualized and executed research on the influencing factors on the level of efficient and effective use of an IS, meaning that the goals for system use are achieved with effective use (Burton-Jones & Grange, 2013). First, we conceptually addressed the influence of learning. Second, we talked about the influence of workarounds on effective use. Third, we conceptualized the influence of user adaptation within the confines of a system and analyzed the influence of adaptive system use (ASU) on effective use (EU). This required a successful replication of the ASU model (Sun, 2012) and the operationalization of the construct of effective use (Burton-Jones & Grange, 2013). In addition, we explored the operationalization in more detail. During our research efforts, we therefore had findings relevant for research on IS projects as well as findings relevant for research on IS post-implementation user behavior and the measurement of effective use. The findings in both areas contributed to our research process on the appropriate means to improve the effective use of IS. We present the findings in the following section.

### 5.1.1 Summary of the Findings

The first two studies in the thesis provide findings on IS project success and its influencing factors. In our first study (Section 3.1.), we were able to develop a nascent theory, which indicates how different perceptions and evaluations of IS project success can develop in one organization that is actually very tightly knit. We identified a set of mechanisms based on our critical-realist approach (Wynn & Williams, 2012). The critical realist approach for this initial explorative part of the dissertation project allowed us to identify the causal mechanisms behind these different perceptions of IS project success on different levels of the multi-channel-retailer and particularly for the end-users in its e-commerce department. We identified three important mechanisms that help to explain the evolving perceptions of end users during an IS project. These are the narrative of success, hierarchical groupthink, and inherent fatalism. The first is the focus in management's communication on motivating employees by showing them that they are successful and taking part in something meaningful for FASHION and the multi-channel retailer as a whole. The second is the common belief of all end users in the e-commerce department's narrative of success. The third is the inherent fatalism of end users, which they use to struggle calmly with their inadequate or ineffective tools. These three mechanisms influenced end users sensemaking process (Weick, 1995) and let them develop an atmosphere where motivated reasoning (Kunda, 1990; Rousseau & Tijoriwala, 1999), which is the reliance on a biased set of cognitive processes, was paramount. It is likely to be important for explaining end users ability to focus on the aspects under their control. Instead of giving up and resisting the change (e.g.

Selander & Henfridsson, 2012) they developed a reliable system (Weick & Roberts, 1993) of employees and their knowledge of technology, which allowed them to deal with the adversity of an ill-conceived technological change in their work system (e.g. Alter, 2013). The common experience of overcoming the adversity created by internal projects within a group of fellow "fighters" was then perceived as IS project success. Individuals described their personal growth in phases of difficulty as the main positive experience. This perception overshadowed the project and its original purpose of improving the working conditions over the course of the project.

In our second study (Section 3.2.), we analyzed whether there a particular configurations of user involvement and participation (UIP) in different phases of an IS implementation project that are related with IS project success in terms of the ability to use an IS effectively. We used usability (Brooke, 1996) as a proxy for that. The results in this study confirm the generally positive findings for the relationship of UIP and IS project success (Bano & Zowghi, 2015). More specifically, we identify user participation in the requirements phase and the appropriate degree of user representation as the critical conditions for perceived usability after the project's completion. This finding adds to anecdotal evidence that UIP should be focused on requirements acquisition (Bano & Zowghi, 2015). The findings indicate that a higher level of user participation will not always result in project success measured in the perceived usability of the implemented software. It is important that representative end users participate in the implementation project presumably because they can provide the critical information that is needed to make those adjustments that considerably improve the usability of the implemented IS.

Beyond our initial studies during which we first explored the issue of different perceptions of success and then followed up with an investigation of the organizational, i.e. managerial means to increase the chance that end users feel enabled to use an IS effectively, we also studied users' means in the post-implementation phase which allow them to use an IS more effectively. In our first study in this research area (Section 4.1.), we analyze the influence of learning on effective use. This conceptual analysis reveals that learnings via social interaction, self-learning, and learning via training are the forms of learning, which are likely to influence the learning actions conceived by Burton-Jones and Grange (2013). Learning via social interaction involves individual users learning from their peers, i.e., mainly colleagues and the superiors during use. Self-learning can involve users' initiative during use, such as learning-by-doing or deliberate acts to explore the systems features or the manual for the system. Furthermore, in many organizations users learns from attending courses in classroom settings to learn the basic features and the user interface of a system. We believe that learning via training predominantly affects how users know about the basic features of a system. Based on current insights, we also come to the conclusion that self-learning is likely to have a positive influence on learning the meaning of the data in the system and helps individuals to take an informed action based on insights from the system. Our conceptual research suggests a similar effect for learning via social interaction. The current findings are a preliminary result and warrant future research to identify the empirical evidence on the conceptualized relationships.

However, we decided to focus our research on the influence of examination of the effect of workarounds on effective use (Section 4.2.), since workarounds can be one of the results of users consolidated knowledge and therefore the consequence of learning, especially when they are put in place to enable system use (e.g. Vassilakopoulou et al., 2012). We find in our case study of a supply chain management (SCM) system in use in a chemical company (CeCo) that those workarounds enhance the effective use of SCM that are designed in line with the goal shared in the work system. Thus, we find that workarounds positively influence effective use and its sub-constructs of transparent interaction, representational fidelity, and informed action. We identify several workarounds that allow end users to have access that is more transparent to the user interface of the IS. Some of these workarounds also enable employees to improve the representational fidelity of the system by allowing them to access and manipulate the representations. These workarounds therefore enable users to work with a user interface that they understand and with data that is true. The kind of workarounds that we identified allow to improve the representational fidelity of the information provided by the system and thereby allow end users to take more informed action based on information from the system.

We also decided to investigate the relationship of user adaptation within the system with effective use, as it was proposed by Burton-Jones & Grange (2013). In this research effort (see Section 4.3), we identified the conceptual link between Sun's model of adaptive system use (ASU) (2012), successfully replicated Sun's model (2012), and operationalized the concept of effective use. This operationalization took place in two stages. First, we developed an initial set of items (see Table 20) and evaluated this set in the context of the loan management system (LMS) of BANK and with MS Excel users in the UK with a panel. We were able to show that the relationship of full-mediation of the relationship between transparent interaction and informed action by representational fidelity existed in both cases. Nevertheless, some issues with the measurement instrument drove us to develop another set of items, which we evaluated in the context of the multi-channel-fashion retailer MCRF. With the new measurement instrument, we did not find evidence for full yet partial mediation. Thus, we find that the ASU model can be replicated and that we find mixed empirical evidence on the proposed hierarchical relationship of the subdimensions of effective use. We also compare a model with the new measures with a model based on alternative measures for transparent interaction and representational fidelity and find that the alternative measures explain less variance in the dependent variable of informed action. Nevertheless, these findings are initial efforts, which warrant further research and analysis for researchers to conclude that effective use needs to be measured as the originally conceptualized combination of transparent interaction, representational fidelity, and informed action.

In sum, the research in this thesis provides findings on the overall research question, which organizational and individual means in the (post-) implementation phase lead to effective use of an IS. In the first study, we focus on the organizational means in IS projects and show the managerial influence on the sensemaking process of individual users. Moreover, we evaluate in the second study in which phase of an implementation project organizations, i.e. their managers, can involve individual users most effectively. This thesis also provides answers on the individual as well as organizational means in the post-implementation phase that

can lead to an improved effective use of an IS. We outline the likely effect of different forms of users' learning of the system on effective use and we present how users' workarounds that are sanctioned by management can lead to effective use of an IS. We also conceptualize the relationship of ASU and effective use and show that we cannot identify an empirical relationship between the two constructs in their current conceptualizations. Finally, we provide a refined measurement instrument for effective use (see Table 22). Thus, we make some findings that constitute a theoretical contribution, yet also have inconclusive results that warrant analysis in future research.

### 5.1.2 Theoretical Contributions

Since we conducted research on IS projects and the effective use in the post-implementation phase, this thesis contributes to both areas of research. The section begins with a presentation of the contribution to research on IS projects. This the followed with a presentation of the contribution to research area of post-implementation.

**Contribution to Research on IS Projects**

With the initial study in this thesis we contribute to research by providing a new concept of the perception of IS project success in organizations. The critical realist approach allowed us to develop a better understanding of the causes for the evaluation of users' expectations and their sensemaking process. Therefore this thesis adds to research on the ambiguity of the evaluation and perception of IS project success (e.g. Thomas & Fernández, 2008). We also add the understanding of the causal mechanisms of narrative of success, hierarchical groupthink, and inherent fatalism to the body of research on the perception of IS projects. We showed for the first time in which way the perception of the business environment and the management of this perception of the management can influence sensemaking inside an organization regarding an organizational restructuring project, particularly an IS project.

In the second study, we contribute to literature on IS projects by reaffirming anecdotal evidence on the appropriate phase for UIP with empirical results from the analysis of configurations of 16 IS implementation projects. Thus, this thesis adds to research on the appropriate ways of user participation in different phases of a project (Bano & Zowghi, 2015). In doing this, this thesis shows the value of the configurational approach and particularly the fsQCA-method (Ragin, 2000) for research on IS projects. This thesis therefore helps to increase the understanding of managerial means such as user participation to make IS projects more successful in the eyes of end users.

**Contribution to Research on IS use in the Post-Implementation Phase**

The first study in this section (see Section 4.1) extends and refines the nomological net of effective use (Burton-Jones & Grange, 2013) with new constructs on the different forms of learning and conceptualizes

their influence on learning actions, as they were conceptualized by Burton-Jones and Grange (2013). Furthermore, the initial analysis of the literature on learning forms already showed that the user training cannot replace learning-on-the-job, particularly concerning the effective use of a system.

The follow up study on the effects of workarounds on effective use (see Section 4.2) also contributes to literature with a refinement and extension of the nomological net of effective use. Burton-Jones and Grange (2013) have argued that workarounds generally represent uneducated adaptations of an IS. We are able to show that workarounds can positively influence the effective use of an IS. Therefore, we extend the literature and the nomological net of effective use by stating that workarounds, especially those sanctioned by the management of an organization, are educated adaptations that often reflect the collective knowledge of end users. This thesis thereby also adds to research that states that workarounds can have varied effects and are not entirely negative (Su, 2013). Furthermore, this thesis contributes to the literature on workarounds by framing workarounds as acts of user adaptation. The link between these workarounds and their enabling effect on the effective use of a main system also adds to research that has focused on the level of features of systems as the relevant level of analysis (e.g., Sun, 2012; Benlian, 2015).

This perspective was part of our research on the effect of user adaptation (see Section 4.3). The initial contribution to literature was again the conceptual extension and refinement of the nomological net of effective use with the link to the ASU model. Furthermore, the first replication of the recently published ASU model (Sun, 2012) is also part of the contribution to theory of this thesis. It shows that this new model is relatively stable and can be replicated successfully. Finally, this thesis contains two operationalizations of effective use, which are the key contributions of this thesis. Thereby we add to the literature on adoption and IS use and answer the call for research on richer concepts of IS use (Burton-Jones & Gallivan, 2007; Burton-Jones & Grange, 2013; Goodhue, 2007). The second version represents a refinement of the first operationalization and enables future researchers to test for end users' perceived level of effective use. Both version were developed based on the conceptualization of effective use by Burton-Jones and Grange (2013). Beyond this contribution of a set of items, this thesis provides a discussion of the issues in the development and measurement process of effective use that can be traced back to the conceptualization of the construct of effective use by Burton-Jones and Grange (2013). This is a valuable report of the experiences in the operationalization process that can inform future research efforts to measure, refine, or reconceptualize the construct of effective use.

### 5.1.3 Theoretical Implications

There are some implications of the findings and theoretical contributions of the research on IS projects in this thesis. The findings of the first study (see Section 3.1) imply that further research on the mechanism that influence the perception of IS project success in organizations is necessary to determine whether the same causal mechanisms are present in different contexts and conditions and whether they will have the same benign influence on the overall perception of project success in all these cases. Hence, additional

longitudinal cases studies that investigate the perception of IS project success by different stakeholders and particularly end-users are necessary. It would be interesting to see whether the perception of the business environment and the resulting organizational narrative will dominate the perception of a project's success in many circumstances or whether we have just researched a special case. This call for future research is closely linked to the concern about the limitations to generalizability of a single case study. However, it is likely that the theoretical understanding and sequence presented in our study is generalizable as the organizational narrative, which informs perception, is likely to depend on the organizational environment.

The implication of the second study (see Section 3.2) is directly related to the empirical typologies of the links between different project configurations and IS project success in terms of usability. The results of the configurational analysis indicate that user participation of the appropriate users in the requirements analysis phase is the key combination of conditions linked with IS project success in terms of usability. Future research should aim to explore variants of these combinations in different contexts in more detail. Again, additional longitudinal case studies, maybe comparative ones, might be the appropriate course of action to investigate the relationship of UIP and usability and subsequently effective use in more detail. Moreover, researchers could evaluate how many organizations actually ask for the participation of a significant number of end users. In many cases, these seem to be the appropriate users to ensure the long-term success of an IS project. Based on the findings in this thesis, additional research on the effect of user participation in later stages of an IS project is also required. The effect of UIP in these late stages might be minimal and might just create a false sense of involvement on the side of the end users. This could have an adverse effect over the course of the IS project when they realize that they have been involved at a stage when they cannot influence the outcome. This is a situation ripe for the inherent fatalism identified in our first study. Another interesting aspect that might follow from the research on IS implementation projects in this thesis is the analysis of the effect of the use of agile project methods on end users' perception of usability and subsequently effective use.

The implications of our research on the post-implementation phase are also related to the nascent state of understanding and theory in the research area. Regarding the first conceptualization of the relationship of learning and effective use (see Section 4.1), future research should test these relationships empirically. This test could also involve the test of established constructs of IS use behaviors that might relate to conceptualized forms or learning. For instance, experimentation as a behavior of self-learning is a purposeful behavior during use and has therefore been conceptualized similarly in other contexts and research (e.g. Karahanna & Agarwal, 2006; Ahuja & Thatcher, 2005). Furthermore, the evaluation could also account for users who combine several self-learning activities to learn more effectively. For example, a user watches a video tutorial or reads about a new feature in the system documentation while simultaneously working with the system.

It follows from our analysis of the effects of workarounds on effective use (see Section 4.2.) that future research should recognize workarounds as users' adaptation actions that encapsulate their state of

knowledge about a system and a task. The decision to develop or adopt a workaround can originate for very different reasons on the individual level. One can hypothesize that users can use a workaround because they resist system use for a lack of knowledge, convenience or lack of personal benefit. However, they can also develop a workaround because the system does not allow them to conduct their task sufficiently. However, they might have sufficient knowledge to develop a solution that enables them to use a core IS of the organization, which they otherwise would not have been able to use. As we focused on the effects of workarounds on effective use, we neglected the origin of different kinds of workarounds and the individual skill of users involved in developing workarounds. These are interesting avenues of future research, which are closely linked with understanding the link between different forms of learning and effective use.

Finally, the mixed results of the operationalization presented in this thesis imply that further thorough conceptual work on the understanding of the appropriate conceptualization and measurement of effective use is necessary. Furthermore, the results accentuate the need for future research with the current measures and comparative studies with measures for alternative yet related concepts. Burton-Jones and Grange (2013) define effective use as an aggregated construct (Law, Wong, & Mobley, 1998). However, we also stated that a change in a user's level of effective use is not necessarily related to a change in all subdimensions (Chin, 1998). This is exemplified by a situation in which users may be able to increase their overall level of effective use only by improving their ability to take IA. It is conceivable that the users' level of RF and TI may does not need to change to lead to an increased ability to take informed action. Hence, future research should challenge the conceptualization of effective use theory and introduce different possible antecedents and explanations for a change in the level of effective use. This thesis provides an initial exploration of the original conceptualization of effective use as defined by Burton-Jones and Grange (2013). Future research should go beyond this initial framework and explore new constellations of conditions and behaviors, which may be related to effective use. For instance, it could be possible to understand *effective use solely as the informed action* in the real world because this is fulfilling the purpose of effective use. IA would therefore be defined as the use of information obtained from a system, which is enabled by using a system with the properties of RF and TI. TI and RF could be system characteristics in such a framework, which can have an impact on the level of effective use. A system would exhibit a high level of RF whenever it accurately displays the characteristics of the represented domain and it would provide a high level of TI, whenever it enabled unimpeded access to its contents. Such a definition would incorporate the understanding of effective use theory by many raters and respondents as presented in this thesis. Measuring an alternative model with the alternative constructs of InfQ or PEOU is a first step. Yet, future research may go beyond that and test additional constructs that might be related to effective use. Constructs such as system quality have been identified as one of the antecedents of IS performance in previous research (e.g. DeLone & McLean 1992, 2003).

