What makes "the System" tick? - Explaining Individuals' Adaptation Behavior towards Effective Use in Enterprise System Implementations

Completed Research Paper

Jens Lauterbach
University of Mannheim
Schloss
Mannheim, Germany
lauterbach@es.uni-mannheim.de

Felix Kahrau
University of Mannheim
Schloss
Mannheim, Germany
kahrau@es.uni-mannheim.de

Benjamin Mueller
University of Groningen
Nettelbosje 2
Groningen, the Netherlands
b.mueller@rug.nl

Alexander Maedche
University of Mannheim
Schloss
Mannheim, Germany
maedche@eris.uni-mannheim.de

Abstract

Over the last three decades, research on adoption, implementation, and use of information technology in organizations such as technology acceptance has undoubtedly provided for valuable and important insights. However, there is still a lack of understanding of users' responses to new IT, their adaptation behaviors and associated outcomes such as effective use in organizations. With a critical realist case study and new conceptualization of individuals' adaptation behavior, we studied an Enterprise System (ES) implementation in work systems of a financial services provider. We found evidence for four generic adaptation modes as response to the ES implementation that are based on mechanisms of exploration or exploitation of knowledge, communication and structures of the ES. These modes can be instantiated differently by each individual, leading to different adaptation patterns that drive effective use and work system assimilation and thus can influence benefits from ES.

Keywords: User Adaptation, Effective Use, Enterprise System, Adaptation Behavior, Assimilation, Learning, Work System, Ostensive Aspect, Performances, Artifacts

Introduction

Despite decades of experience, the implementation of Enterprise Systems (ESs) remains challenging for many organizations. Studies on ERP implementations, for example, report that as many as 78% of all these projects underachieve in realizing the benefits initially anticipated; some of them even failing to deliver any benefits whatsoever (Panorama 2013). Nonetheless, benefits such as standardization of IT-enabled value chains, creation of new business capabilities, efficiency gains, and increased productivity (Brynjolfsson and Hitt 2000; Shang and Seddon 2002; Sykes et al. 2014) continue to motivate businesses to engage in ES implementations. However, in order for these benefits to materialize, organizations need to engage in often disruptive and complex renewal or change projects (Andersen 2006). In these, literature suggests that an organization needs to go through organizational adoption and implementation or conversion phases to finally achieve use in post-adoption (Cooper and Zmud 1990; Damanpour and Schneider 2006; Soh and Markus 1995). These projects then challenge not just the organization and its management per se, but each individual employee (Sykes et al. 2014). Consequently, potential sources of failure have shown to be as manifold as the potential benefits: From project failures in pre-adoption, before go-live (Bulkeley 1996; Krotov and Ives 2011), or in post-adoption due to employees' resistance (Kim and Kankanhalli 2009; Lapointe and Rivard 2005; Wen et al. 2011) to unforeseen user adaptation, learning, and reinvention behaviors around the new system (Benbasat and Barki 2007).

Past research has provided rich insights on these user behaviors such as recurring adoption decisions for the technology (Jasperson et al. 2005) or adaptations as response to disruptive IT and their influence on individual outcomes such as system use and performance (e.g., Beaudry and Pinsonneault 2005; DeSanctis and Poole 1994; Elie-Dit-Cosaque and Straub 2011; Jasperson et al. 2005; Sun 2012; Sykes et al. 2009). It has also been found that these behaviors as response to new IT in organizations are drivers for effective use (Burton-Jones and Grange 2013). The definition of effective use suggests that individuals use a system to achieve the goal of successfully performing their work (Burton-Jones and Grange 2013). As soon as they are able to effectively use the system for most of their work performances (Pentland and Feldman 2005), users do not perceive the IT as "out-of–the-order" anymore (Hsieh and Zmud 2006). From an organizational perspective, this leads to assimilation (Saraf et al. 2013) of the new IT, that is, the technology spreads across the organizational work processes and the execution of these processes becomes equally effective (Liang et al. 2007; Purvis et al. 2001; Setia and Setia 2011).

While linking and relating individuals' adaptation behaviors in the post-adoption phase of an IT implementation to effective use seems important, it has been scarcely studied by previous research. Consequently, we suggest that there is still a lack of a deeper understanding of how, when, and why individuals address the challenge of adapting to new IT – such as ESs– towards a state of effective use. Additionally there is a need to understand the cumulative effects on the organization and its work systems that are created through these bottom-up adaptation behaviors towards effective use (Alter 2012; Lucas et al. 2007; Nan 2011; Soh and Markus 1995). In this paper, we present our research that attempts to address this gap by following a critical realist (Mingers 2004; Wynn and Williams 2012) approach and performing an exploratory case study at a financial services provider. The company introduced a new loan management system (LMS) in one of their service units. Based on this study, we intended to answer the following research question:

How and why do individuals' adaptations as response to an ES implementation evolve over time towards effective use for individuals and their work system?

The remainder of this paper is structured into five sections: the *second section* introduces to related work and lays the theoretical foundation for our case study by introducing to the philosophical assumptions of critical realism (CR). Here, we develop a CR conceptualization of adaptation behavior as response to ES. *Section three* describes our CR case study methodology. In *the findings section*, we then unfold the chain of events of our case. This is the basis for our identification of six mechanisms, modes and patterns of individuals' adaptations as response to ES that we derive in *section five.* In *section six* we conclude with a summary as well as a brief discussion of limitations and our contribution.

Related Work and Theoretical Foundation

Individuals' responses to new IT

As discussed above, reasons to adopt new IT such as ESs are manifold and range from purely technical reasons (e.g., replace legacy system that is increasingly difficult to maintain) to complex business rationales (e.g., sus-

tain or achieve competitive advantage) (Markus and Tanis 2000; Seddon et al. 2010; Sykes et al. 2014). In any case, though, as organizations go through a process of adoption and conversion respectively implementation of new IT (Cooper and Zmud 1990; Soh and Markus 1995), individuals such as prospective users will gain awareness of the upcoming change and have to be involved. Their involvement is needed to create a "living" Information System (IS) (Paul 2007) in which the new technology is actually applied to the business problems at hand. Even before they make their own decision about adoption and acceptance, or even consider actual use, they supposedly start to respond and adapt their behavior (Beaudry and Pinsonneault 2005; Sykes et al. 2009).

Over the last thirty years, most research on these responses centered around theories that apply socio-psychological models such as the theory of reasoned action (Ajzen and Fishbein, 1980), the diffusion of innovation theory (Rogers 1983, 1995), or the theory of planned behavior (Ajzen 1985) to the IS context (Chin and Marcolin 2001). From these, prominent theories such as the technology acceptance model (Davis 1989; Venkatesh et al. 2003) and task-technology-fit (Goodhue and Thompson, 1995) have been developed in the IS context. These models vary in their theoretical structures, constructs, and relationships. However, they all address individuals' responses to technology (Chin and Marcolin 2001) by focusing on predictors of individuals' beliefs and intentions to adopt and use a technology. Thus, the main structural elements of these theories are cognitions, such as beliefs, and actions resulting from these cognitions such as actual use.

This dominant thrust of research has been critiqued due to the use of measures limited to behavioural intentions, self-reported use, and a lack of considering organizational dynamics as well as only a moderate support for the relationship between usage and individual or organizational impacts (e.g., Legris et al. 2003; Petter et al. 2008). Critics highlight that dynamics and changes of individuals' cognitions, choices, and actions are important structural elements of the individuals' responses to new IT (e.g., Hsieh et al. 2011; Jasperson et al. 2005; Jeyaraj and Sabherwal 2008) that need researchers' attention.

Thus, to extend the understanding of individuals' behavior conceptualized through cognitions and actions in the context of IT adoption, recent research attempts to better capture the context and complexity of users' behavior (Barki et al. 2007; Elie-Dit-Cosaque and Straub 2011). This research stream wants to better understand adaptation behaviors and explain its impact on individual and organizational outcomes. To do so, it employs richer models that take into account a broader range of individuals' responses to IT, rather than focusing on usage and its antecedents only (Benbasat and Barki 2007; Elie-Dit-Cosaque and Straub 2011). Such ideas of adaptation in response to IT-induced change have been present in literature for some time (DeSanctis and Poole 1994; Leonard-Barton 1988; Orlikowski 1992; Tyre and Orlikowski 1994), but have been defined diversely. Over the last decade more comprehensive theoretical conceptualizations (e.g., Beaudry and Pinsonneault 2005; Fadel 2012) have informed such research. For example, based on coping theory, user adaptation has been defined as "the cognitive and behavioral efforts exerted by users to manage specific consequences associated with a significant IT event that occurs in their work environment" (Beaudry and Pinsonneault 2005, p. 496). Such efforts can aim at the individuals' self, the work, or the technology and result in different individual outcomes (Beaudry and Pinsonneault 2005; Sykes et al. 2009).

It has been found that adaptation behaviors (e.g., learning) are drivers for effective use (Burton-Jones and Grange 2013), a concept suggested to address the problem of "shallow" conceptualizations of system use (Barki et al. 2007; Burton-Jones and Straub 2006). It emphasizes that individuals use a system to achieve the goal of successfully performing their work (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006). As soon as they are able to effectively use the system for most of their work performances (Pentland and Feldman 2005), users do not perceive the technology as "out-of–the-order" anymore (Hsieh and Zmud 2006). From an organizational perspective this leads to assimilation (Saraf et al. 2013) of the new technology, that is, the technology spreads across the organizational work processes and the execution of these processes becomes routinized and equally effective (Liang et al. 2007; Purvis et al. 2001). Assimilation can only be achieved by overcoming organizational inertia (Hannan and Freeman 1984). Especially in the ES context, where we generally deal with mandatory adoption (Jasperson et al. 2005; Schwarz et al. 2014), inertia is found when people in the organization are not "[…] motivated and able to use the system once it has gone live" (Seddon et al. 2010, p. 318). Such an inability to use the system is often caused by a lack of knowledge, which, in turn, is a major barrier for benefits realization from ES (Seddon et al. 2010).

Looking at the literature, we found that there is still a lack of a thorough understanding of how, when, and why individuals address the challenge of adapting to new IT such as ES technology towards effective use (Burton-Jones and Grange 2013). Additionally there is a need to understand the cumulative effects of these bottom-up

adaptation behaviors towards effective use, on the organization and its work systems (Alter 2012; Lucas et al. 2007; Nan 2011; Soh and Markus 1995). Yet, only a few studies have addressed these issues (e.g., Burton-Jones and Grange 2013; Kohli and Devaraj 2003; Sykes et al. 2009, 2014) and additional research seems warranted (Benbasat and Barki 2007; Chin and Marcolin 2001; Fadel 2012; Nan 2011; Turner et al. 2010). In doing so, we follow the call for research to go beyond conceptualizations of "shallow system usage" (i.e., rather how and why than whether or how often IT is used) with the overarching goal to better understand adaptation behavior towards effective use in the ES context and its links to outcomes for work systems within organizations.

Conceptualizing individuals' adaptation behaviors

To answer this call, our study intends to create a better understanding of users' responses to ES implementations. In this, we focus particularly on the users' adaptation behavior in order to achieve effective use after a change or renewal project. In our study, we are guided by critical realism (CR) as a research philosophy. CR has been suggested as a promising foundation for IS research. It addresses both natural and social science by providing the means to deal with technological as well as human or social aspects (Mingers 2004). One particular strength is that CR offers "researchers new opportunities to investigate complex organizational phenomena in a holistic manner" (Wynn and Williams 2012, p. 787). The application of CR as the underlying philosophy has ontological, epistemological, and methodological implications for our study. While we introduce these briefly, a more detailed discussion can be found in Mutch (2002) and Wynn and Williams (2012). First we will draw on the ontological assumptions for explicating structure and context, that is, to "identify components of social and physical structure, contextual environment, along with relationships among them" (Wynn and Williams 2012, p. 796). They serve as basis for defining a preliminary realist conceptualization of adaptation behavior as response to ES implementations.