Furthermore, Burton-Jones and Grange (2013) identify two major drivers of effective use: learning and adaptation. While we explored this conceptually and tried to link ASU and effective use, future research on potential

drivers should extend the user behaviors of interest that might lead to effective use. Especially already established conceptualizations of user behaviors that incorporate adaptation actions or learning behaviors, such as the concepts of emergent use (Karahanna & Agarwal, 2006) could provide interesting avenues for future research. This might entail an effort to explicate the boundaries of measures of IS use and users' behavior during use. In sum, additional conceptual research seems necessary to devise an intricate understanding of the nomogical net of effective use. Specifically, future research needs to determine in more detail what constitutes effective use and its antecedents in order to allow a more effective measurement of effective use and its antecedents.

### 5.1.4 Practical Contributions

The practical contribution of the research presented in this thesis is also twofold. For practitioners concerned with enabling later effective use of an IS during IS implementation projects, this thesis provides the following insights. First, they need to keep in mind that IS project success is perceived and depends on the situation and general mindset of each group of stakeholders. Hence, it is important to manage expectations and allow all types of users to develop realistic expectations about the future state after the renewal or implementation of an IS. If practitioners neglect this aspect of their work, they will have to manage expectations later on, which might result in disillusionment and user resistance to change. Furthermore, practitioners should keep the importance of the wider organizational narrative in mind. Especially, how it can affect their sphere of work. This thesis does not provide a guide how managers can placate a different narrative to overshadow a failure to achieve the initial goals of an IS project. However, it indicates how a powerful narrative can positively influence end users perception and therefore their willingness to act aligned with the organizational goals.

Furthermore, our research also provides insights on how practitioners can effectively manage the participation of user in IS projects to acquire crucial insights on the application domain and to manage users' expectations. The results presented in this thesis indicate that managers should focus the efforts for user participation on the phase of requirement analysis. The research also indicates that they should make sure to involve representative users. Key users and other special user groups can have special interests that are not aligned with the vast majority of users (e.g. Damodaran, 1996). Practitioners should make sure to create opportunities for the participation of end users or generally make sure that those participating are representative of the main group of users. Such an approach should help to increase end users perceived level of usability of the software after the implementation because they could develop realistic expectations and a sense of involvement with the project. Such an enablement to use an IS effectively is likely to lead to a more productive use of an IS. While this is the focus of the practical implications of the research in this thesis in this area, it also shows that most of the predominant forms of user participation such as user training late in the project are less effective than involving users early on. The results of the research indicate that a sense of enablement and common achievement are important to ensure effective use of IS across an organization after a renewal or implementation project.

While the studies on the effective use in the post-implementation phase mainly contribute to research, they also include a practical contribution. The research shows that employers should think about their users' specific needs for learning and adaptation of the IS that they are supposed to use to increase the likelihood of effective use of the implemented IS. The initial research results indicate that classic frontal classroom training sessions are not very purposeful for increasing the level of overall effective use. They might just provide the basic knowledge that permits users to know where all the features of the system are. Nevertheless, learning during use by own efforts and due to reflection of the process of use as well as learning from colleagues and support staff is important. Practitioners should aim to identify ways in which they can encourage learning from peers and support staff (Lauterbach et al., 2014) in their organization as well as provide the tools such as e-learning platforms that allow users to learn the system and the execution of specific tasks in their own time.

In addition, this thesis shows that practitioners should not regard workarounds as negative per se, yet examine the nature of workarounds individually and the reasoning for their use by employees. They might identify workarounds that allow an effective use of the implemented IS and can spread their use in the overall organization by sanctioning them for use in the organization. This might also make it possible to identify new ways of using the already implemented system for new tasks or develop new opportunities for effective operations. This might also allow cutting costs for customization efforts regarding implemented IS. Practitioners can also use the developed measures for effective use for the evaluation of the effective use in their organization. This would allow them to identify impediments to effective use related to a reduced ability to interact with a system in transparent fashion or due to the fidelity of the representations of the system's content. However, such a use, if successful, would point towards the need for a reconceptualization of the basic construct of effective use and need a comparison of other measures for system characteristics.

In sum, the research presented in this thesis has rich practical contributions for both IS implementation projects and post-implementation use. Although many organizations invest heavily in learning and development to upskill their staff, many are skeptical about the success of their investments (Sharma & Yetton, 2007). This thesis indicates ways to increase the effectiveness of their support for users learning to use a system and provides an initial approach to measure the effect of their efforts to improve the effective use of IS in an organization.

### 5.1.5 Limitations

Each study presented in this thesis has individual limitations, which are presented in the conclusion sections of the individual studies. In this section, I will go beyond the particular remarks regarding the individual limitations and speak to the overall limitations of the body of work presented in this dissertation. Some limitations are particular to the research on IS projects in this thesis, other have more relevance for the IS post-implementation research.

Both single case studies presented in this thesis (see Sections 3.1. and 4.2) are limited with regard to the generalizability of their results. However, as the research in both areas is explorative, a single case study is

the appropriate research method for gathering initial insights. The generalizability of the findings from both studies can be increased by future research on multiple cases. Nevertheless, there are also some limitations to our multiple case study research on IS implementation projects (see Section 3.2.) For this research method, it is still the case that the number and kind of selected cases has potentially a significant influence on the results. Therefore, future research should conduct additional studies that allow the analysis of even more diverse cases of different IS implementation projects to identify important contextual conditions that are likely to influence results. Furthermore, while UIP is one of the crucial levers to improve the perception of success of IS projects it can also have a negative effect, if it is ill managed. Hence, future research also needs to provide a more detailed analysis on how practitioners managed user participation in each case. This also speaks to the point that future research could chose to analyze the influence of different forms of user participation on conditions of IS implementation projects. This would require a different theoretical background for the analysis. Generally, for all our case studies it remains true that only future research on cases in different contexts and conditions will allow to determine the generalizability of the findings (Schneider & Wagemann, 2010). As our initial research on the use of configurational theory in the IS research community also included a systematic literature review (Webster & Watson, 2002), we also face potential issues with a lack of completeness of a literature review. Nevertheless, the research presented in this thesis is based on a literature review devised while following established guidelines (Webster & Watson, 2002), which should minimize such issues.

A possible limitation to all our data collection efforts via survey instruments are biases in the response patterns of individuals or issues with the measurement method. For the multiple-case study on IS implementation projects (see Section 3.2.) a response bias for those who made negative experience is possible. The fact that we also conducted interviews in each organization allowed us to mitigate such issues. In our other survey-based research efforts, we controlled for the representativeness of the group of respondents. We also controlled for measurement issues such as the common-method-bias. Nevertheless, other limitations of survey research persist. The level of perceived effective use or usability could also be influenced by individual learning and individuals' ability to learn a system and its functionality. People differ in their ability to process information and their prior knowledge and motivation (Jonassen & Grabowski, 2011) can influence their perceived effective use or usability. This difference might be subsumed in the construct of computer self-efficacy (e.g. Compeau & Higgins, 1995) at the time of measurement in a future research effort. Such skill should allow these users to use an IS more effectively. Other individual characteristics might also influence effective use. Therefore another research avenue relates to the impact of personality traits (e.g. Rammstedt & John, 2007), age, use experience (Kim & Malhotra, 2005), frequency of use (Wilson et al., 2010), learning style (e.g. Kolb & Kolb, 2005), and mindfulness (e.g. Sun, Fang, & Kong, 2016)) on effective use. For example, younger generations are more likely to experiment with an IS because they are more tech-savvy than older generations who did not grow up with this technology (c.f., Vodanovich, Sundaram, & Myers, 2010). Specifically, this could be done with an integration of personal innovativeness with IT (PIIT) (Agarwal & Prasad, 1998; Wang, Li, & Hsieh, 2013). Furthermore, it would also be interesting to integrate the general conditions in an organization and level of perceived support in the model. For instance,

this could be done by extending the model with the measure of facilitating conditions (FCond) (Venkatesh, Morris, Davis, & Davis, 2003). The understanding of the nomological net could be extended with the role of individual trust in the system. For instance, the concept of 'trust' regarding IS use can be divided into three categories (Craig, Tams, Clay, & Thatcher, 2010), which are the trust in the functionality of an IS, the trust in the extent the system will help to fulfill tasks, and the trust in the reliability of the system. This might allow developing a deeper understanding than the level of fidelity of representations. Besides trust, the influence of emotions (Beaudry & Pinsonneault, 2010) on users' effective use might also be an interesting avenue for future research.

The type of system might also be an important influencing factor. We chose to focus on the effective use of organizational IS because of the overall context of the thesis. Nevertheless, it could be an interesting avenue for research to examine the differences in learning forms for utilitarian ISs (e.g., ESs) and hedonic ISs which are connected to home and leisure activities such as social media applications (c.f., van der Heijden, 2004). While these avenues of future research are all enabled by our operationalization of the construct of effective use, it is a limitation of our work that the operationalization presented in this thesis is a specific and detailed operationalization of the multi-dimensional construct (Schmiedel, Vom Brocke, & Recker, 2014) as conceptualized by Burton-Jones and Grange (2013). While the operationalization in this thesis is based on current guidelines on construct specification (Diamantopoulos, Riefler, & Roth, 2008; MacKenzie et al., 2011), other researchers might still operationalize these constructs differently and develop different measures for effective use. Thus, future research on the construct of effective use might ideally be based on objective system related measures such as log files.

# 6 Conclusion

In sum, this thesis contributes to research in IS projects and IS use in the post-implementation phase. Parts of the contribution to research on IS projects is the nascent theory for the explanation of divergence in perception and a particular form of users sensemaking in an underachieving IS renewal project. The findings of this case study add the explication of the influence of the causal mechanisms of narrative of success, hierarchical groupthink, and inherent fatalism in the sensemaking process of individual end users to previous research on the subjectivity of IS project success (Cecez-Kecmanovic et al., 2014; Thomas & Fernández, 2008). Furthermore, this thesis adds to previous anecdotal evidence (Bano & Zowghi, 2015) that user participation is most appropriate in the phase of requirements acquisition of an IS implementation project. The findings in this thesis also point towards the importance of involving the appropriate users at this stage of the project, i.e. those users that represent the eventual end users in the best way.

Moreover, the thesis also contributes to research on IS use in the post-implementation phase. The contributions include a refinement and extension of the nomological net of the theory of effective use (EU). This includes a more detailed conceptualization how individual forms or learning influence those learning actions that influence the subdimensions of effective use. It also includes an extension of the understanding of the role of workarounds in the nomological net of effective use and this thesis highlights that workarounds are not good or bad per se, but that some workarounds can have a positive effect on effective use. This thesis also includes a conceptualization of the effect of user adaptation within the systems and includes the replication of a recent research paper in this research area. Finally, this thesis provides the first operationalization of the construct of effective use as conceptionalized by Burton-Jones and Grange (2013).

These findings contribute significantly to research and practice because they provide the exploration of a richer concept of IS use (Burton-Jones & Straub, 2006) and address the issues of lacking materialization of benefits of implementations of IS. As only the effective use of technology can improve the productivity of workers (Orlikowski, 2000), it is critical for research and practice to identify the impediments to effective use for individual users of organizational IS. It is also important to identify the enabling factors during an IS project and afterwards in the phase of use that enable users to make effective use of their tools, i.e. for most modern knowledge workers the ISs that they are using regularly. This thesis includes an explanation for some of the most important levers to increase the level of effective use in the phase of an IS project as well as in the post-implementation phase of use. Whenever the users in an organization use their systems effectively, their use can be a reason for a competitive advantage. The integrated work of individuals with technology to create a benefit can represent a competitive advantage because individual users' knowledge and their integrated work are difficult to imitate and often closely integrated into a specific organization (Barney, 1991). Thus, our research also indicates the means to develop a competitive advantage by using organizational IS more effectively than competing organizations. This is especially relevant in an age in which organizational IS are perceived to be a commodity and many organizations use very similar systems. Using

a relatively standardized software more effectively can represent the necessary competitive advantage compared to competitors. Hence, all efforts in this research project serve the purpose of providing a more detailed understanding of the conditions that enable effective use of IS.

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# Appendix A: Literature Review Configurational Approach

The following literature review underlines the originality of our idea: We conducted a systematic literature review to assess the spread of a configurational approach in the mainstream of the field of IS project research in the last two decades. We chose two of the most prominent databases, Web of Science and EBSCOhost Business Source Premier, for our review. Furthermore, we searched in the "basket" of eight journals which are regarded as the main journals in the field of IS research. These journals include the *European Journal of Information Systems*, the *Information Systems Journal*, *Information Systems Research*, the *Journal of AIS*, the *Journal of Information Technology*, the *Journal of MIS*, the *Journal of Strategic Information Systems*, as well as *MIS Quarterly*. We restricted the time period of our research to the period from 1994 to 2017 to gain an overview of the development in the field. To identify appropriate literature, we used the following search string: (Information System OR Enterprise System) AND (Project Success OR Product Success). This yielded 246 results in total. We identified 156 results on Web of Science and 90 on EBSCOhost Business Source Premier (see Table A1). After checking for duplicates and analyzing the titles, we identified a set of 100 articles for further review. Upon further analysis of the articles' abstracts, we identified 63 for full text review. Out of these 63 articles, we identified 50 articles that are actually relevant for IS project success research (see Table A2). Only one of these articles used a configurational perspective. However, the researchers did not use QCA, but adaptive conjoint analysis (ACA) for their particular analysis (Benlian & Hess, 2011). ACA is an analysis method, which is based on the maximization of the utility function that is composed of different parts of a hypothetical configuration. QCA on the other hand is an analysis method, which allows the independent analysis of configurations that can be observed when analyzing the past based on a given current state. Thus, we can conclude that the analysis of project configurations is currently not a widespread approach in the field of IS projects research. However, some researchers have outlined configurational research as a future avenue and referred to QCA as an analysis method for the analysis of configurations (cf. Seddon, Calvert, & Yang, 2010).