CR implies the "existence of an independent reality; a stratified ontology comprised of structures, mechanisms, events, and experiences; emergent powers dependent upon - but not reducible to - lower-level powers; and an open systems perspective" (Wynn and Williams 2012, p. 790). Wynn and Williams (2012) describe stratification as the reality consisting of three nested domains. In the domain of the real there are entities and structures and their inherent causal powers that exist independently. The domain of the actual is a subset of the real and contains the events that "occur when the causal powers of structures and entities are enacted, regardless of whether or not these are observed by humans" (Wynn and Williams 2012, p. 790). The empirical domain again is a subset of the actual and consists of those events that we are able to experience through perception and measurement (Wynn and Williams 2012). CR wants to "use our knowledge of the experiences in a given situation [for example a case study in an organizational setting] to analyze inferentially what the world must be like in terms of the structures and mechanisms that must constitute this reality for some accepted outcome to have occurred" (Wynn and Williams 2012, p. 790).

The core structures that we define here are cognitions and actions as building blocks of individuals' adaptation behavior in the context of an ES implementation (Mingers 2004; Wynn and Williams 2012). To do so, we distinguish between what people think they do, what they actually do, and what doing it does (Schultze and Boland 2000). We draw on the literature on organizational change and routines (Pentland and Feldman 2005; Volkoff et al. 2007) that has been influenced by structuration theory (Giddens 1984; Jones and Karsten 2008). It emphasizes the distinction between ostensive (abstract pattern) and performative aspects (specific actions to perform a task). Ostensive aspects are used by individuals to guide, account for, and refer to specific performances (Pentland and Feldman 2005). The ostensive aspect is either "stored" in an individual's cognition, or can be documented in artifacts such as written rules, procedures or IT (Pentland and Feldman 2005). The latter can serve as a proxy for the ostensive aspect. Artifacts such as work logs and databases provide an archival trace of the performative aspect (Pentland and Feldman 2005). Artifacts can also be enrolled in performances to "varying degrees, at the discretion of the participants" (Pentland and Feldman 2005, pp. 796). This is of particular interest to our research as the process of enrolling a new or changed IT artifact such as ES into established work practices will allow us to study adaptation behaviors leading to effective use.

Conceptualizing the Enterprise Systems artifact and work system

Many IS studies struggle in conceptualizing the IT artifact (Akhlaghpour et al. 2013; Orlikowski and Iacono 2001). To address this challenge, we follow Strong and Volkoff (2010) in their conceptualization of an ES. Drawing on the ontological considerations by Wand and Weber (1995), Weber (1997), as well as on the concept of ES misfits (Sia and Soh 2007), Strong and Volkoff (2010) define four layers of an ES artifact. First, surface

structures are "the facilities that are available [...] to allow users to interact with the information system" (Weber 1997, p. 78). Second, 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 and functionality of the software system. Third, physical structures describe how deep structures are mapped to the underlying hardware system. Finally, latent structures are not embedded in the materiality of the ES but emerge from the interactions of all the other structures combined.

CR suggests that structures can be nested, that is, cognitions and actions of individuals as well as artifacts are embedded in a larger structure: the work context (Wynn and Williams 2012). This immediate work environment that individuals in organizations (such as ES users) are dealing with has been referred to as a work system (e.g., Jasperson et al. 2005; Yamauchi and Swanson 2010), which is the immediate organizational context in which individuals perform their work. Such work systems can be differentiated by their characteristics: "A work system is a system in which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce specific products/services for specific internal and/or external customers" (Alter 2012, p. 75). It has been recognized that the work system level is conceptually valuable in studying multi-level IS change phenomena (Jasperson et al. 2005; Lyytinen and Newman 2008), as "IS change re-configures a work system by embedding into it new information technology (IT) components" (Lyytinen and Newman 2008, p. 592).

Thus, we introduce the work system level here for conceptualizing a middle ground between the organizational and the individual level. This helps us to extend the horizontal study of users responses to a technology over time with the vertical analysis to develop a diachronic analysis of interactions between individuals and their work system (Lyytinen and Newman 2008) as proxy for the organization. This improves analytical accessibility and should theoretically help reducing the number of potential counter-mechanisms (Wynn and Williams 2012). These counter-mechanisms work against generative mechanisms that could be candidates for producing the events we observe in our case. In this work system we conceptualize the material aspects of the ES as artifact with physical, deep and surface structures. Implicitly, we recognize latent structures as influences of the material structures of the ES on the work system.

A critical realist framework to study adaptation behavior as response to ES

From the previous explanations, we now derive our CR framework for our study of individuals' adaptation behavior towards effective use in ES implementations (see Figure 1). Similar to Morton (2006), we draw on the open systems perspective of CR (Wynn and Williams 2012) and the notion that "organizations are social systems of collective action that structure and regulate the actions and cognitions of organizational participants through rules, resources, and social relations" (Jasperson et al. 2005, p. 533). Thus, we differentiate between two levels of analysis. Adaptation behavior on the individual level represents a structure with sub-structures that is part of a larger structure, the work system. Individuals' cognitions are conditioned by individuals' characteristics and experiences (1). Individuals influence the work system through their actions and are in turn influenced through interventions from the work system (Jasperson et al. 2005) (2). Actions are what people actually do and are defined as work performances in the sense of Pentland and Feldman (2005). Artifacts such as ESs can be enrolled in performances or can be used as guidance (e.g., written rules or process descriptions) (3). In the latter case they convey the ostensive aspect, that is, a generic understanding of how to perform certain actions for example to complete a task or a process (4).

The ostensive aspect guides individuals for example when they need to interpret surface or deep structures of the ES artifact while performing an action such as completing a task with the system. The structurational roots (Giddens 1984; Jones and Karsten 2008) of the ostensive-performative relationship imply a structuring process of adaptations (DeSanctis and Poole 1994; Orlikowski 2000) in which individual actors produce, reproduce, and change the ostensive aspect in performances through ongoing situated action (recursive relationship between action and structure; e.g., Orlikowski 2000) (5, 6).

Now, what makes "this system tick"[1] is an (external) IT intervention such as the implementation of a new ES (7). Here the CR stance suggests that mechanisms inherent in these nested entities and structures (i.e., perfor-

[1] This expression has ambiguous meaning, first it refers to the open system of critical realism that is brought to action through its underlying mechanisms. Second, it refers to ESs deep structures. Employees in the company we studied were struggling to understand them, so they asked "What makes the system tick?" in their search for clarification.

mances, ostensive aspect, artifacts, and the work system and its relationships) have causal powers or dispositions, capacities or potentials to do certain things (Wynn and Williams 2012). Entities and structures in our framework possess an ensemble of powers which may or may not be triggered by an IT event in a given context to create events and, ultimately, individual and work system outcomes (8) that can be observed by empirical experiences (Mingers 2004; Wynn and Williams 2012). A relevant outcome in our study of these adaptation behaviors is effective use (Burton-Jones and Grange 2013) of the new system for the individual. Additionally, we argue that as soon as an increasing number of individual work performances are supported by effective use of the system, this effectivity spreads across processes that we can observe on the work system level. These processes are performed jointly by individuals within the work system. Following the literature on assimilation of innovations (e.g., Fichman and Kemerer 1997; Saraf et al. 2013), we define this "spreading" of effective use across the work system as work system assimilation.

Hence, structures and entities such as individuals' performances and ostensive aspects interact through enacted mechanisms that may be the cause of the emergence of events. For a given instantiation of this system in an environmental context, however, it cannot be assumed that if the same mechanisms are enacted in the future, they will generate the same events. Thus, the focus of CR and our research is on explanation rather than prediction (Wynn and Williams 2012).

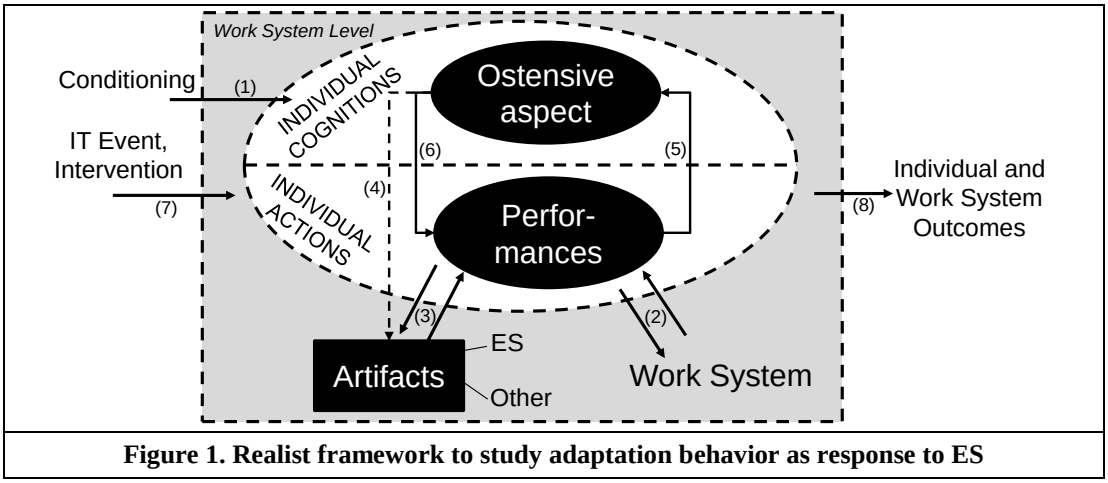

Figure 1. Realist framework to study adaptation behavior as response to ES

Methodology

For deepening our understanding of the how and why of adaptation behavior and its outcomes in the context of ES implementations, we followed a case study approach (Yin 2008) with a CR stance (Wynn and Williams 2012). Our CR framework served as theoretical scaffold (Mueller and Raeth 2012) to distinguish between what is relevant and what is not in order to avoid death by data asphyxiation (Langley 1999).

Case description

Our case site was located in the retail banking division of BANK, a global financial services provider with roots in central Europe that performed a multi-year ES 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. In the center of our investigation is BANK's credit service unit Credit Factory (CF). Here, as part of the overall program, a new Loan Management System (LMS) had been implemented. LMS is specific to the banking industry. It is provided by one of the world's leading vendors for ERP software and its characteristics are those of an ES as defined in the literature. It is an industry-specific, customizable software package that integrates information and business processes (e.g., across various units within CF and BANK's branch employees) and is fundamentally different from IS due to its scope, complexity, and risks (Devadoss and Pan 2007; Markus and Tanis 2000).

CF deals with back-office processes, that is, post-processing of credit business such as mortgage loans as a service for advisors in BANK's branches. Several departments are responsible for different aspects of credit pro-

cessing, like collateral management or credit applications or associated after-sales activities such as redemptions and prolongations. The three main ones are Sales Service Group (SSG), Production Service New (PSN), and Production Service Stock (PSS). SSG is responsible for all communication with the customer, that is, advisors in branches. PSN is responsible for processing new loans, that is, mainly inserting and processing data for new contracts into the loan management system currently used by CF. PSS on the other hand processes all cases that deal with manipulating or changing contracts already in stock.

Service employees of these three departments were faced with the implementation of the standard software LMS as part of the replacement of BANK'S whole core-banking system. At the time the project started the old loan management system OLMS had been in place for over thirty years and had to be replaced due to technical and regulatory requirements. In our case analysis later, we focus on the explanation of outcomes for PSS and PSN and include contextual information from SSG to support our findings. PSS and PSN will in the findings section be characterized as work systems.

Project activities for the LMS implementation at CF as part of the overall ES implementation program in the IT department of BANK started early in 2013 with requirements analysis and definition followed by configuration and implementation activities and testing until November. Migration of legacy data was performed in December with final release of the software in early January 2014. Selected members of CF were involved in these activities such as gathering requirements, redefining processes (process descriptions documented in a software tool), and testing. From September onwards, change management activities (mainly trainings) were performed in CF until December 2013. Trainings were done for all employees in the three departments starting with a one-day basis training and self-trainings with the training-system and pre-defined training cases until December.