Table A1: Results of Literature Review

| | **# of articles** |
|---|---|
| Initial results | 246 |
| Duplicates | 25 |
| Selection based on title | 100 |
| Selection based on abstract | 63 |
| Selection based on full text | 50 |
| Research on configurations | 1 |

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Table A2: Literature Overview

| Citation | Qualitative Data Analysis | Quantitative Data Analysis | Configurational Methods | Research Methodology | Research Context |
|---|---|---|---|---|---|
| (Markus, Axline, Petrie, & Tanis, 2000) | yes | no | no | Case Study | Implementation Project |
| (Akkermans & van Helden, 2002) | yes | no | no | Case Study | Implementation Project |
| (Parr & Shanks, 2000) | yes | no | no | Case Study | Implementation Project |
| (Yoon, Guimaraes, & O'Neal, 1995) | no | yes | no | Survey | Implementation Project |
| (Rai, Maruping, & Venkatesh, 2009) | no | yes | no | Survey | Offshoring Projects |
| (Larsen & Myers, 1999) | yes | no | no | Case Study | Implementation Project |
| (Ramon Gil-Garcia, Chengalur-Smith, & Duchessi, 2007) | no | yes | no | Survey | Implementation Project |
| (Doherty & King, 2001) | no | yes | no | Survey | Implementation Project |
| (Ewusimensah & Przasnyski, 1994) | no | yes | no | Survey | Implementation Project |
| (Yetton, Martin, Sharma, & Johnston, 2000) | no | yes | no | Survey | Development Projects |
| (Seddon, Calvert, & Yang, 2010) | yes | no | no | Case Study | Implementation Project |
| (Fitzgerald & Russo, 2005) | yes | no | no | Case Study | Implementation Project |
| (Butler & Fitzgerald, 1999) | yes | no | no | Case Study | Development Projects |
| (Newman & Zhao, 2008) | yes | no | no | Case Study | Implementation Project |
| (Häkkinen & Hilmola, 2008) | yes | yes | no | Case Study | Implementation Project |
| (Jiang, Klein, & Discenza, 2002) | no | yes | no | Survey | Development Projects |
| (Bussen & Myers, 1997) | yes | no | no | Case Study | Implementation Project |

Table A2: Literature Overview

| | | | | | |
|---|---|---|---|---|---|
| (Wei, Wang, & Ju, 2005) | yes | no | no | Case Study | Implementation Project |
| (Martin, 2003) | yes | no | no | Case Study | Development Projects |
| (Finlay & Forghani, 1998) | yes | no | no | Case Study | Implementation Project |
| (Taylor-Cummings, 1998) | yes | no | no | Case Study | Development Projects |
| (Bartis & Mitev, 2008) | yes | no | no | Case Study | Implementation Project |
| (Singh, Tan, & Mookerjee, 2011) | yes | yes | no | Case Study | Development Projects |
| (Osei-Bryson, Dong, & Ngwenyama, 2008) | no | yes | no | Survey | Implementation Project |
| (Procaccino, Verner, Darter, & Amadio, 2005) | no | yes | no | Survey | Development Projects |
| (McBride, 1997) | yes | no | no | Case Study | Implementation Project |
| (Chua, Lim, Soh, & Sia, 2012) | yes | no | no | Case Study | Implementation Project |
| (Remus & Wiener, 2010) | yes | yes | no | Case Study | Implementation Project |
| (Lacity, Willcocks, & Subramanian, 1997) | yes | no | no | Case Study | Implementation Project |
| (Doherty, Ashurst, & Peppard, 2011) | yes | no | no | Case Study | Implementation Project |
| (Benlian & Hess, 2011) | no | yes | yes | Survey | Implementation Project |
| (Keil, Rai, & Liu, 2012) | no | yes | no | Survey | Implementation Project |
| (Liu & Yetton, 2008) | no | yes | no | Survey | Implementation Project |
| (Ngwenyama & Nielsen, 2013) | yes | no | no | Case Study | Implementation Project |
| (Bernroider, 2012) | no | yes | no | Survey | Implementation Project |
| (Wen, Forman, & Graham, 2013) | no | yes | no | Case Study | Development Projects |

Table A2: Literature Overview

| | | | | | |
|---|---|---|---|---|---|
| (Schlichter & Rose, 2012) | yes | no | no | Case Study | Implementation Project |
| (Daniel, Agarwal, & Stewart, 2013) | no | yes | no | Case Study | Development Projects |
| (Mastrogiacomo, Missonier, & Bonazzi, 2014) | yes | no | no | Design Science Research | Development Projects |
| (Cecez-Kecmanovic et al., 2014) | yes | no | no | Case Study | Implementation Project |
| (Floropoulos, Spathis, Halvatzis, & Tsipouridou, 2010) | no | yes | no | Survey | Implementation Project |
| (Pan, Hackney, & Pan, 2008) | yes | no | no | Case Study | Implementation Project |
| (Jiang, Klein, & Chen, 2006) | no | yes | no | Survey | Implementation Project |
| (Guha et al., 1997) | yes | no | no | Case Study | Implementation Project |
| (Irani, Sharif, & Love, 2005) | yes | no | no | Case Study | Implementation Project |
| (Dhillon & Caldeira, 2008) | yes | no | no | Case Study | Implementation Project |
| (Spaeth, Krogh, & He, 2015) | no | yes | no | Survey | Open Source Projects |
| (Temizkan & Kumar, 2015) | no | yes | no | Network analysis | Open Source Projects |
| (Gregory, Keil, Muntermann, & Mähring, 2015) | yes | no | no | Case Study | Transformation Project |
| (Liu, Wang, & Eng Huang Chua, 2015) | yes | no | no | Case Study | Implementation Project |

# Appendix B: Conceptual Model of the Configurational Approach

A configurational approach in combination with some variant of the qualitative comparative analysis (QCA) is unique in that it enables this level of theorizing from a relatively small number of cases (Ragin, 1989; Ragin, 2000). We provide a conceptual model to illustrate the difference between a configurational and the current universalistic approach. The current universalistic approach is based on the hypothesis that there is a positive relationship between user involvement and system success (Bano & Zowghi, 2015), which we adapted to project success in our model (see top half of Figure B1). Instead, a configurational approach can be based on two different kinds of hypotheses (bottom half of Figure B1). On the one hand, it can be assumed that a there is configuration which constitutes the ideal solution: The greater the similarity of an IS project configurations with the ideal configuration, the greater is the project success in terms of usability and effective use. However, configurational theory implies that there are equifinal solutions. Thus, we propose to do research under the assumption of configurations with equifinality, that is, there are equifinal configurations, which are associated with project success in terms of effective use and usability.

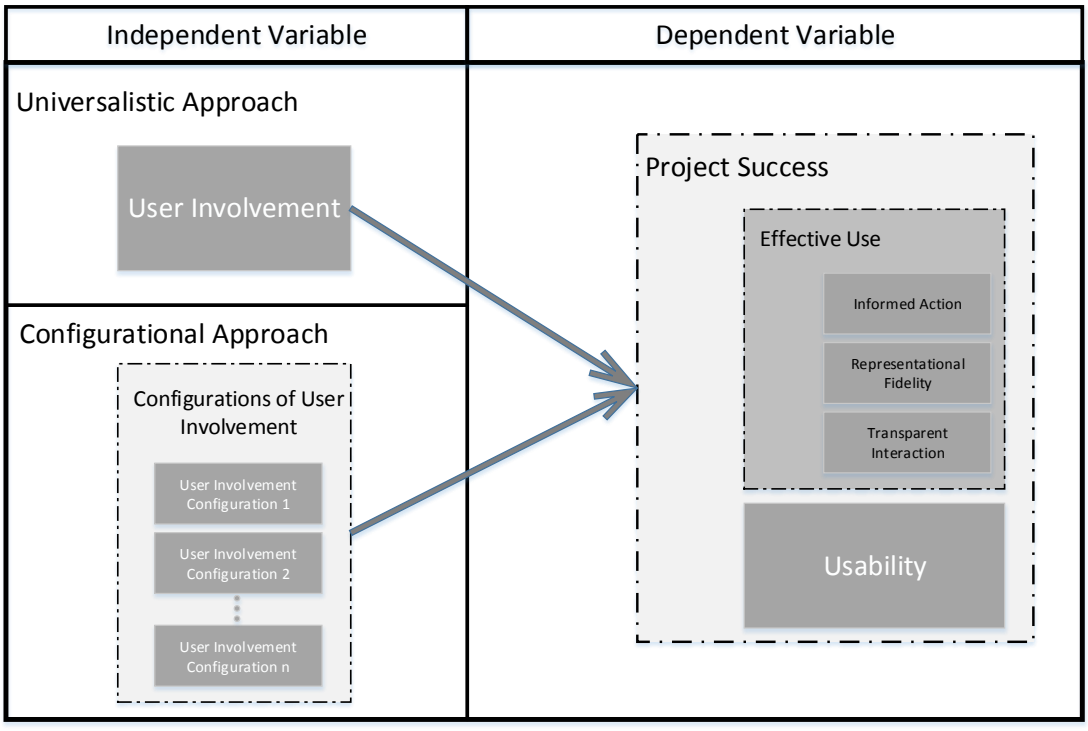



Figure B1. Conceptual Model

Thereby, we answer the call for a rigorous mixed-method approach for the study of the multifaceted and complex relationship of user involvement and participation and system success (Bano & Zowghi, 2015), although, we define system success differently as a part of project success. Thus, we address Bano's and

Zowghi's (2015) call for research on the effect of different levels and degrees of user involvement on system success or overall project success.

# Appendix C: Illustrative Online Questionnaire Items (SUS)

Table C1: Examples Survey Items (SUS)

| | English | Spanish | German |
|---|---|---|---|
| **1** | I like to use this system frequently. | Me gusta utilizar este sistema frecuentemente. | Ich verwende dieses System gerne regelmäßig. |
| **2** | I find the system unnecessarily complex. | Encuentro el sistema innecesariamente complejo. | Ich empfinde das System als unnötig komplex. |
| **3** | I think the system is easy to use. | Pienso que el sistema es fácil de usar. | Ich denke das System ist einfach zu verwenden. |
| **4** | I need the support of a technical person to be able to use this system. | Necesito soporte del personal técnico para hacer uso del sistema. | Ich benötige die Hilfe von technischem Fachpersonal, um in der Lage zu sein dieses System zu verwenden. |
| **5** | I find the various functions in this system are well integrated. | Encuentro que las diversas funciones del sistema están bien integradas. | Ich finde die verschiedenen Funktionen dieses Systems sind gut integriert. |
| **6** | There is too much inconsistency in this system. | Hay demasiada inconsistencia en este sistema. | Das System ist uneinheitlich aufgebaut. |
| **7** | I imagine that most people learn to use this system very quickly. | Creo que la mayoría de la gente aprende a hacer uso del sistema rápidamente. | Ich denke, dass die meisten Personen sehr schnell lernen das System zu verwenden. |
| **8** | I find the system very cumbersome to use. | Encuentro el sistema bastante incómodo de usar. | Ich finde es sehr umständlich das System zu verwenden. |
| **9** | I feel very confident using the system. | Me siento muy confiado (comodo) manejando del sistema. | Ich fühle mich beim Verwenden des Systems sehr sicher. |
| **10** | I needed to learn a lot before I could get going with this system. | Necesité aprender muchas cosas antes de poder manejar el sistema. | Ich musste viele Dinge lernen, bevor ich mit dem System umgehen konnte. |

# Appendix D: Description of Within-Case Analysis

**Case UniPortal (Students and Non-Students)**

UniPortal is an application of a German university that allows managing the whole student life cycle. In fact, the application includes different modules such as student management, grade management, course and lecture management as well as room management. Moreover, it is used by different user types, e.g. students, teachers, secretaries, and class and room management coordinators. In total, the system is used by around 13.000 end-users. The goal of the project UniPortal (full name: UniPortal campus management implementation) was to replace the old campus management software at this university. The application that was used before was a software bought from a software company and was adapted to the specific needs of the university. Since the software vendor decided to no longer support the old system, the university had to find a new software solution. As a result, the management of the university decided to purchase the successor of the software from the same vendor, which was expected to have the same functionality plus additional new features. Like before, the decision was made to purchase the basic software product and adapt it to the needs of the university. Thus, the IT department of the university was told to form a project team which should be in charge of the introduction process. The project time was set to five years and the implementation should include in total four software modules. The core project team included six people and three to four people who were partly involved in the team. They were mainly from the IT department. A clear and official measurement method for project or product success was not implemented.

At the beginning, the project team intended to use a waterfall approach. This approach had to be changed in the middle of the project, after around 2.5 years, because the basic product did not offer the expected functionality as well as poor code quality. The project goal and approach had to be changed in order to overcome this issue. As a consequence, the new approach was based on the Scrum method and the project scope was narrowed to only one software module instead of four.

Moreover, the form and intensity of end user participation during the project differed by user group and also changed over time. First of all, the IT department employees decided on their own which and how existing IT systems should be integrated and connected. Subsequently, some end user groups were involved. The user group of students was not involved and only participated in part during the testing. The project manager explained that there was a time at the beginning of a new semester, when the university launched the new application, and everything had already been implemented. At this point, the majority of the students saw the new application for the first time. Other user groups, like secretaries, lecture and study management as well as the course management at the faculties were involved and received information about the project process since its beginning. However, there was no direct participation during the project in the way that all end users became part of the project team itself and that they were able to make decisions. Rather a project board was introduced and each management area and faculty had a voice in this project

board. This board was able to make decisions and influence the development and customization process. However, since the university bought the basic product, sometimes even the IT department was not able to change features or functions, even though the project board decided to do so. Moreover, the board members were mainly selected due to their managerial position in their area, which means that most of them do not interact as often with the campus management system as other employees that work in the operational business of the university. In the later phases of the project such as the testing phase, the project team selected additional end users to participate and tried to select users, who could be described as super users that actually define and use the implemented business processes on a daily basis.

In addition, the communication with the end-users changed over time. Since the project team learned that each faculty and management area had very distinct processes, they started with individual meetings with representatives of each area to receive their specific requirements and then tried to harmonize these requirements. This was done in additional meetings in which all areas were represented, e.g. by the study program directors. Even so, the project team had to deal with some communication issues due to several reasons. First of all, the limited project resources made it impossible to talk to each end user. Hence, the project team used a communication tree, in which end-users, like secretaries, talked to their manager and they talked to the project team. As a result, some end-users complained during the implementation phase that someone never talked to them or that the provided functionalities did not match their requirements. As the project manager stated, the degree of conflict changed in relation with the distance to the users. The degree of conflict was lower if users were able to talk directly to the project team. On the other side, the communication with the majority of the end users of the user groups of students only took place after the go-live and only via email. However, the degree of communication conflicts was reduced over time, not least because the software also improved over time.

Like the degree of communication conflicts, the degree of user motivation to participate in the project changed over time. The business units of the university did not realize that the new system would have a huge impact on existing business processes and on their work environment. As the project manager explained, many users saw the new system as a kind of update, which will be implemented at a certain point of time, and everything will continue as it was before. Even, when the users figured out that the system will change their work routines, only a few users became motivated to actively participate in the project. Moreover, many users, which liked the old system, hoped that the new system would not be introduced. Only when it became clear, that the new system would definitely replace the old software solution, end users started to participate and tried to influence the project's progression. The project manager put it in a nutshell when he stated, that the end users became motivated, because they became frightened. At the same time, it was difficult for some end users to participate in the project due to their daily workload as well as a lack of knowledge about information systems. In addition, some end users, which participated, showed "fear of change". This added to the difficulty of the introduction of the new system with some new features.

Another issue for the user participation in this project was the fact, that there was no official and clear user participation process for the majority of the end users. Nevertheless, the management wanted as many users as possible participating in the project. The limited project resources as well as the missing participation process made it difficult to involve many of the end users. However, the used process including the already mentioned communication tree and the meetings became over time the official UIP process. Additionally, some end users created workarounds to avoid the inconvenient and unproductive UIP process. They used their direct contacts to the IT department to influence the project.

After the project duration of five years, the project manager concluded, that the user participation meant that some project phases took longer than expected. At the same time, the user participation also had a large and positive impact on the product quality. The interviewed project manager as well as the project member summarized the current user feedback about the final product as "okay" and the project, after the scope reduction, as successful.

**Case ConstructionERP**

ConstructionERP is an ERP system of a Colombian construction company and it is currently used by around 40 end users. The company itself is a medium size family company and a couple manages it. The, the old system, which needed to be replaced, was used as a baseline for the functionality of the new system. In addition, screenshots of the old system were used to design the new system's user interface. The development approach was based on a simplified version of the Rational Unified Process (RUP), which is an iterative software development process framework created by the Rational Software Corporation (Kruchten, 2004). An external software company was contracted to develop the software and a single-point-of-contact approach was selected. The owner of the company selected one employee for this position, who participated directly in the project team and was supposed to collect all requirements of the other end users.