Data collection

Exploiting the rich opportunities of case studies and to ensure validity, reliability, and credibility through data triangulation, multiple data collection methods and informants were used with the aim to understand, describe, and explain the case site with regard to the research objective (Volkoff et al. 2007; Wynn and Williams 2012). *Analysis of documents* such as project documentation, intranet pages, org charts, role descriptions, process descriptions, and others alike was needed to identify initial topics and relevant stakeholders for interviews and observations. *Participant observation* for clerks at CF targeted the development of an understanding of social and cultural aspects of stakeholders as well as their interactions with (O)LMS. *Interviews* as primary data source with managers and clerks provided insight into personal experiences and thoughts of different stakeholders of the project (Schultze and Avital 2011). With semi-structured interviews (Myers and Newman 2007), we intended to "generate deeply contextual, nuanced, and authentic accounts of participants' outer and inner worlds [...] their experiences and how they interpret them" (Schultze and Avital 2011). In order to get a complete picture, to gather rich data, and to avoid "elite bias" (Myers and Newman 2007), stakeholders on all organizational hierarchy levels were interviewed.

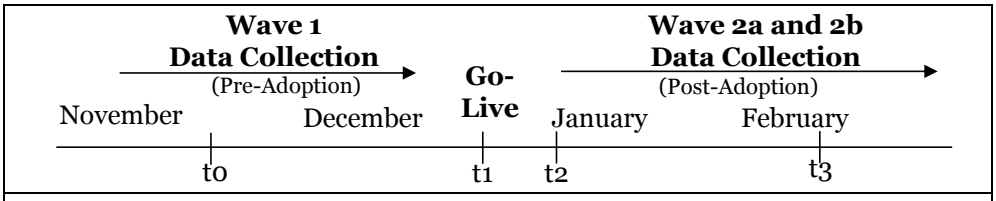

Figure 2. Timeline

Two of the authors of this paper were on-site at BANK starting from early 2013 to explore the overall implementation program by analyzing several documents and selectively talking to program members from the IT department. Starting from November 2013 in parallel to the change management activities of CF, we intensified our presence at CF. As depicted in Figure 2, primary data collection was done in two waves: wave one capturing the pre-adoption phase (i.e., status quo before go-live from t_0 to t_1) and wave two post-adoption (i.e., the immediate time after go-live until the end of February).

In wave one, starting from November, one researcher participated in the one-day basis training for LMS. In December, two researchers performed interviews as well as participant observations to capture the status quo before go-live. For the purpose of this study, our observations mainly focused on clerks since we were mainly

interested in understanding their adaptations as response to the new ES. Managers were not observed (except for one case, where the manager sat next to a clerk we observed), instead they were interviewed for triangulation purposes and as a source for contextual information. Then, one week after go-live in January 2014, the same two researchers were on-site to observe respondents of wave one and to selectively perform interviews (wave 2a until t_2).

The last round of interviews was performed end of February (wave 2b until t_3). The interviewees that were also observed by the researchers remained the same in wave one and two with two exceptions. Also, one top manager was interviewed three times and one clerk at PSN was observed three times throughout wave 1 and 2. Similar to Volkoff et al. (2005), we directly captured our observations in memos during or after participant observation and at the end of each day on-site. Additionally, we performed de-briefings with a third researcher that was not on site to discuss and document what we had experienced.

The interviews performed in German took from 30 to 120 minutes and were tape-recorded and transcribed. For our interviews we had two types of interview guidelines, one for managers and one for employees/clerks that were (prospective) users of LMS. During wave one, we asked people about their work processes and interactions with colleagues, the role of technology, and expectations towards the technology and its impacts. In wave two, we asked about what had changed in their work, in the technology, and what problems and actual impacts had occurred. In each interview we closed with an open question where the interviewee was asked to freely talk about what s/he had experienced. All transcripts, observation memos, and documents were stored in our research database (Microsoft Sharepoint, AtlasTi, Excel) from which we extracted and analyzed the data summarized in Table 1.

Area/Role	Total # Persons	Interviewed Wave 1 and 2	Interviewed once	Total # Person Interviews	Total # Observations
Top Management	4	3	1	8	-
PSS (Team Manager)	1	1	-	2	-
PSS (Clerk)	3	3	-	6	5
PSN (Team Manager)	1	1	-	2	1
PSN (Clerk)	3	2	1	5	7
SSG (Team Manager)	1	-	1	1	-
SSG (Clerk)	4	4	-	8	7
Totals	**17**	-		**32**	**20**

Table 1. Interviews and Observations

Data analysis

For our data analysis, we followed the epistemological assumptions and resultant recommendations for CR-based research. In particular, this entails mediated knowledge, explanation by mechanisms, un-observability of these mechanisms, and the possibility of multiple mechanisms to explain a certain event (Wynn and Williams 2012). It is important to highlight that resultant contributions from such research can be characterized as type II theory (Gregor 2006) in that it is "restricted to providing an explanation of the reasons a phenomenon occurred in a given complex social system" (Wynn and Williams 2012, pp. 793).

As a means of capturing the complexity of our case, we followed the principles suggested for CR case studies (Wynn and Williams 2012). In general, these principles suggest an iterative approach similar to the one used in Grounded Theory (Glaser and Strauss 2008). Thus, we performed open coding for the transcribed interviews, analyzed documents, and observation memos. This initial coding was intended to make the data transparent for the researchers and to give an explanation of events (Wynn and Williams 2012). A first round of coding was done after the wave one interviews had been performed and during the timeframe of observing impacts of the new system just after go-live (wave 2a). During that time, we also went back to the literature to identify theories that might help to explain what we saw. As further interviews and observations were performed and the

analysis progressed, we further developed our initial theoretical idea for explaining structure and context and developed a preliminary CR framework – similar to Morton (2006). Taking this rough guideline, we continued with axial coding (Glaser and Strauss 2008) but categorized our data into individual and work system adaptations and outcomes.