The project faced several issues during the execution. First, the appointed employee that was internally in charge of the project changed four times during the entire project time. Furthermore, the selected employee did not have the power to make decisions and mainly had the task to transfer information. The actual decisions were made by the two owners, which sometimes had problems finding a common solution. Moreover, the project team faced the issue that some of the selected employees were not able to communicate correctly the end users' requirements, which led to the development of unnecessary or incorrectly working software functions. Furthermore, since the entire business processes of the company had to be implemented in the ERP system, the system became quite complex and it was later announced that changes had to be implemented carefully to avoid running into problems in another part of the software. This affected the project and led to a doubling in project time and budget. However, the final product that is currently used by the company received very good end user feedback and the end users are motivated to use the new ERP system.

**Case ResidentialSoft**

ResidentialSoft is an administration tool for residential complexes. Currently several landlords and tenants use this online platform, which provides administration functions like booking common areas as well as paying residential bills, e.g. electricity bills. The application is used by around 11 admins and 1,500 end-users. The initial idea was born, conceptualized and developed inside a Colombian software company based on the developers' personal experience with being a resident of residential complexes. After a first version of the application was created, it was tested within several residential complex companies. These tests revealed that the application had the potential to be a successful product, but at the same time, it needed many changes to meet the users' requirements. Thus, the application was modified based on the received end user feedback. During the creation of the updated version, some end users participated and the developer used three ways to receive end user feedback. The first method was using the creation of user interface mockups. This was followed by several discussions with end users about their opinions about the mockups. Second, select end users were observed while they used the online platform in order to identify issues and the most used, or most liked functions of the application. Finally, the application includes a tracking function, which records how end users use the platform. All this information was used to improve and modify the version until the desired quality and functionality was achieved. Then the platform was released to the public market. The software company did not measure the project or product success. Hence, the company expects that users are satisfied with the product because of a lack of negative feedback.

**Case SkillSoft**

SkillSoft is a platform to testing and manage end users' IT skills. The initial idea was based on the requirements of a company that focuses on trainings, especially for digital skills. We refer to this company as SkillSoft Company. SkillSoft Company also provides the platform as a service to other companies. Currently the platform is used by around 5.000 end-users, including the user-types admins, probands, and supervisors.

The normal usage process of the platform is the following: A company decides that all or some employees of an area should be tested on their IT skills concerning a specific application, like Microsoft Excel. This company then asks the SkillSoft Company to conduct the test. SkillSoft Company then creates a test for this software product, e.g. Microsoft Excel, and the selected employees will carry out the test. The final results will be provided to the employees and the employee's company. Furthermore, recommendations on how each employee should be trained to achieve the required skill level will be given.

The main part of the analyzing and requirements phase was carried out by SkillSoft Company employees. After these steps, the theoretical blueprint of the platform was handed over to a software company and the idea was discussed with a developer team. Together, the IT architecture for the future platform was created and developed, following a development approach based on a simplified version of RUP (Kruchten, 2004). The product was then tested and finalized together with the help of end users.

**Case UniAlerts**

UniAlerts is an early warning system used by two universities, which aims to detect academic and financial problems of students to start a support process. The software is currently used by three different types of end-users: 2 admins, 60 teachers and around 15.000 students. The development approach of this project was based on a simplified version of RUP (Kruchten, 2004) and the final version was released after 1.5 years of development.

The initial idea for the software came from a Colombian university that struggled with the drop out of a many students. After analyzing, the different cases and the reason for each drop out, they recognized that most of the students dropped out due to financial issues or academic problems. At the same time, it became clear that the drop out was mostly only the final resort, and that most drop outs could have been avoided, especially if the students had asked for support right at the time when they had started to struggle with a financial or academic issue. Based on these insights the idea was born to create a system, which would analyze the existing data in the different university systems, like the current grades of the students and the financial situation of each student. It is important to mention, that the university holds records of how each student finances his or her study as well as information of students' scholarships and when their financial cushion will be used up. The new system was supposed to be able to detect possible future dropouts and their reasons. This would then initiate a support process. The support process involves meetings with the student to find a solution that allows avoiding a drop out. Even though the system is designed to support the students, this specific end user group was only included during the testing and finalization phase. The analyzing phase and the requirements phase was mainly conducted by the project team inside the university, including teachers and other academic employees. The results of these two phases were then discussed with an external software company, which developed and implemented the desired system. Since the software is an essential support tool for many students, the current feedback about the software seems to be very good and only a few change requests were made.

**Case LabSales**

LabSales is a sales force tool for the pharmaceutical industry. Currently, the software is used by around ten companies in three different countries. Around 366 end-users (11 admins, 50 managers, 300 sales representatives) use it on a daily basis. However, the number of end users is growing.

The initial idea for the project was based on the work experience of a manager that worked in the pharmaceutical industry. He started his career as a sales agent and moved up the ladder until he became the head of business intelligence in a multinational laboratory in Latin America. In this position, he was in charge of the region Latin America that included the countries Colombia, Peru, Chile, Argentina, Venezuela and the Dominican Republic. He learned that there was an interesting business opportunity for software that would offer an easy way for the managers and for the sales agents to analyze and manage their business in real-time. Hence, his team started to develop such an application as an in-house development project based on their own experience and thoughts. The outcome of this project was the first version of LabSales. The

first tests with the new application revealed a high business potential. However, the first version had to be widely modified to match the end users' requirements. Therefore, the manager left the company and started his own company with the goal to focus and continue the development of this application. For the second version, which is currently being used and is the object of this research, end users' feedback was included to improve the functionalities and the system quality. However, the entrepreneur is of the opinion that end users should not participate during the analyzing phase in order to be able to create innovative or even revolutionary products. He shares the view, that the participation of end users hinders the creative aspect, which is needed for successful products, and that UIP is only useful to improve an already existing product. Hence, UIP was never used during the analyzing phase and only some end users were involved during the requirements and finalization phase. In addition, for the testing phase, the real end users were not involved and the company used internal testers instead before releasing the new version. The project time for the second version was around 1.5 years and the third version is currently under development. The development approach was based on a simplified version of RUP. It seems that the end users like the current version of the application, and that they do not have any serious issues with it. However, some sales agents do not like the functionality of the software that allows their managers to observe their work in real-time.

**Case MGIS**

MGIS is a project of a public authority. The authority is among other things responsible for geo-information and provides software solutions to other public authorities. MGIS is a geographic information system for the purpose of land consolidation. It has been implemented to replace and comprehensively extend an existing solution that only had display functionalities. In the legacy system, users could view maps and display information that is relevant for land consolidation. In general, the system provided all information necessary to start the planning of land consolidation measures, but the system offered no planning functionalities at all. Thus, the authority implemented MGIS as a planning tool, which includes functions to create data and maps. It is based on the same standard software product the legacy system was based on, although much more features are implemented. According to the project manager, the standard software contained all required basic functions that were customized for the needs of the organization.

The project team to implement the software solution for about 750 users consisted of three employees of the IT department and few external project members belonging to the software vendor responsible for the development of extensions to the standard product. Furthermore, several users who were key users of the legacy system were included in the extended project team. The goals of the project were already clearly defined before the project started. They were refined throughout the project. The requirement to implement a software solution like MGIS came up in two one-day workshops concerning the legacy system where experiences were exchanged between approximately 50 users and IT. Moreover, the later project manager used these workshops to present technical possibilities for future systems and to discuss user requirements. Thus, the requirements were already roughly defined before the actual project started. According to the interviewees, the project is considered highly successful as quality, costs, and time could be achieved as

defined at the beginning of the project. The overall approach to development in the project can be classified as a mix of waterfall and agile project management elements.

Considering the participation of users in different project phases, the general requirements originated in the workshops already mentioned were used as a basis to conduct a detailed analysis of the requirements together with the users. Although the final functional specification was written by members of the IT department, users still participated in this phase. After the requirements had been specified, pilot offices were chosen to include employees in the extended project team. Different parts of the software were customized and developed in iterations. The extended project team always had the chance to work with the prototypes and to comment on them. According to the project manager, the feedback of the users was used to create the preliminary version of the software. This solution was tested by members of the pilot offices before go-live. Moreover, the two key users of each office got a one-day training and were responsible for spreading the knowledge to their colleagues. The project manager stated that not all key users did this job in a positive manner. Some of them conducted real training sessions while others only helped in case of problems. Some key users themselves had problems to understand the new system due to a lack of technical knowledge.

The users who were part of the project team were highly involved as only motivated users considering the project as an opportunity to implement a software product that helps them doing their work were chosen to participate in the project. However, the involvement of the other users was diverse. On the one hand, some users were happy that a new software product was implemented and excited about the final product, as it is similar to established geographical information systems. According to the project manager, especially younger users were already familiar with the usage of such a system and thus liked it. In contrast to that, especially older users would have preferred to continue working without the support of such a software system and thus rather see the software as a burden. Therefore, the project team was very motivated on the one hand and hence was able to implement a good solution, but on the other hand, skeptical users did not participate and did not get involved.

**Case FGIS**

FGIS is a project of the same public authority by which MGIS has been implemented. However, the projects have been conducted by two different departments. FGIS is also a geographic information system, but it is destined for forestal planning. An existing system that had been implemented some years ago was comprehensively reworked and extended with new functions, meaning that about 25 percent of the software were changed. Similar to MGIS, FGIS is a standard software product that has been extended to be suitable for the purpose of forestal planning. In contrast to MGIS, all enhancements of the software were developed by a third party company and not the software vendor. The software mainly serves the purpose of creation and administration of forestry. The final product of the software is a forestal map.

When several enhancements of the software were requested, the project was initiated by the specialist departments where the 25 users of the software are working. Thus, the requirements have been documented

and it was decided by a coordination board to start the project. The project team consisted of two employees of the IT department, external consultants and developers, and six users belonging to different departments. As the requirements were already roughly documented before the projected started, the goals and the scope of the project were clearly defined from the start. Retrospectively, the project was a success as costs and time were as planned. According to the project manager, also the quality goals were achieved in the end, although it was necessary to implement a service pack some weeks after go-live as the first productive version contained mistakes, which were, however, not critical. The development in this project was a closely adhered waterfall approach.

Based on the documented requirements a detailed analysis of the needs was conducted. In this phase, the degree of user participation was very high as users were equally entitled to influence decisions regarding the future system. There were about ten joint workshops of the project team to work out precise requirements. The results were used by the external company to create a recommendation what the new system should look like. It was discussed with the project team in a subsequent step. After the decision to adjust the software was discussed, the external company mostly developed the solution on its own. In this phase, the internal IT department and future users of the system only participated in the case of questions. This implies that no prototypes or preliminary versions of the software were presented to the users. However, after the system was completed two test cycles took place to validate that all requirements were fulfilled by the new system. If this was not the case, they had to bring about necessary improvements. There had been misunderstandings between the project team and the external company that had to be corrected. Before going live, all users had the opportunity to participate in a one-day training conducted by the users who were part of the project team.

The user involvement seemed to be rather high. Especially the users who were part of the project team were very motivated as the adjustments of the software were requested directly by them and not by superiors or IT department. Moreover, as about 25 percent of the users directly participated in the project it was possible to involve nearly all users either by direct communication or indirectly through the participating users. The users consider the software very important for their work and it is perceived to be more efficient than the previous software version. The latter is especially important, as the users are reliant on the system as a large part of their work is done in it. The interviewees stated this and one result of the conducted survey is that the users require the software for about 80 percent of their work. However, there are also single users who perceive the software in a more negative way.

**Case MIS**

The MIS project has taken place in the same organization as the two projects described in the preceding chapters. The case is about a major release of a software module of an IS for project managers in the area of land consolidation. The software includes project management and financial management functions. The software allows creating and planning land consolidation measures, cost planning, approval, and handling

of invoices. In the considered project, the module cost and financing has been significantly reworked, meaning that about 50 percent of the functions have been changed. In particular, the invoice process has been completely changed due to new stricter legal requirements, which were the trigger of the project. The module, which was developed completely in-house and hence, is not based on a standard software. It is clearly delimitable from the rest of the IS which was especially important for the online survey among users of the software.

The software has approximately 900 users and the general project team consisted of four persons of the IT department, one user of the software, and one employee of a higher-level authority. Considering the basic conditions, the project was solely conducted due to changed legal requirements that were passed on to the project team by the upper-level authority. Therefore, the general goal of the project was clearly defined. However, the underlying business processes were modified several times within the project as some of the legal requirements were adjusted several times and had not been clearly communicated. Because the legal requirements had to be met to a certain date, the project team was exposed to high time pressure. This also affected the project management success. Due to time pressure, the quality management had been neglected. Therefore, it was necessary to implement an additional release four weeks after the go-live of the software. Furthermore, especially the planned costs could not be met. It was planned to complete the project using 60 person days, but 400 person days were required in the end. The employed development approach during the project was originally a waterfall approach, which was gradually altered to a more agile approach due to large number of required changes.

User participation in the requirements analysis phase did not take place, as all requirements, where legal requirements that had been passed on by management. Based on this requirements, the IT department developed prototypes mainly consisting of HTML sites showing the process flow. These prototypes were presented and discussed with users of the software. However, all fundamental steps were already predefined and could not be influenced by users. Only minor changes were still possible. After the development was completed, a two days testing phase together with some users had taken place. The project manager described this phase as a poor. It should have been much longer. Before going live, about 60 persons, who were supposed to pass on their knowledge to their colleagues, received a one-day training. However, each of them handled the knowledge transfer to the colleagues differently and not always in a satisfying manner.

The users are not particularly involved with the software. They consider the new version of the software as a burden. According to the project manager, they “experienced an enormous additional burden through the new legal requirements. Hence, users would have preferred to use the old software version instead of the new one”. This also caused a low motivation of the users involved in the project. However, the users at least consider the software to be generally important for their work and know that it was inevitable to change the software system.

**Case CAD-WS**

The implementation project of CAD-WS took place in a mechanical engineering company. The company uses a computer-aided design (CAD) system for construction purposes and an Enterprise Resource Planning (ERP) system as an overarching system. All CAD files are stored in the ERP-system, for instance, to ensure version management as well as reliable data storage. As one machine consists of hundreds of different documents, an interface software is needed to create and access the documents in the ERP-system. It also is needed to ensure an effective management of all documents belonging to a machine. In the past, the company had used a software solution provided by the vendor of the ERP-system. As this solution had several restrictions, it was necessary to implement a new one. CAD-WS is a standard software product that has been extended by several enhancements. It enables the design engineers to work completely independent from the ERP-system, meaning that all required functions are provided by CAD-WS although using foundational functions of the ERP-system. The software, for instance, includes an approval process and provides functions to display clearly all documents of a machine, to create automatically all documents in the ERP-system, and contains additional features like a 3D-preview of the documents.

The software has about 750 users while the project team consisted of two employees of the IT department, external consultants of the software vendor, and two persons of the department responsible for all construction based processes, who are not users of the software. During the implementation, the project manager changed due to staff turnover. It was the goal of the project to carry over all functions of the old system into the new one. Therefore, the objectives and the scope of the project were clearly defined. However, according to the responsible team leader in the concerned IT department, it would have been better to question which functions are still required. This would have been a chance to get rid of old, not needed functions. Considering the project management success, the project was partly a success. The planned quality, in general, could be achieved although some functions were implemented later than planned. The go-live date initially planned could not be achieved due to the staff turnover, but the new planning by the second project manager could be met. Further, the costs were in the plan. The necessary development in the project was managed with a waterfall approach.

Although two persons of the specialist department participated during the whole project, the degree of user participation was rather low as the actual users of the system only participated in a very limited form. The project started with the selection of the software. According to the interviewees, it was relatively easy to decide which software should be used as the introduced software is the only comprehensive product with the required functionality. It was already licensed within the scope of other implemented products. However, before the purchase decision, there was a joint workshop of the project team together with three key users of the old system to examine if existing weak points of the old system could be solved with the targeted one. After the software product had been chosen users did not directly participate in the project until the first version of the software was productive. They only were involved indirectly because the project members of the specialist department were responsible for user support and therefore were in contact with

the users. Furthermore, an existing list with features requested earlier by the users was available. The software was implemented in iterations meaning that the standard software product was implemented and gradually extended by the functions to be developed which were available in the legacy system. The developed versions were taken into the productive environment monthly and could be used by the users. This could be done, as it was possible to run the legacy and the new system in parallel. Therefore, at the beginning the use of the new system was not mandatory; instead, users could decide to use the new system, although some functions still had to be executed in the old system, as they were not yet available in the new one. Using this proceeding, the project team got some feedback about the new software during the project, although users only participated in a very limited form during development and implementation. For the initial go-live, about 20 short tutorial videos had been created that were provided to the users. Before the implementation of new software versions, the key users were always informed and were supposed to forward the information. If bigger changes were implemented, all users were informed about the new functionalities by e-mail.

Considering user involvement, according to the project manager, some users consider the software to be a burden. They would prefer to work without such a system, which is not possible in a large company. However, these users also consider CAD-WS to be less bothersome than the legacy system. In contrast to that, many users are happy about the new solution as they have several advantages in comparison to the old one. For instance, it was not possible to work with the CAD software as long as the legacy system was active what was annoying for many users. Such problems do not exist with the new system. Furthermore, the users know that the alternative for using CAD-WS would be to work directly with the ERP-system. That would result in a much higher effort. Therefore, the attitude of the users towards the system is generally positive.

**Case DMS**

The project DMS took place in the same company as CAD-WS. A document management system has been implemented. DMS is an Add-On to the ERP-system used by the organization. In general, it is a standard software although it has been extended comprehensively by the software vendor to fit the purpose of the organization. The project was part of a program in which the sales process of one division of the company has been completely revised. Before DMS was implemented, information belonging to the sales project of a machine was not available for all involved employees and it was often difficult to find all documents belonging to the project. These issues were solved with the software DMS as it enables the employees to store all sales relevant documents in a structured manner. Such documents comprise for instance customs documents, experiment reports, and all correspondence with the customer.

The project team was composed of two persons belonging to the IT department, several employees of the software vendor, and six persons of different departments partially representing the 400 users for whom the system is designated. The general goals of the project were defined before the project started, although the detailed demands had to be examined in the project. According to the project manager, it was an issue that the future users of the system were not aware that a document management is not comparable with the

folder structure provided by an operating system that is more flexible. From a project management point of view, costs were lower than predicted although the project duration was longer as planned. In general, the interviewees consider the project to be a success from a quality perspective even though there are performance problems meaning that users complain about a delay when working with the system. These problems could not be solved entirely and were present in the period when the online survey was conducted. The necessary development in the project was managed with a waterfall approach.

Users representing three different sites of the company were part of the project team and thus participated in the project. The project started with a kick-off workshop to discuss the general requirements of the users. After this workshop, the project manager prepared the specification book mostly on his own. In this phase, he communicated with single affected users to get information regarding the requirements. All requirements were presented and discussed with the users at the end of this project phase. Based on the specification book the software vendor extended the standard software and created a prototype that covered about 70 percent of the requirements. This prototype was used to develop the final solution in several iterations further. Although the users had the chance to give feedback and could access the prototype, the development was mostly done in alignment between the external software vendor and the internal IT department, implying that users were seldom participating. After the product has been finished, there was a testing phase with several additional users to the ones belonging to the project team. Furthermore, before the system went live for all users, a pilot department got the software earlier and worked with it to ensure that everything works properly. Before the go-live, all users got a training.

The users of DMS rather see the software as a burden than as personally important and relevant. Especially, in the first weeks after go-live, it was seen as a great burden. According to the project manager, many users would prefer to work like before. The new solution is less flexible and there still are performance problems. Especially the latter is annoying for the users as it could not be solved despite several attempts. However, many users at least also see the advantages of the software. The motivation of the users in the project team has varied. According to the interviewed user, some users were glad to be part of the project team and were interested in creating a good solution, while others were engaged in other projects and thus were not that motivated and missed many project meetings.

**Case Money**

The software Money was developed and implemented in a bank that is a public enterprise. The project was to replace an old application and was part of a large-scale project to replace all host applications. Money is a completely in-house developed solution that contains functions to calculate prepayment penalties. The 100 users mainly employ it if a customer wants to pay back a loan before the end of the contract duration, wants to make a special redemption payment, or requests a change of conditions. While the main functions are the same, several functions are slightly different for different departments due to varying requirements depending on the type of application area, for instance, consumer credit or mortgage. The goals of the project were clearly defined, as there is a process that is always conducted before a project starts. For

instance, the project includes a project proposal, basic concept, and clearly defined goals and non-goals. While it was the general goal to substitute all necessary functions of the old system, it was also analyzed which functions were not required anymore and could thus be excluded.

The core of the project team consisted of four members of the IT department and five persons of different departments using the software. In addition to the development using the agile method SCRUM, testing was done in parallel without an agile approach. To integrate the two tracks, one project member was included in both teams to communicate the results of testing and to decide what should be added to ongoing sprints. According to the interviewed persons, the project is considered as a success. While costs and quality were in line with the project plan, the go-live was delayed for about three months due to two other technical release cycles.

The degree of user participation was high throughout the project. The legacy system had been used as template based on which the requirements were discussed in the project team. Especially, one user who is responsible for all special cases and thus knows all the cases of the different departments and one user of the department mostly using the system, had been participating a lot and were able to influence decisions regarding the whole system. Based on the requirements, a prototype with all main functions had been developed that was used to further discuss the requirements with the users and thus to analyze how users proceeded, what the interface should look like and which sub-screens should be created. In this phase, even more users participated and the system was developed further in several iterations. Each time a sprint was completed; the system was presented to users and discussed with them. The interviewed project member stated that the completed system at the end looked fundamentally different in comparison to the first prototype. While testing had generally been done continuously, two test phases with workshop character, including ten users, and each lasting two to three days were conducted to test the most important cases. Before go-live, the users received a handbook and a presentation document, but no training was conducted. Furthermore, the users who participated in the project served as first contact persons if users had problems or questions.

Regarding user involvement, users were not excited in the beginning that a new system was introduced as other systems had been recently introduced and they still had to learn how to work with these systems. Furthermore, they were used to the old system and did not require a new system to do their work. However, the users knew that it was necessary to substitute the old system for technical reasons. Moreover, all users were continuously informed about the project. For instance, they were informed by their managers and via the intranet. The interviewed project member stated that she had several conversations with future users in which she tried to counteract possible reservations. According to the interviewees, the users mostly perceived the system in a positive way at the end of the project and the project team received positive feedback about MONEY. Moreover, the users regard the software to be personally important as it helps them to calculate the prepayment penalties.

**Case TicketRep**

TicketRep is a software that has been implemented in a large insurance corporation. It is a reporting tool that is used by the first-level IT support to get information about malfunctions reported by users of different software systems. In the organization, several systems are used to process user tickets whereby even for single cases often several systems are involved. First outsourcing and then partly recalling the decision by bringing back parts of the first level support caused this situation. Before TicketRep has been implemented, it was difficult to get information about the current progress of specific tickets. It was especially not possible to track their status across different systems without querying every single system. Therefore, in case a user wanted to know the status of a ticket, it was difficult to provide the required information. In order to overcome these problems and to provide reporting functionalities across all helpdesk systems, TicketRep has been introduced. The implemented software is a standard reporting system that has been customized and extended by further comprehensive developments to match the needs of the company.

The project was completely done in-house, implying that no external company was involved. This was possible as the company already used the standard software for other purposes and thus due to prior experience the software vendor was not required to take part in the project. TicketRep has about 100 users of which a small number made up the project team together with six employees of the IT department responsible for customization and further development of the software. While the actual costs of the project did not exceed the planned costs, the go-live was delayed for some months. At the time the interviews were conducted, the interviewees could not make a final statement about the quality, as the system recently went live and thus they did not get any feedback from the users yet. However, they were optimistic that the project would also be a success from a quality point of view. As the users should have used the software for some time before judging the system, the online survey was conducted some weeks after the interviews. The overall approach to development in the project can be classified as a mix of waterfall and agile project management elements.

There was a workshop with all project members including the users at the beginning of the project. In this workshop, the requirements for the future software were gathered. Afterwards, the IT project members consolidated the requirements in a document that was sent to the users who could add further points. The next step, the evaluation of different software solutions that came into question for the designated purpose, was done without the participation of users. After the tool was chosen, it was presented to the users, but they did not have the chance to influence the decision at this point in time. In the next phase, the software was adjusted to the needs of the company. Various prototypes were developed in several iterations based on which further requirements were discussed with the users. According to the project manager, users could comprehensively influence decisions in this phase. After the preliminary software version had been completed, there was a field test with various users who had the chance to work with the system and to give feedback. Subsequently, 20 pilot users were chosen who worked with the system in the productive envi-

ronment. Before go-live, the users got a documentation for the system. Furthermore, online training sessions were offered for key users of the software. According to the project manager, training that is more comprehensive was not required as the users of the software are IT personnel.

The users were highly involved, as they knew that the tool would simplify the ticket reporting. Moreover, the tool only provides additional benefits without extra effort and its usage is voluntary. Therefore, the basic attitude of the users towards the system has been positive from the beginning and no measures had to be taken to convince the users.

**Case CorporateWiki**

In the case of CorporateWiki a standard intranet software was chosen, customized, and implemented in a large utility company. It was the goal to change the intranet from a pure information display to a social platform. The software would allow social collaboration among workers and easier provision of information. Management expected leaner processes, improved communication and an enhanced company culture from the implementation of a social intranet. The legacy intranet system was rather complex and could therefore not be handled by non-technical employees.

The project was executed in an adapted waterfall approach. In the beginning, requirements were collected by the project manager with the management and media team that would run the system and provide the content on it. Subsequently, the organization chose a standard software, which met about 90% of the requirements. In the preparation of the customization, the project manager talked to the team-leads of the different departments in the company. He also coordinated the developers' efforts in the customization phase. An iterative approach was chosen by showing intermediate results to the team-leads and adapting to their feedback. This was followed by a sequential go live. First, a pilot group started to work with the system before it was implemented in the whole company. The pilot group was one service department. They gave feedback on functionality and usability of the system and the project manager considered this feedback and initiated necessary adaptations. The full implementation of the new intranet was communicated to the employees by the management. A competition was created to motivate them to use the new platform. At the time of our case study research, the intranet was implemented and in use for half a year.

There are two different groups of users of CorporateWiki. 90% of the employees of EnergyServ are working in the service department. The remaining part works in other positions such as software development or sales. However, user participation during the implementation process was confined to the team-leads of the service workers, who were part of the pilot group for the project. While they participated in the project, they were not really involved because the two main features of CorporateWiki had no immediate benefits for them. They did not require and do not use a social collaboration feature or information provision feature of CorporateWiki. Furthermore, the service workers can also be divided up into two groups: in-house workers and travelers. The travelers have a different situation to the in-house workers as they are working di-

rectly at the customers' sites. This user group was not included in the pilot group. Additionally, the remaining ten percent were not part of the pilot group. Thus, the participating users did not represent all potential future end users.

No users were participating in the selection process of the standard software. During a belated phase of requirements gathering and analysis, the project manager collected input from some team-leads in the service department. During development the users were asked to give feedback to ideas and implemented features, thus there was consultative user participation. Initially, the software was exclusively implemented for the pilot group. During the implementation and testing phase, some users participated through participation of trainings and by writing change requests. The level of user involvement differed per group. Workers who were not in the service-team seemed to be highly involved, especially the interviewed users. They understand the system and actually benefit from the systems' capabilities such as social collaboration, knowledge sharing and file storing. Users, who were pilot users, were also particularly involved in the project and more active users of the system overall, once it was fully operational. This highlights the relationship of participation and involvement. However, most service workers did not see the CorporateWiki as important or necessary for them and were therefore not involved.

**Case ChemLawTool**

The development of ChemLawTool was motivated by the new European chemical law REACH. REACH forces our case company ChemCompany to register chemicals and manage them securely. ChemLawTool is a task management tool, which helps to create, assign and execute the tasks necessary to comply with REACH. ChemCompany employees are used to this kind of software and the users of ChemLawTool also used a legacy system with similar features like ChemLawTool. There are about around a hundred users working with the tool, who can be differentiated in three user groups. One group manages project data, another group uses the tool for controlling, and the managers create and analyze reports.

At the beginning of the project, the project lead collected the requirements together with his superior based on the new law and a previous tool. Subsequently, the project lead on the customer side checked the market for standard software together with his superior and future users. As no standard software fulfilled all requirements, they decided to request a custom-made software from an IT and service-providing subsidiary of ChemCompany. Although both companies act as if they are separate companies and employ a classical supplier-customer relationship, this relationship is exclusive, which means the supplier has no competitive pressure and the customer has no possibility to choose another supplier. During the course of the project, the initial project lead became the commercial project manager while a technical project manager on the supplier side was elected. A single-point-of-contact-approach was implemented, which means the team on the customer side communicated with the team on the technical site only via the project managers on both sides. A waterfall model was used as a product development approach. The project took about one year to be finished.

The commercial project manager who himself is a future user of ChemLawTool was the only user who participated over the course of the project. He finalized the requirements and tested the software after the completion of the development. Thus, he participated in the project during all but the development phase in a consultative role. A broad group of users only participated in the implementation phase as they gave feedback and initiated some late change requests. Substantial changes were not possible at this point, especially because as the law came into effect at a specific point of time, which made being on time a priority. Furthermore, the commercial project manager as the only involved user was biased in his assessment of ChemLawTool by his responsibility for a project plan and alignment with the project budget. The involvement of the commercial project manager was high, as the software was his "baby" (Commercial Project Manager, ChemCompany). However, the other users were not involved or motivated at all. The project was only communicated to them once. Using it is a legal requirement for the operating license of the company and therefore all potential users have to use the software. Even this existential element for use did not increase their involvement.

# Appendix E: Items and Cluster Analysis ASU Replication

**Personal Innovativeness (PIIT)**

(adapted from Agarwal and Karahanna 2000)

Please indicate to what extent you agree with the following statements about that incident you reported. (7-Point Likert scale from 1 = strongly disagree to 7 = strongly agree)

PIIT1: If I heard about a new information technology, I would look for ways to experiment with it.
PIIT2: In general, I am hesitant to try out new information technology *(reverse coded; dropped)*.
PIIT3: Among my peers, I am usually the first to try out new information technologies.
PIIT4: I like to experiment with new information technologies.

**Facilitating Conditions (FCOND)**

(adapted from Venkatesh et al. 2003)

During that incident reported above... (7-Point Likert scale from 1 = strongly disagree to 7 = strongly agree)

FCOND1: I had the resources necessary to change.
FCOND2: I had the knowledge necessary to change.
FCOND3: A specific person (or group) was available for assistance for that change *(dropped)*.

**Triggers**

(adapted from Sun 2012)

Please indicate to what extent you agree with the following statements about that incident you reported. (7-Point Likert scale from 1 = strongly disagree to 7 = strongly agree)

*New task (NT):*
NT1: My task changed (e.g., I had a new task).

*Changes in system environments (SE):*
SE1: The system environment of Excel in my organization changed.
SE2: Our Excel was being upgraded.
SE3: The peripheral facilities (e.g., printers, copiers, and scanners) changed in my organization.
SE4: I used different versions of Excel.

*Other people's use (OU):*
OU1: I saw other people's use of that feature.
OU2: Someone showed me a new feature.
OU3: Someone showed me a new way of using a feature I knew.

*Discrepancy (DP):*
DP1: Some Excel features did not work as I thought.
DP2: There were discrepancies between what I expected and what I found out in terms of the features in Excel.

*Deliberate initiative (DI):*
DI1: Somebody asked me to use certain features.
DI2: I was forced by others to change.