AtlasTi was used for coding and tracking the field data. As coding further progressed, we further organized codes into trees, compared similarly coded passages to generate more abstract concepts, and wrote memos to propose abstract concepts and potential relationships. We then used the concepts to develop a timeline of events for individuals and the overarching work systems. From the understanding we developed there, we retroductively extracted theoretical mechanisms that were able to explain the described chain of events (Wynn and Williams 2012). Retroduction is a form of theoretical reasoning in which preliminary analytical frames are built from the data and then refined gradually (Mueller and Urbach 2013). Such inference also seeks to meet CR's goal of explaining by identifying and verifying the existence of a set of mechanisms, which are theorized to have generated the phenomena under study. In retroduction, "we take some unexplained phenomenon and propose hypothetical mechanisms that, if they existed, would generate or cause that which is to be explained" (Mingers 2004, p. 94). After we had identified a mechanism, we went back to the data to assess its plausibility and strength or power which in CR is called empirical corroboration (Wynn and Williams 2012). In order to challenge the analysis – that is, the steps of open and axial coding, concept development, retroduction, and empirical corroboration – the three researchers constantly challenged each other's ideas and discussed preliminary results such as codes, coding trees, concepts, and mechanisms. This research process ensured that we stayed grounded in the data and reflected and incorporated state of the art literature (Volkoff et al. 2007).

Findings

Although all departments (PSS, PSN, and SSG) at CF were provided with the same technological configuration of LMS and the same change management measures, the ability to deal with the IT-induced change and the respective outcomes for PSS and PSN were very different. In the following section, we describe the chain of events and the different outcomes for PSS and PSN. In the next section, we then hypothesize what mechanisms (the how and why) might have caused the different outcomes. Finally, we synthesize our findings to suggest four principal individual adaptation modes that we use for explaining the different outcomes for the two work systems.

Pre-Adoption: Preparing for go-live

In the pre-adoption phase (time until go-live), the preparation of individuals for LMS in all work systems was similar; although they perform different tasks and use (O)LMS differently in their daily work based on their work system characteristics (see Table 2).

The individual preparation mainly consisted of trainings that were mandated as part of the LMS implementation project: *"They talked about it early this year, basically the whole summer. Later it got more concrete, it was announced that there would be trainings, and some colleagues were sent to support the project"* (Q1: Clerk 1, SSG). Classroom and self-trainings started in October and had the same structure and contents for all participants: *"We had a classroom training, where we got the possibility to try out the system, how it works, where we really could sit in front of the PC and have seen it, how it works, where we could complete training cases"* (Q2: Clerk 1, SSG). These trainings mainly addressed surface structures of the new ES, that is, they dealt with how to navigate through the system's User Interface (UI) and window logic and how to enter or change data for simple loan contracts. Also, the training cases were rather rigid and did not leave much room for exploring the system: *"The training case was very prescriptive, click there now, and then you see this and that. So without really thinking about it, employees actually just reproduced and clicked what was written there"* (Q3: Team Manager, PSN). Another prospective user of LMS supported this view: *"I have done [the training cases] and I have just reproduced and clicked without understanding what I was doing. So it was indeed everything prescribed, click here, click there and then this has to happen […] and not in a way that I need to think myself"* (Q4: Clerk 3, PSS).

Initially, this preparation resulted in a good feeling, although trainings could not really convey a deep understanding of the system: *"I now have an idea what's coming and that's reassuring. This is somehow that I can say, well I know the system, for myself you know, I say I know the system now, although I do not really know it, but now I'm a bit bolder and say, well it will work out somehow"* (Q5: Clerk 2, SSG).

In the pre-adoption phase individuals in all work systems experienced and performed similar preparations and had similar perceptions of how that would help them. Pre-adoptive adaptations such as learning in trainings were however restricted to surface structures of LMS and gave no hint of how the deep structures of the system might work. As a result, individuals across all work systems were only able to create a limited ostensive representation of the system's functionality based on the training they had received and performed. That is, they roughly understood how they might employ the UI to navigate through the system and could enter data for simple cases such as the opening process for a new loan.

Characteristics	Work System 1 (PSS)	Work System 2 (PSN)
Services produced	Maintenance of existing mortgage loan products as service for branch employees	Opening of new mortgage loan products as service for branch employees
Processes and activities/tasks	Standardized processes, higher complexity (Processes require a thorough understanding of the business logic, i.e. background on loan contracts e.g., to analyze bookings on an account)	Standardized processes, low complexity (processes require less understanding of business logic for opening new loan contracts – most information is provided in the loan contract from the branch)
Customer interaction	No direct customer contact; only via SSG	No direct customer contact; only via SSG
Environmental influence	No direct influence, exchange with other work systems via work system management	No direct influence, exchange with other work systems via work system management
Infrastructure and technology	Equal for both work systems	
LMS/OLMS use	Mainly for changing data of existing loan contracts and analyzing data and reports (e.g. for irregular bookings) generated by the system	Mainly for entering data to create new loan contracts
Performance measure (WS)	# of orders/cases (referring to loan contracts in stock) processed; quality of orders processed; optimal performance: zero cases open to be processed at end of each day	# of orders/cases (new loan contracts) processed; quality of orders processed; optimal performance: zero cases open to be processed at end of each day

Table 2. Work System Characteristics

Post-Adoption: Towards effective use

During the first days after go-live, clerks in all work systems were struggling to regain orientation and were fighting with their lack of knowledge. Technical and organizational problems emerged, which hindered the effective performance of their work with the new system: "*[…] no one knows what to do […] we all had this feeling that you do not know anything anymore"* (Q6: Clerk 3, SSG). A team manager elaborated further: *"It was very difficult to resolve [problems] in the first few days, how we should enter the data for new [loan] contracts […] we had quite a lot of cases to clarify, how are we going to enter the data for that new contract? What do we need to enter here? […] for the people it was actually really hard. Really, they get a new system and are dependent on processes and then they get process descriptions that do not fit to the system"* (Q7: Team Manager, PSN).