**Adaptive System use (ASU)**

(adapted from Sun 2012)

Please indicate to what extent you agree with the following statements about that incident you reported. (7-Point Likert scale from 1 = strongly disagree to 7 = strongly agree)

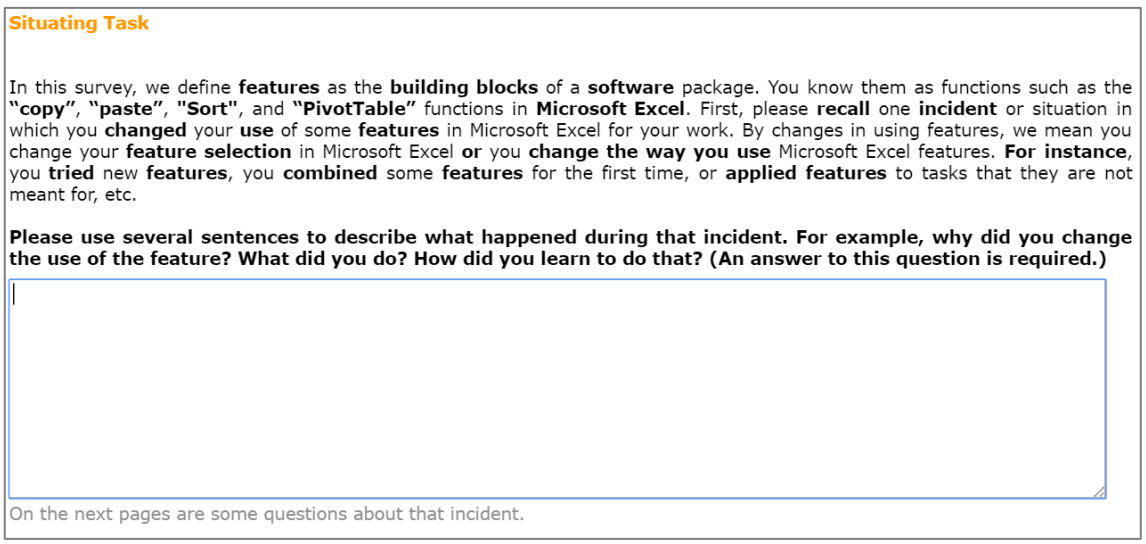
*Trying new features (TR):*
TR1: I played around with features in Excel.
TR2: I used some Excel features by trial and error.
TR3: I tried new features in Excel.
TR4: I figured out how to use certain Excel features.

*Feature substituting (FS):*
FS1: I substituted Excel features that I used before.
FS2: I replaced some Excel features with new features.
FS3: I used similar Excel features in place of the features at hand.

*Feature combining (FC):*
FC1: I generated ideas about combining features in Excel that I was using.
FC2: I combined certain features in Excel.
FC3: I used some features in Excel together for the first time.
FC4: I combined features in Excel with features in other applications to finish a task.

*Feature repurposing (FR):*
FR1: I applied some features in Excel to tasks that the features are not meant for.
FR2: I used some features in Excel in ways that are not intended by the developer.
FR3: The developers of Excel would probably disagree with how I used some features in Excel.
FR4: My use of some features in Excel was likely at odds with its original intent.
FR5: I invented new ways of using some features in Excel.
FR6: I created workarounds to overcome Excel's restrictions.

## The Situating Task



## Cluster Analysis

Similar to the work of Sun (2012), we conducted a two-step approach to perform the cluster analysis. The cluster analysis serves to classify cases of the overall study (in this study 281 cases) into groups being as homogenous as possible within each group, but as heterogeneous as possible among the different groups. In the first step, we performed a *hierarchical* cluster analysis using SPSS (version 23) to identify the number of clusters. Like Sun (2012), we used the Ward's minimum variance method for cluster formation and Euclidean distances as the similarity measure. Finally, a three-cluster solution seemed to result in meaningful pattern. In the second step, we conducted a *K-means* cluster analysis where we defined the *K* value to be three. The ANOVA indicated significant differences among the three identified clusters (see Table E1).

Table E1. ANOVA Results of the Three Clusters

| | **Mean Square Cluster** | **Mean Square Error** | **F** | **Significance** |
|---|---|---|---|---|
| **Novel Situation** | 42.419 | 0.908 | 46.738 | .000 |
| **Discrepancies** | 284.693 | 0.982 | 289.86 | .000 |
| **Deliberate Initiative** | 204.356 | 1.193 | 171.278 | .000 |

Based on the cluster analysis, we were able to analyze the degree of differentiation of each cluster to the other ones based on the triggers. Table E2 summarizes the results by presenting the means, standard deviations and the differentiation tests.

Table E2. Cluster Center and Comparison

| | **Mean (S.D.) of Cluster Groups and Patterns of Triggers** | | | **Significant Contrast Values (Bonferroni tests)** |
|---|---|---|---|---|
| | Cluster 1 (n = 146) | Cluster 2 (n = 59) | Cluster 3 (n = 76) | |
| **Novel Situation** | 4.28 (0.84) high | 4.19 (1.02) high | 3.02 (1.09) low | 1-2$^{***}$; 1-3$^{***}$; 2-3 (n.s.) |
| **Discrepancies** | 4.79 (0.97) high | 2.10 (0.82) low | 1.83 (1.13) low | 1-2 (n.s.); 1-3$^{***}$; 2-3$^{***}$ |
| **Deliberate Initiative** | 3.92 (1.25) high | 4.22 (1.19) high | 1.30 (0.56) low | 1-2 (n.s.); 1-3$^{***}$; 2-3$^{***}$ |
| $^{***}p < 0.001$; n.s.: not significant | | | | |

In two clusters, we came to the same results as Sun (2012). We also identified one cluster, which can be referred to as intensive triggering. This cluster is characterized by high levels of all three ASU triggers and contains (as in Sun's work) the most cases (n = 146). Another cluster – also identified by Sun (2012) – is the cluster of non-intensive triggering characterized by low levels of all triggers (cluster 3). Only, the characteristics of cluster 2 differ from Sun's (2012) results. While Sun identified a cluster, he named discrepancy triggering and which has only a high level of the trigger discrepancy, we identified a cluster having high levels of novel situation and deliberate initiative. Due to the differing results, we conducted a two-step

clustering analysis as provided by SPSS (version 23), which combines the two steps conducted by Sun (2012) (meaning combination of *hierarchical* and *k-means* clustering approach). The two-step clustering resulted in two categories, namely the intensive triggering conditions and the non-intensive triggering conditions (see Table E3).

Table E3. Cluster Center and Comparison

| | Mean (S.D.) of Cluster Groups and Patterns of Triggers | | t values |
|---|---|---|---|
| | Cluster 1 (n = 151) | Cluster 2 (n = 130) | |
| Novel Situation | 4.47 (0.73) - high | 3.28 (1.11) - low | 10.79*** |
| Discrepancies | 4.45 (1.21) - high | 2.23 (1.48) - low | 13.87*** |
| Deliberate Initiative | 4.31 (1.03) - high | 2.07 (1.34) - low | 15.79*** |
| ***p < 0.001 | | | |

As stated by Sun "a potentially thorny but essential issue in cluster analysis is the selection of the number of clusters" (2012, p. A8). Thus, the existence of a third cluster remains questionable. Therefore, our remaining cluster analysis refers to the clusters of high and non-triggering conditions. Based on the two identified clusters, we performed in the next step independent samples t-tests to test differences in ASU. The analysis revealed that – similar to Sun's (2012) results – the means of trying new features did not significantly differ between the groups. Thus, this first-order sub-construct of ASU seems to have no impact on the characteristics of the two clusters (see Table E4).

Table E4. Adaptive System Use in Different Triggering Conditions

| | Mean (S.D.) of Cluster Groups | | t values |
|---|---|---|---|
| | Cluster 1 (n = 151) | Cluster 2 (n = 130) | |
| Trying new features | 5.69 (1.10) | 5.47 (1.43) | 1.42 (n.s.) |
| Feature substituting | 4.61 (1.13) | 3.86 (1.73) | 4.32*** |
| Feature combining | 4.76 (1.17) | 3.92 (1.77) | 4.77*** |
| Feature repurposing | 3.67 (1.40) | 2.23 (1.37) | 8.72*** |
| ***p < 0.001; n.s.: not significant | | | |

# Appendix F: Exploratory Factor Analysis of First Set of Items

Table F1: Results for EFA Pattern Matrix Panel Data

| | 1 | 2 | 3 |
|---|---|---|---|
| RF5 | ,918 | -,017 | ,058 |
| RF2 | ,913 | ,035 | ,017 |
| RF6 | ,911 | ,025 | -,024 |
| RF1 | ,892 | ,020 | ,045 |
| RF4 | ,873 | ,059 | -,048 |
| RF3 | ,831 | ,115 | ,024 |
| IA5 | -,112 | ,983 | ,030 |
| IA6 | -,065 | ,969 | -,028 |
| IA4 | ,015 | ,854 | ,081 |
| IA3 | ,233 | ,782 | -,074 |
| IA2 | ,221 | ,763 | -,050 |
| IA1 | ,192 | ,715 | ,015 |
| TI2 | -,108 | -,026 | ,912 |
| TI1 | ,020 | ,064 | ,818 |
| TI6 | ,160 | -,107 | ,793 |
| TI5 | ,131 | -,116 | ,764 |
| TI4 | -,044 | ,014 | ,757 |
| TI3 | -,078 | ,238 | ,740 |

Table F2: Results for EFA Pattern Matrix BANK Data

| | 1 | 2 | 3 |
|---|---|---|---|
| IA2 | ,961 | -,069 | -,004 |
| IA5 | ,954 | ,001 | -,079 |
| IA1 | ,936 | -,080 | ,064 |
| IA6 | ,936 | ,035 | -,146 |
| IA3 | ,890 | ,009 | -,017 |
| IA4 | ,707 | ,187 | ,067 |
| RF1 | -,165 | 1,061 | -,202 |
| RF2 | -,065 | 1,029 | -,121 |
| RF3 | ,050 | ,819 | ,103 |
| RF5 | ,223 | ,744 | ,004 |
| RF4 | ,148 | ,655 | ,103 |
| RF6 | ,269 | ,638 | -,053 |
| TI3 | ,313 | ,411 | ,297 |
| TI4 | ,211 | ,385 | ,302 |
| TI2 | -,080 | -,110 | ,993 |
| TI5 | ,049 | -,305 | ,914 |
| TI6 | -,149 | ,163 | ,815 |
| TI1 | ,082 | ,184 | ,694 |

# Appendix G: Item Development Process[1]

**Construct conceptualization:** It is the first step of the procedure suggested by MacKenzie et al. (2011) to develop a conceptualization of the constructs. This step is not only important to avoid trouble during the validation phase (MacKenzie et al., 2011), but also useful in crystallizing one's conceptual model (Clark & Watson, 1995). First, MacKenzie et al. (2011) recommend to examine how a construct has been used in prior research or by practitioners. For effective use (EU), we initially adapted Burton-Jones' and Grange's (2013) conceptualization of the EU constructs. Subsequently, we identified the type of *property* the construct represents and the *entity* to which it applies for each construct (MacKenzie et al., 2011) (Table G1). It is worth mentioning that we adapt the conceptualization of EU dimensions that was originally developed by Burton-Jones and Grange (2013). Originally, they are an assessment of use (i.e., *behaviors*), not as assessments of a system or user (Burton-Jones & Grange, 2013). Therefore, they differ from existing concepts, such as perceived ease of use, which focus on a person's *perception* of their use of an IS (Davis, 1989; MacKenzie et al., 2011).

Table G1: Specification of the Constructs' Conceptual Domain

| Construct Name | | Entity (E) and General Property (GP) |
|---|---|---|
| **Effective Use** | Transparent interaction | E = Person; GP = individual IS usage behavior |
| | Representational fidelity | E = Person; GP = individual IS usage behavior |
| | Informed action | E = Person; GP = individual IS usage behavior |

Furthermore, we evaluated whether a construct had any subdimensions (MacKenzie et al., 2011). Burton-Jones and Grange (2013) originally define EU as an aggregate construct with three hierarchically related subdimensions. Thus, EU also represents a multidimensional construct with three facets *TI*, *RF*, and *IA*. Table G2 lists the definitions of the constructs, their subdimensions and relevant sources.

**Measure development:** After clearly conceptualizing each construct, the next step is the actual generation of items (MacKenzie et al., 2011). Our development of items was informed by the theoretical definitions of the constructs, discussions with global IT department employees of the Building Material Company (BMC) that was the case site for the pre-test, discussions with agent telephony application *AgentDesktop-Web* (ADWeb) users in the customer service centers (CSCs), and exemplary measures for EU constructs provided by Burton-Jones and Grange (2013). In total, we developed 15 items to account for the constructs

[1] This part of the thesis is mainly based on the following work: Gnewuch, U. (2017). The Effect of Learning on the Effective Use of Enterprise Systems - A Mixed-Method Study in Customer Service Centers. University of Mannheim.

presented for this empirical study (see Table 22). The overall number of items is much larger than the presented number because the item development was part of a larger empirical study (Gnewuch, 2017).

Table G2: Construct Definitions

| Construct Definition | | | Sources |
|---|---|---|---|
| Effective use | | The extent to which users are using a system in a way that helps attain the goals for using the system. | Adapted from Burton-Jones and Grange (2013) |
| | Transparent interaction | During interaction with the system, the extent to which a user is accessing the system's representations unimpeded by the system's surface and physical structures. | |
| | Representational fidelity | During interaction with the system, the extent to which a user is obtaining representations that faithfully reflect the domain that the systems represents. | |
| | Informed action | The extent to which a user acts on faithful representations that he or she obtains from the system to improve his or her state in the domain. | |

**Content validity assessment:** After we had generated an initial set of items representing the constructs, we evaluated their content validity (MacKenzie et al., 2011). Content validity has been defined as "the degree to which items in an instrument reflect the content universe to which the instrument will be generalized" (Straub, Boudreau, & Gefen, 2004). To assess content validity, MacKenzie et al. (2011) recommend the variance analysis approach by Hinkin and Tracey (1999) in which individuals are asked to rate the extent to which each item captures each construct domain using a five-point Likert scale. However, Hoehle and Venkatesh (2015) suggest the approach by Anderson and Gerbing (1991) in which raters are only asked to select the most appropriate construct for each item[2]. We followed their advice. To assess content validity,

[2] In order to analyze the results of their approach, Anderson and Gerbing (1991) suggest to compute two indexes from the data: the proportion of substantive agreement (PSA) and the coefficient of substantive validity (CSV). PSA indicates the proportion of respondents who assign an item to its intended construct by using the following formula:

$$PSA = \frac{nc}{N}$$

where *nc* is the number of respondents who assigned the item to its intended construct and N is the total number of respondents. PSA values can range from 0 to 1, with a high value indicating higher agreement that the construct definition represents the respective item (Anderson & Gerbing, 1991). In addition, CSV values were calculated. CSV is the extent to which respondents assign an item to the posited construct rather than to any other construct by using the following formula:

$$CSV = \frac{nc - n0}{N}$$

where *nc* is the number of respondents assigning an item to the intended construct, *n0* is the highest number of assignment of the item to any other construct, and *N* is the total number of respondents (Anderson & Gerbing, 1991). CSV values range from -1 to +1. High

we conducted the assessment in four rounds with different participant groups. To receive as much feedback as possible from a broad spectrum of academic and business backgrounds, the content validity assessment included researchers, BMC employees, students, and participants recruited by a market research firm. Thus, the content validity raters largely reflected the target population (Anderson & Gerbing, 1991; MacKenzie et al., 2011).

We conducted the **first round** with IS researchers (i.e., Ph.D. students, assistant professors, and master's students), to whom we provided a Microsoft Excel spreadsheet with four tabs. The first tab contained the construct definitions and task instructions. The other three tabs represented the actual content validity assessment. Each tab listed the candidate items and provided a drop-down menu to select the best fitting construct for each item. Additionally, the participants could provide feedback on an item in the cell next to it. The primary purpose of this round was to explore the general suitability of the initial items and to check whether the wording of the items could be understood by IS researchers. We experienced that respondents had considerable difficulties in grappling and differentiating the newly developed items for the concepts.

Hence, we adapted the problematic items and conducted a **second round** with employees of BMC. We invited the participants via email. The email included instructions and a link to the content validity assessment, which was implemented using an online survey software[3]. We provided definitions of the constructs and subdimensions on the top of each page. We asked participants to assign items to the best fitting construct by selecting it in a drop-down menu. After carefully reviewing problematic items, we dropped or modified several of them.