Increasingly, these struggles with the system led to problems building up: *"You sit here thinking that nothing works at all […] and at the beginning we had the feeling that we said, it is not so simple, it does not work like that […] so the first few weeks, 1, 2, 3 weeks, 4 weeks […] we really had a problem and we were not just stupid […], they [the management] always said, come on, you need to reduce the inventory* [backlog of cases to be processed]*, do something! Yes, we said, we would like to, but it's not that simple"* (Q8: Clerk 1, PSS).

From an organizational perspective, all work systems were in a state of inertia directly after go-live (Hannan and Freeman 1984). Contrary to the definition of inertia introduced above, though, people at CF were motivated to use the system and also showed no signs of resistance (Kim and Kankanhalli 2009; Lapointe and Rivard 2005; Rivard and Lapointe 2012) in the classical sense: *"I really would like to understand this system and get to know it, but I was not given the possibility to do so. Yes, and I think on my own, with the running system, it will be hard to gather this experience"* (Q9: Clerk 3, SSG). Together with the above, this indicates that this state of inertia was caused by individuals' inability to act, because they initially lacked sufficient knowledge of how to use the system effectively, that is, could not perform informed actions (Burton-Jones and Grange 2013; Seddon et al. 2010).

While all of the work systems under consideration in our study struggled immediately after go-live, it is interesting to see that the cases developed differently thereafter. Looking at PSS and PSN, we were able to observe a significantly different degree of effective use for individuals and thus their work system (assimilation), that is, in their execution of processes with the new system (Liang et al. 2007; Purvis et al. 2001). While individuals in one group of CF were able to use the system effectively for single work performances and had achieved a relatively high degree of effective use (PSN), their counterparts in the other work system continued to struggle (PSS).

Specifically, PSN achieved a relatively high degree of work system assimilation until end of February (t_3). Due to their tasks and processes that deal with opening new loan contracts, individuals were mandated to intensively work with LMS. After the initial problems materialized, users managed to work with and use LMS effectively relatively fast. This is also evidenced by the number of open cases (new loan contracts processed) at the end of each day which had already gone to zero by the end of January: "*Zero* [cases of new loan contracts at the end of the day]*, theoretically that's the best case, yes and that's where we were end of January, the last week of January, we were really green* [status of the service level towards the customer]*, clean, perfect"* (Q10: Team Manager, PSN). This statement exemplifies that the work system PSN at that point in time had almost reached the performance it had before the implementation of LMS (see performance measure in Table 2). We conclude from this observation that effective use of LMS in individual performances had spread across the processes of the work system. This suggests that we were observing a cumulative effect linking individual behavior to work system outcomes.

Thus, users in PSN were able to adapt to the new system by referring to the available documentation (process descriptions or training material), relied on knowledge from communication with peers and external change agents (that had been brought in by the ES implementation program from a subsidiary of BANK that had already used LMS), and just tried out the system. Trying in PSN was relatively easy, because they mostly just needed to enter data in the right data fields by navigating through the UI. This they had already done in their trainings. Thus, they already had an idea of how surface structures of the system worked. Additionally they did not have to understand the deep structures of LMS in detail. Members of PSN described this situation as follows: *"We then just tried it out, with the new process descriptions and the training materials. But I think we managed that quite well and it worked, things like questions of course, then came up during work and then we clarified them step-by-step. So in the first three weeks we were certainly slower but now we're back to normal"* (Q11: Clerk 2, PSN). S/He continued: *"In my opinion, the introduction of LMS has gone relatively smoothly. We had relatively few problems. The fact that we had the training before, we were well prepared. There were little technical problems. Of course, it was a lot to sort out what we did not know so from the start. But no major problems* [...] *we were not able to handle. This has somehow all worked very well"* (Q12: Clerk 2, PSN).

Quite contrarily, things at PSS developed differently. They were not able to overcome the state of inertia from the beginning; instead it seems as if their inability to act and perform informed actions (Burton-Jones and Grange 2013) was even reinforced. Similar to PSN, individuals were very much dependent on the system to do their work and were negatively influenced by unexpected system behavior. Several things contributed to that development. First, in the beginning, most of the tasks and processes could not be performed due to technological restrictions from data migration, that is, loan contracts in stock could not be changed until the first payments mid of January: *"At go-live they found out that we cannot do anything until the 15th, the first payment date. There was quite some confusion, rather than effective work. We tried to work on some things that were possible. My team however, we are dealing with redemptions* [of loans]*, we could not do anything. So we just watched how the stock of cases* [loans in stock to be processed] *increased but nothing could be processed"* (Q13: Clerk 2, PSS).

Second, due to the different characteristics and higher complexity of their tasks (relatively as compared to PSN, see Table 2), users needed detailed knowledge about the system logic (i.e., deep structures) to be able to do their work: *"But we have to master the situation somehow, that's clear. What I – and I think also others – criticize is that still yes still, we know too little about what makes this system tick* [processing logic of LMS]. *Yes, each case appears to be different, there are always some exceptional situations where you continue processing your case, because there's something still being clarified, some specifics, and I always use the metaphor for this that I have the feeling that I just poke about in the fog"* (Q14: Clerk 2, PSS). This illustrates that the knowledge that was needed had not been covered by the training sessions, thus individuals had no experience of how to use the system: *"What really landed on our feet […] this phase of training for our people, zero, it was no use, absolutely no use"* (Q15: Clerk 3, PSS).

Knowledge also was not covered in process descriptions or training cases and was also not (readily) available from peers or change agents. Although both PSS and PSN had the possibility to consult change agents or members of the IT project staff through communication channels, they still were a scarce resource: *"What I found problematic in the beginning and, just because the first 14 days were really very important* [for learning]*, I would have wished that we would have had the external specialists* [external change agents] *for our team alone, because, we actually had here at our location only one specialist in the beginning and we had to share him with others"* (Q16: Clerk 3, PSS). This lack of knowledge had severe consequences for individuals that had to deal with unexpected system behavior rooted in the new system logic (i.e., deep structures): *"[…] it was really bad, we couldn't do very much* [due to the technical constraints]*, and what we could do didn't really work either. It was so dissatisfying. You had the feeling that you're at work and haven't achieved anything. At times, we tried three cases a day, tried and then somehow it didn't work, either we lacked the knowledge or the mortgage loan hadn't been migrated as we expected it. This was really not satisfying"* (Q17: Clerk 3, PSS).