In the **third round**, we asked students to evaluate the item pool that we had modified based on the previous assessment. We invited them to participate in the content validity assessment via social media (i.e., instructions and links were posted in Facebook groups of several large German universities). To incentivize potential participants, we raffled coupons for a fashion retail shop. We used the same online survey software as in round two, albeit with refined items. Once more, we critically analyzed and reworded the problematic items. Due to the fact that the majority of items performed very well, we decided to conduct a final content validity assessment with potential IS users.

For our **fourth** content validity assessment, we worked with participants recruited by a market research firm. We instructed the market research firm to provide a sampling frame (approximately 400 participants)

positive values suggest that an item was primarily assigned to its intended construct (Anderson & Gerbing, 1991). According to Anderson and Gerbing (1991), the minimal cut-off value for a good survey item is 0.6 for PSA and 0.5 for CSV. This indicates that at least 60% of all raters have assigned an item to its intended concept and that the item was not closely associated with any other construct.

[3] Questback Unipark: https://www.questback.com/de/questback-unipark

that matched the characteristics of typical organizational IS users in the United Kingdom, to avoid issues with a potential language barrier. Furthermore, we applied the following criteria regarding demographics: age 18-65, employed in an office job, and living in the UK. We selected these criteria as we assumed that people with these characteristics probably work with an IS and, therefore, can better relate to the context of the content validity assessment. We conducted this round with a different online card sorting software[4], which provides more usability than the traditional online survey software used for the previous rounds. Participants could sort the items per drag-and-drop to the best fitting construct.

Upon completion, we analyzed all responses according to the following two criteria: First, we removed the responses from unengaged participants who sorted more than 90% of the items into one category. Second, we scrutinized all remaining responses for the duration that the participants took to complete the content validity assessment. This procedure led to 136 usable responses. In general, the items had satisfactory PSA and CSV values. Only some IA and RF items were below the recommended CSV threshold value. Since EU is a complex theory and several constructs, may appear similar, participants seem to have been confused by their definitions. However, many items were very close to the thresholds. We expected these items carefully and, in some cases, re-worded them. Insights from the interviews and talks at BMC were instructive for the modification. Together with the best performing items, we were going to use them for the evaluation in the pre-study. We expected that the items were going to better understood by survey participants at BMC than the generically worded items in the content validity assessment.

**Measurement model specification:** In the first step of the development process, we adopted EU as a multidimensional construct. Therefore, we needed to define the relationships between first- and second-order constructs (Hoehle & Venkatesh, 2015). Burton-Jones and Grange (2013) state that the aggregate level of TI, RF, and IA define one's level of EU. However, a change in a user's level of EU is not necessarily related to a change in all subdimensions (Chin, 1998). For example, users can raise their overall level of EU by improving their ability to take IA. Thus, their increase in EU is related to an increase in their level of IA, whereas the level of RF and TI does not change. Nevertheless, we stuck with conceptualization of EU as defined by Burton-Jones and Grange (2013) for the pretest in order to evaluate the understanding of EU behind it.

**Pre-Test:** In parallel to the survey development, we conducted interviews (Bhattacherjee & Premkumar, 2004) with different types of users in different locations and other stakeholders of the implementation project. Additionally, we observed work activities in the customer-service-centers (CSCs) and collected documents, such as user manuals, training material, and process descriptions. For the data collection via interviews, we followed the advice by Myers (2013) and conducted eleven semi-structured interviews with different types of users in two different locations in Germany and other stakeholders of the implementation project (see Table G3).

[4] OptimalSort: https://www.optimalworkshop.com/optimalsort

Table G3: Interviews Partners

| Area | Department / Organization | Job title | # of Interviews |
|---|---|---|---|
| Business | Customer service center | Agent | 4 |
| | Customer service center | Supervisor | 2 |
| | Logistics | Head of logistics | 1 |
| IT | Global IT: Infrastructure | Lead architect | 1 |
| | Local IT: Infrastructure | Support staff | 1 |
| | Local Business IT | Change manager | 1 |
| 3rd Party | Implementation partner | Senior consultant | 1 (via phone) |
| | | | Total: 11 |

As illustrated in Table G3, we selected participants with different backgrounds. Therefore, it was possible to account for different views of the overall implementation project, but also for learning processes of different users. Additionally, this addresses the elite bias as employees of different status within the organization were interviewed (Myers, 2013). The interviews varied in length from 20 minutes to one hour. With the exception of the phone interview, we tape-recorded and subsequently transcribed all interviews. We took notes during the phone interview and wrote a transcript from memory shortly afterwards. We also observed the agents' work activities and engaged with people to understand their activities and beliefs in the form of participant observation (Myers, 2013). We observed five agents for 30 to 120 minutes and took field notes during observation. Furthermore we collected documents, such as ADWeb user manuals, training material, and project plans. Additionally, we studied service desk tickets to provide insight into the communication between users and support staff. Our main goal in this qualitative effort was to fully understand the use context and to properly fit the developed items to the context. Furthermore, it enabled us to identify the fit of theoretical assumptions for item development and the developed items and therefore makes use of quantitative and qualitative methods in a complementary manner (Venkatesh et al., 2013). In our final study (see section 4.3.3), we did not conduct individual interviews and instead discussed the items developed in the pre-study with user groups, works council and key users several times to iteratively develop items that actually capture the theoretical concept developed above.

We developed a survey instrument including instructions, after we had developed the measures for all new constructs and formally specified the measurement model. For our pre-test, we examined learning and EU of the agent telephony application *AgentDesktop-Web* (ADWeb) which is used by all (CSC) employees and also by employees at BMC's internal support desk. ADWeb not only allows accepting, transferring, and making calls, but also provides very important information for the employee. When an existing customer calls, it displays the caller's name and phone number, which enables the employees to provide a better customer service. Moreover, ADWeb displays real-time information on the number of customers waiting in the queue, number of agents available, and the length of the current call. Employees are requested to monitor this information and to react if, for example, there are many customers waiting in the queue (i.e., end the current call as soon possible in order to be available for the next customer). The global IT department provides system documentation and several user manuals.

Table G4: Demographics of Pre-Test

| Demographic | Category | n=48 | % |
|---|---|---|---|
| **Age** | <25 | 10 | 21% |
| | 25-34 | 17 | 35% |
| | 35-44 | 11 | 23% |
| | 45-54 | 4 | 8% |
| | >54 | 6 | 13% |
| **Gender** | female | 25 | 52% |
| | male | 23 | 48% |
| **Education** | Less than High School / Grammar school / Secondary school | 1 | 2% |
| | High School / Grammar school / Secondary school | 16 | 33% |
| | Some College/University | 12 | 25% |
| | Bachelor's degree | 11 | 23% |
| | Master's degree | 8 | 17% |
| **Work Experience** | <1 | 9 | 19% |
| | 1-2 | 11 | 23% |
| | 3-5 | 13 | 27% |
| | >5 | 15 | 31% |
| **Position** | Agent | 29 | 60% |
| | Supervisor | 3 | 6% |
| | other | 16 | 33% |
| **Main job responsibilities (more than one option possible)** | Order intake | 15 | 31% |
| | Dispatching | 13 | 27% |
| | Supervision of agents | 3 | 6% |
| | Other | 19 | 40% |
| | Support (e.g. IT or SSC) | 11 | 23% |

We selected the items with the highest PSA and CSV and tailored them towards ADWeb and consulted BMC employees, and a language expert on the instructions and the survey design and structure. Based on their feedback, we removed some items reduce complexity and we slightly modified the instructions. Subsequently, we sent the survey to all employees in several CSCs of BMC in Europe: (1) a medium-sized CSC in the UK, (2) a small CSC in Poland, (3) a small CSC in Belgium, and (4) a small CSC in Germany. In addition, we controlled for participant characteristics (see Table G4). Our survey was based on item on a five-point Likert scale. We collected 55 responses in total and we scrutinized all responses for the duration that the participants took to complete the survey. Unengaged respondents who took too little time and/or did not correctly answer reverse-coded items (e.g., TI1) were excluded from the sample. This procedure led to 48 usable responses.

**Scale Purification and Refinement:** For our scale validity assessment, we selected PLS-SEM, specifically SmartPLS 3.0 (Ringle et al., 2015), which has been suggested for this application (Hair et al. 2011). First, it was not possible to conduct an appropriate exploratory factor analysis (EFA) to test the measurement model for unidimensionality because of the ratio of the number of items and the sample size. Second, we assessed internal consistency reliability using both Cronbach's alpha (CA) and composite reliability (CR). The results in Table G6 present satisfactory values for CA (i.e., CA > 0.7) and CR (i.e., CR > 0.7) (Nunnally & Bernstein, 1994). CA values ranged from 0.79 to 0.95, whereas CR values ranged from 0.85 to 0.97. Table G5 shows that all items but TI1 loaded highly on their parent constructs (i.e., loadings > 0.7), thus supporting indicator reliability (Chin, 1998). As illustrated in Table G6, the analysis of convergent validity

yielded AVE values well above the suggested threshold value of 0.5 for all constructs (Fornell & Larcker, 1981). Discriminant validity assessment showed that the loadings of all items were higher for its designated construct than for any of the other constructs (Table G6).

Table G5: Item Loadings Pre-Test

| | TI | RF | IA |
|---|---|---|---|
| **TI1** | 0.44 | -0.07 | 0.07 |
| **TI2** | 0.85 | 0.46 | 0.56 |
| **TI3** | 0.92 | 0.62 | 0.75 |
| **TI4** | 0.92 | 0.54 | 0.67 |
| **RF1** | 0.47 | 0.88 | 0.73 |
| **RF2** | 0.49 | 0.84 | 0.74 |
| **RF3** | 0.40 | 0.84 | 0.71 |
| **RF4** | 0.64 | 0.92 | 0.89 |
| **IA1** | 0.57 | 0.80 | 0.92 |
| **IA2** | 0.65 | 0.66 | 0.84 |
| **IA3** | 0.58 | 0.86 | 0.88 |
| **IA4** | 0.75 | 0.79 | 0.88 |

However, some items exhibit significant cross-loadings on other constructs (i.e., greater than 0.7) (Chin, 1998). This particularly affects items for RF and IA (e.g., IA4). The concern that parts of the measurement model lack discriminant validity is enhanced by the results of an assessment of the Fornell-Larcker criterion (Fornell & Larcker, 1981). We highlight the violation in Table G6. This indicates inadequate discriminant validity for the EU dimensions RF and IA.

Table G6: New Items with results from Reflective Measurement Model Assessment of Pre-Test

| **Constructs** | | **CA** | **CR** | **AVE** | **TI** | **RF** | **IA** |
|---|---|---|---|---|---|---|---|
| **EU** | **TI** | 0.81 | 0.88 | 0.65 | **0.81** | | |
| | **RF** | 0.89 | 0.93 | 0.76 | 0.58 | **0.87** | |
| | **IA** | 0.90 | 0.93 | 0.77 | 0.72 | 0.89 | **0.88** |

The second step in the PLS-SEM analysis was to assess a potential formative measurement model. We used the bootstrap resampling technique (5000 resamples) to determine the significance of the formative indicators which represent the subdimensions of the multidimensional constructs (Hair et al., 2011). As shown in Table G7, the weights of all formative indicators were significant, thus supporting **indicator validity** (Chin, 1998). However, RF (4.95) and IA (6.83) exceed the threshold of 3.3 for multicollinearity (Petter, Straub, & Rai, 2007) indicating multicollinearity between these EU dimensions. As shown in Table A6, there are significant interconstruct correlations between the formative indicators of the second-order constructs EU (i.e., greater than 0.7) (Bruhn, Georgi, & Hadwich, 2008; MacKenzie, Podsakoff, & Jarvis, 2005). The EU

dimensions are strongly correlated (i.e., TI and IA: 0.72 and RF and IA: 0.89). This result indicates inadequate **construct validity** for the second-order constructs effective use.

Table G7: Results of the Formative Measurement Model Assessment

| Second-order Construct | First-order Construct | Weight | Significance | VIF |
|---|---|---|---|---|
| **Effective use** | TI | 0.268 | $p < 0.01$ | 2.16 |
| | RF | 0.407 | $p < 0.01$ | 4.95 |
| | IA | 0.417 | $p < 0.01$ | 6.83 |

In summary, the initial assessment of both the reflective and formative measurement model revealed issues in the measurement of effective use. Thus, we identified problematic items with low validity, low reliability, strong and significant measurement error covariances, and/or strong and significant cross-loadings and consider their redesign or elimination from the measurement model (MacKenzie et al., 2011).

In our search for the reasons for the complications of the operationalization, we identified two main factors that play a pivotal role in the operationalization of the theory of EU. The study context and the abstract nature of the theory of EU. Furthermore, we also decided to focus in our research on the relationship of the sub-dimensions of EU. According to Burton-Jones and Grange (2013), the theory of EU refers to ISs in very broad terms, and not only to ESs (i.e., complex, enterprise-wide ISs) specifically. Using the IS categorizations by McAfee (2006) and Borgmann (1999), they demonstrate how their theory can be applied to different types of ISs with different levels of complexity (e.g., to less complex ISs, such as word processors, and to more complex ISs, such as decision support systems). However, it can be argued that in order to *empirically* measure the theory of EU, the system under investigation needs to exhibit a certain level of complexity, so that users who participate in the study are able to understand how the concepts, such as RF and IA, relate to their use of the system. The mere presence of a complex IS, however, is not the only important aspect of the study context. This is due to the fact that users of complex ISs often rely on a limited set of routines with relatively few touch points to these systems, the so called "familiarity pockets" (Yamauchi & Swanson, 2010). Thus, there are less opportunities to assess how users with very small familiarity pockets effectively use a system compared to users who work deeply with it (i.e., use many of its features). Interestingly, this aspect can be linked to the conceptualization of EU which states that EU is not only concerned with a system, but also with the tasks for which it is used (Burton-Jones & Grange, 2013). This is important for an empirical study of EU, as users who perform very simple or highly structured tasks (e.g., entering customer information into a database) are less dependent on their ability to obtain RF and to take IAs. Thus, given the scope of their tasks, they do not need to put much effort into learning and developing larger familiarity pockets. In contrast, other users may need to serve these customers and make personalized offers based on the data that was entered. Therefore, they are much more dependent on their ability to obtain faithful representations in order to take IAs. As a result, they need to build much larger familiarity pockets by learning

how to achieve RF and how to leverage the system's representations. Consequently, it is likely to be easier to measure empirically the distinct EU dimensions when studying users with larger familiarity pockets who perform more difficult and less structured tasks in a complex system.

For example, ERP systems are commonly considered highly complex ISs (Umble, Haft, & Umble, 2003). They offer many different representations of the organization's domain (e.g., customers, suppliers, materials, and orders). Therefore, ERP systems provide many opportunities to investigate empirically whether users are able to obtain faithful representations (e.g., correct order information) and take IAs (e.g., release orders for production). Less complex ISs, however, may provide considerably fewer opportunities to measure EU, even though the theory of EU can still be applied to them on a *conceptual* level. Preliminary support for this proposition comes from the fact that we were able to identify the concept of EU of the ADWeb during work observation and interviews, while the quantitative measurement of the distinct EU dimensions proved to be difficult in the pre-test. In the interviews, several employees highlighted the relatively low complexity of ADWeb as compared to other applications. Moreover, most users had only developed small familiarity pockets regarding ADWeb:

> *"ADWeb is basically self-explaining. You can set your agent status to available, busy, or unavailable. [...] You can transfer calls using ADWeb. It is not too difficult"* (Supervisor 1)

Although ADWeb certainly provides opportunities for obtaining RF and taking IAs its low complexity, along with the fact that many users did not work deeply with it (i.e., small familiarity pockets), might have resulted in the difficulties to distinctively measure the closely related facets of EU.

We figure therefore that further *empirical* measurement of the theory of EU should be therefore be conducted (1) in a context of a rather complex system that is (2) used to perform comprehensive tasks, so that (3) large familiarity pockets need to be developed by its users. Table G8 presents a comparison of the context of the pre-study with the one of a possible future study while taking into account the three elements of use (Burton-Jones & Straub, 2006).

In summary, we concluded that we needed a second data collection effort to understand the interdependencies of the sub-dimensions of EU theory. In our second data collection effort, we incorporated all the learnings from our analysis of the study context and explored the abstract nature of EU theory (see Section 4.3.3). We made sure that we selected a complex system (SAS) that was used comprehensively and partly with unstructured tasks that require deep interaction with the system, and therefore users which had to develop larger familiarity pockets (Yamauchi & Swanson, 2010). Future research can go beyond the analysis of the relationship of sub-dimensions of EU in the main body of this thesis and continue the evaluation of EU as second-order construct.

Table G8: Measuring Effective Use in a Different Study Context

| Element of Use | **Context of Pre-Study** | **Context of Full-Study** |
|---|---|---|
| System | • Less complex system (i.e., ADWeb) | • Highly complex system (e.g., ERP or CRM system) |
| Task | • Mainly simple tasks (e.g., making and accepting calls, setting agent status, etc.) | • Comprehensive and less-structured tasks that require significant interaction with the system |
| User | • Mainly users with small familiarity pockets | • Users with large familiarity pockets |

# Appendix H: Other Final Survey Items

Table H1: Measures Perceived Ease of Use

| Construct | ID | Item | Source |
|---|---|---|---|
| Perceived Ease of Use | PEOU1 | My interaction with the system is clear and understandable. | Adapted from: (Davis, 1989; Venkatesh & Davis, 2000) |
| | PEOU2 | Interacting with the system does not require a lot of my mental effort. | |
| | PEOU3 | I find the system to be easy to use. | |
| | PEOU4 | I find it easy to get the system to do what I want it to do. | |

Table H2: Measures Information Quality

| Construct | ID | Item | Source |
|---|---|---|---|
| Information Quality | InfQ1 | The [system] provides the precise information that I need. | Adapted from: (Sasidharan et al., 2012) |
| | InfQ2 | The [system] provides output that is exactly what I need. | |
| | InfQ3 | The [system] provides me with sufficient information to do my tasks. | |
| | InfQ4 | The [system] has errors in the program that I have to work around. (dropped) | |
| | InfQ5 | I am satisfied with the accuracy of the [system]. (dropped) | |
| | InfQ6 | The output options (formatting, print type, etc.) of the [system] are sufficient for my use. | |

Table H3: Measures for demographics

| Measures | ID | Item | Source |
|---|---|---|---|
| Demographics | Age | How old are you? | |
| | Gender | What is your gender? | |
| | Education | What is your highest level of education? | |
| | Position | What is your current job position in your organization? | |
| Prior Use Frequency | PUF | How many times during the last work day did you use the [System] to perform an activity? | Adapted from: (Wilson et al., 2010) |
| Prior Experience | PE | How long have you been using the [system]? | Adapted from: (Kim & Malhotra, 2005) |

# Appendix I: Demographics and Descriptive Statistics Final Data Set

Table I1: Demographic and Descriptive Statistics Final Data Set

| Demographic | Category | n=115 | % |
|---|---|---|---|
| **Age** | 18-25 | 33 | 29% |
| | 26-35 | 18 | 16% |
| | 36-45 | 22 | 19% |
| | 46-55 | 31 | 27% |
| | 56-65 | 11 | 10% |
| | approximate avg. | 38 | |
| **Gender** | female | 81 | 70% |
| | male | 34 | 30% |
| **Education** | Basic school | 14 | 12% |
| | Secondary school | 47 | 41% |
| | High school Diploma | 36 | 31% |
| | Bachelor's degree | 13 | 11% |
| | Master's degree | 5 | 4% |
| **Form of Employment** | Full-time | 55 | 48% |
| | Part-time | 60 | 52% |
| **Position** | Sales Clerk | 73 | 66% |
| | Lead Sales Clerk | 17 | 15% |
| | Assistant department head | 9 | 8% |
| | Department head | 2 | 2% |
| | Other | 10 | 9% |
| **Category** | | **Values** | |
| **Work experience with system** | Average of all participants (n=115) in years | 7 | |
| **Average task share with system** | Share of task involving system use in % | 51 % | |
| **Average use frequency** | Incidents of system use last working day (avg.) | 5.16 | |
| **Values for Case Site overall** | | | |
| **Average age user** | | 39 | |
| **Potential Female respondents** | 370/525 | 70% | |
| **Potential Male respondents** | 155/525 | 30% | |

# Appendix J: Analysis of Second Set of Items

Table J1: Results for EFA Pattern Matrix SAS Data (Original Model)

| | 1 | 2 | 3 |
|---|---|---|---|
| RF1 | ,930 | -,051 | ,021 |
| RF2 | ,880 | ,003 | ,012 |
| RF4 | ,874 | ,033 | -,036 |
| RF3 | ,841 | -,036 | ,089 |
| RF5 | ,830 | ,007 | -,132 |
| TI2 | -,054 | ,878 | -,063 |
| TI1 | ,091 | ,795 | -,121 |
| TI3 | -,083 | ,789 | ,085 |
| TI4 | ,054 | ,707 | -,039 |
| TI5 | -,045 | ,702 | ,073 |
| IA1 | -,137 | ,083 | ,893 |
| IA5 | ,005 | -,073 | ,868 |
| IA3 | -,070 | -,137 | ,769 |
| IA2 | ,124 | ,039 | ,714 |
| IA4 | ,267 | ,194 | ,490 |

Table J2: Results for EFA Pattern Matrix SAS Data (Alternative EU Model)

| | 1 | 2 | 3 |
|---|---|---|---|
| InfQ2 | ,873 | -,004 | -,051 |
| InfQ1 | ,867 | -,066 | ,093 |
| InfQ6 | ,836 | -,167 | ,081 |
| InfQ3 | ,793 | -,051 | ,232 |
| InfQ5 | ,598 | ,364 | -,225 |
| InfQ4 | -,411 | -,202 | ,389 |
| IA5 | -,043 | ,872 | -,047 |
| IA1 | ,037 | ,827 | ,006 |
| IA2 | ,052 | ,716 | ,094 |
| IA3 | -,142 | ,708 | ,072 |
| IA4 | -,014 | ,671 | ,168 |
| PEOU1 | ,072 | ,028 | ,833 |
| PEOU3 | ,040 | ,060 | ,831 |
| PEOU2 | -,130 | ,016 | ,803 |
| PEOU4 | ,110 | ,107 | ,741 |

Table J3: Results for EFA Pattern Matrix SAS Data (All Items)

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| PEOU3 | ,927 | ,037 | -,110 | -,003 | ,070 |
| PEOU1 | ,895 | ,053 | -,025 | -,010 | -,088 |
| TI2 | ,793 | -,067 | ,066 | -,060 | ,055 |
| TI1 | ,779 | ,073 | -,113 | -,121 | ,355 |
| TI4 | ,763 | ,087 | -,025 | -,016 | -,205 |
| PEOU4 | ,695 | ,045 | ,109 | ,113 | -,160 |
| PEOU2 | ,658 | -,041 | ,023 | ,074 | -,363 |
| TI3 | ,454 | -,216 | ,408 | ,041 | ,185 |
| RF1 | ,063 | ,924 | -,019 | ,006 | -,024 |
| RF2 | ,070 | ,856 | ,145 | -,033 | -,147 |
| RF4 | ,085 | ,847 | -,041 | -,048 | ,142 |
| RF3 | -,038 | ,787 | ,104 | ,050 | ,106 |
| RF5 | -,086 | ,784 | ,000 | -,111 | ,261 |
| InfQ6 | -,059 | ,079 | ,912 | -,112 | -,102 |
| InfQ1 | ,031 | ,015 | ,880 | -,004 | -,051 |
| InfQ2 | -,087 | ,049 | ,822 | ,044 | ,044 |
| InfQ3 | ,155 | ,110 | ,778 | -,014 | -,101 |
| InfQ5 | -,207 | ,333 | ,374 | ,295 | ,145 |
| IA1 | -,003 | -,187 | ,036 | ,890 | ,167 |
| IA5 | -,066 | -,020 | -,076 | ,884 | ,122 |
| IA3 | -,055 | -,049 | ,025 | ,779 | -,289 |
| IA2 | ,043 | ,092 | ,037 | ,703 | -,001 |
| IA4 | ,296 | ,308 | -,224 | ,536 | ,029 |
| InfQ4 | ,137 | -,226 | ,086 | -,037 | -,796 |
| TI5 | ,357 | -,202 | ,361 | ,020 | ,372 |

Table J4: Item Loadings and Cross-Loadings SAS Data (Original Model)

| | IA | RF | TI |
|---|---|---|---|
| **IA1** | 0,866 | 0,274 | 0,399 |
| **IA2** | 0,839 | 0,428 | 0,359 |
| **IA3** | 0,638 | 0,234 | 0,173 |
| **IA5** | 0,846 | 0,355 | 0,283 |
| **RF1** | 0,388 | 0,928 | 0,200 |
| **RF2** | 0,372 | 0,891 | 0,237 |
| **RF3** | 0,424 | 0,883 | 0,225 |
| **RF4** | 0,332 | 0,869 | 0,239 |
| **RF5** | 0,244 | 0,758 | 0,178 |
| **TI1** | 0,250 | 0,245 | 0,759 |
| **TI2** | 0,266 | 0,148 | 0,805 |
| **TI3** | 0,357 | 0,175 | 0,824 |
| **TI4** | 0,266 | 0,211 | 0,694 |
| **TI5** | 0,350 | 0,181 | 0,757 |

Table J5: Item Loading and Cross-Loadings SAS Data (Alternative EU Model)

| | IA | InfQ | PEOU |
|---|---|---|---|
| **IA1** | 0,875 | 0,424 | 0,349 |
| **IA2** | 0,827 | 0,405 | 0,394 |
| **IA3** | 0,657 | 0,244 | 0,255 |
| **IA5** | 0,837 | 0,350 | 0,274 |
| **InfQ1** | 0,410 | 0,914 | 0,435 |
| **InfQ2** | 0,399 | 0,826 | 0,367 |
| **InfQ3** | 0,429 | 0,919 | 0,543 |
| **InfQ6** | 0,325 | 0,803 | 0,368 |
| **PEOU1** | 0,328 | 0,463 | 0,890 |
| **PEOU2** | 0,236 | 0,268 | 0,705 |
| **PEOU3** | 0,341 | 0,427 | 0,905 |
| **PEOU4** | 0,423 | 0,489 | 0,866 |

# List of Publications and Workshop Submissions during Dissertation Project[1]

**Werder, K., Haake, P., Maedche, A., Schlichter, J., Pappert, G., Bonertz, T., 2014. Usability Readiness of German Software SMEs - Three Segments and their Characteristics, in: Mensch Und Computer, 14. Fachübergreifende Konferenz Für Interaktive Und Kooperative Medien, Interaktiv Unterwegs - Freiräume Gestalten, München, Germany, 31. August - 3. September 2014. Ed.: M. Koch. De Gruyter Oldenbourg, pp. 185–194.**

**Haake, P., Maedche, A., Müller, B., 2015. User Involvement in Enterprise System Implementation Projects – A Configurational Approach. 2015 OASIS Pre-ICIS Work. Fort Worth, TX, USA, December 12th, 2015.**

**Haake, P., Lauterbach, J., Mueller, B., Maedche, A., 2015. The Effect of User Adaptation on the Effective Use of Enterprise Systems. ICIS 2015 Proc. 36th Int. Conf. Inf. Syst. Fort Worth, United States, December 13-16, 2015.**

Haake, P., Morana, S., Schacht, S., Zhou-Hartmann, L., Maedche, A., 2016. Designing an End User Participation and Involvement Assistant for Continuous IS Development. Proc. Int. Conf. Inf. Syst. 2016, December 11-14, 2016, Dublin.

**Gnewuch, U., Haake, P., Mueller, B., Maedche, A., 2016. The Effect of Learning on the Effective Use of Enterprise Systems. Proc. Int. Conf. Inf. Syst. 2016, December 11-14, 2016, Dublin.**

**Haake, P., Schacht, S., Lauterbach, J., Mueller, B., Koegel, C., Maedche, A., 2016. Operationalization and Measurement of the Concept of Effective Use. Proc. 26th Annu. SIGADIT-Workshop, December 11-14, 2016, Dublin.**

**Haake, P., Schacht, S., Mueller, B., Maedche, A., 2017. Enterprise System Renewal - The Divergence Between Perception and Reality. 13. Int. Tagung Wirtschaftsinformatik (WI 2017), St. Gall. Switzerland, 12.02. - 15.02.2017. Ed. J.M. Leimeister.**

**Li, Y., Haake, P., Mueller, B., 2017. Explaining the Influence of Workarounds on Effective Use: The Case of a Supply Chain Management System. ECIS 2017 25th Eur. Conf. Inf. Syst. Guimarães, Port. June 5th-10th 2017.**

**Haake, P., Schacht, S., Mueller, B., Maedche, A., 2017. Unternehmenssoftware "erfolgreich" erneuern - Divergenzen zwischen Wahrnehmung und Realität. HMD Prax. der Wirtschaftsinformatik 54, 375–388.**

[1] All highlighted publications are related to this thesis

# List of Submissions Included in Thesis

Haake, P., Schacht, S., Maedche, A., 2017 Adaptive System Use Revisited – A Methodological Replication. AIS Transactions on Replication Research (TRR), resubmitted after first review.

Haake, P., Burgmaier, M., Eichhorn, K., Kaufmann, J., Schacht, S., Mueller, B., Maedche, A., 2017. Configurations of User Involvement and Participation in Relation to Information System Project Success. International Journal of Project Management, submitted.

Haake, P., Schacht, S., Lauterbach, J., Gnewuch, U., Koegel, C., Mueller, B., Maedche, A., 2017. Operationalization and Measurement of the Concept of Effective Use. Information & Management, submitted.

# Curriculum Vitae (short) – Phillip Haake

| | |
|---|---|
| Associated Ph.D. Student in Information Systems, KIT | Since October 2015 |
| Ph.D. Student in Information Systems, University of Mannheim | Since December 2013 |
| M.Sc. Mannheim Master in Management, University of Mannheim | September 2011 – Dezember 2013 |
| B.Sc. Business Administration, University of Mannheim | September 2008 – June 2011 |
| Alternative Service in lieu of military service, Johanniter Hannover | July 2007 – June 2008 |
| Abitur, Sophienschule Hannover | August 2000 - June 2007 |

# Eidesstattliche Versicherung

gemäß § 6 Abs. 1 Ziff. 4 der Promotionsordnung des Karlsruher Instituts für Technologie für die Fakultät für Wirtschaftswissenschaften

1. Bei der eingereichten Dissertation zu dem Thema *Understanding Effective Use in the Information System (Post-) Implementation Phase* handelt es sich um meine eigenständig erbrachte Leistung.

2. Ich habe nur die angegebenen Quellen und Hilfsmittel benutzt und mich keiner unzulässigen Hilfe Dritter bedient. Insbesondere habe ich wörtlich oder sinngemäß aus anderen Werken übernommene Inhalte als solche kenntlich gemacht.

3. Die Arbeit oder Teile davon habe ich *bislang nicht* an einer Hochschule des In- oder Auslands als Bestandteil einer Prüfungs- oder Qualifikationsleistung vorgelegt.

4. Die Richtigkeit der vorstehenden Erklärungen bestätige ich.

5. Die Bedeutung der eidesstattlichen Versicherung und die strafrechtlichen Folgen einer unrichtigen oder unvollständigen eidesstattlichen Versicherung sind mir bekannt. Ich versichere an Eides statt, dass ich nach bestem Wissen die reine Wahrheit erklärt und nichts verschwiegen habe.

Karlsruhe, den *22.07.2017*

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***Phillip Haake***