Thus, PSS achieved a low degree of work system assimilation (individuals were at a low degree of effective use and thus processes could not be performed effectively) until end of February (t_3); in some processes almost none. This significantly impacted overall performance of the work system. This was visible through the high number of cases (loans in stock to be processed) that were open at the end of each day: *"We had before* [go-live] *at best, a daily stock of cases in the evening left of 400, 500 pieces. If you had that left in the evening it was like you thought, oh God, hell has broken loose. But now* [t_3] *we're at 10,000"* (Q18: Clerk 1, PSS). Again, this statement exemplifies that the work system PSS at that point in time had not even closely reached the performance it had before the implementation of LMS (see performance measure in Table 2). We conclude from this observation that effective use of LMS in individual performances was not present and thus negatively affected the effectiveness of processes of the whole work system.

In summary, post-adoption development and outcomes for individuals and the overall work system of PSS and PSN were quite different. Individuals in PSN were able to use LMS effectively (effective use) for most of their work performances after a relatively short period of time. This led to a high degree of work system assimilation. Thus, inertia from the first weeks was overcome and most of the processes could also be performed effectively (in an acceptable time and quality). While departing from the same state of inertia, the evolution of events for PSS was very different. Individuals struggled with their lack of knowledge about deep structures of LMS for which they had no experience from trainings. Documentation was not available in this regard, nor easily accessible through communication channels within or outside the work system. Thus they were not able adapt successfully to LMS to achieve effective use for most of their individual work performances. This caused their work system to remain in a state close to inertia with a low degree of assimilation of LMS.

Discussion

Candidate mechanisms for explaining differences in effective use

Our analysis based on the CR framework lead us to suggest the existence of six conceptual mechanisms that were enacted to explain the very different chain of events for PSS and PSN. Thus, we applied the principle of retroduction to explain the emergence of the different degrees of individuals' effective use and work system assimilation as outcomes by identifying a set of plausible candidate mechanisms. CR suggests that this step of retroduction means to logically and analytically link our initially introduced structures (CR framework) with the help of mechanisms to the chain of events (Wynn and Williams 2012). In the following paragraph, after identifying a mechanism, we briefly discuss if this mechanism was not only enacted but also had the power to

cause the differences in outcomes between PSN and PSS in t_3. For this purpose, we tested each mechanism for its power of causal explanation with the questions suggested by Wynn and Williams (2012) to ensure empirical corroboration. In this section, we use terms that we introduced in our CR conceptualization, to emphasize the idea of retroduction.

M1) Constraining deep structures: The first mechanism we found refers to the fact that individuals were constrained in their work performances by deep structures of the ES artifact. This can be due to a lack of knowledge (ostensive aspect) about the entities and mechanisms of deep structures or by events triggered through these deep structures that cause individuals to adapt their work performances and cause a restructuring of the cognitive ostensive aspect. Individuals in PSS had to struggle particularly with these deep structure issues. First, they were not able to work because of deep structure constraints, that is, technical problems from data migration. Then they needed explicit knowledge about the system logic and its behavior to process cases referring to existing loan contracts. In PSN individuals were only to a limited extent constrained in the first weeks by technical problems. And, they only had to know very little about system logic and functionality for entering data for new loan contracts (see Table 2). The different statements of individuals in PSN and PSS underline the existence of this mechanism: *"OLMS, our [old] program ticks differently compared to LMS and this posting logic, you have to comprehend that. How is LMS ticking? How does LMS process that? What's going on in the background?"* (Q19: Clerk 3, PSS).

The statements of individuals in PSN were completely different: *"What was problematic a bit was that we did not know a 100% what data we had to enter, whether we must incorporate certain cost items, for example for loans, or not* [...] [however] *we had relatively few problems. The fact that we had the training before, we were well prepared. There were little technical problems"* (Q20: Clerk 1, PSN). Thus, we suggest that this mechanism has the power to support the difference in outcomes between PSS and PSN.

M2) Constraining surface structures: Closely related to the first mechanism, individuals are constrained to effectively use LMS in their work performances by surface structures of the ES artifact. This can be due to a lack of knowledge or experience (ostensive aspect) about the entities and mechanisms of surface structures. Individuals in both work systems faced this challenge. The UI of LMS was very different from that of OLMS due to its characteristics as standard product software. For example, it contained many folders or data fields that were not explicitly relevant for the work of clerks in PSS or PSN. Thus there was increased search and navigation effort for all individuals. Also, all individuals had received the same preparation with regard to trainings focusing on these surface structures in pre-adoption, so we conclude that the mechanism was enacted, but does not explain the differences in outcomes.

M3) Leveraging horizontal and vertical communication: The third mechanism enacted drives individuals to interrupt their immediate work performances such as interactions with the ES artifact for interactions with peers (horizontal) or managers (vertical) inside their work system for communication purposes. This communication was in our case mostly triggered by the need to gather knowledge for solving problems in immediate work performances. We found that this communication was effective if it resulted in new knowledge (update of the cognitive ostensive aspect) or the availability of new artifacts containing information (ostensive aspect) that solved problems in immediate performances. Also, the knowledge supported and enhanced work performances at a later point in time. Individuals in all work systems faced the challenge that they had to communicate intensively with peers or managers in post-adoption to give and get information about the problems they were facing with the system: *"First, I looked myself if there is anything I can do differently and if I could not progress [in the system] so after so 1, 2 attempts, then I asked my deputy team leader [...] he also knew LMS pretty well and so we clarified this along the way"* (Q21, Clerk 1, PSN).

Comparing PSS and PSN, however, our data suggests that individuals in PSN were more successful in their adaptations towards effective use by solving problems through communication: *"But I think we managed that quite well and it worked, things like questions of course, then came up during work and then we step-by-step clarified them. So in the first three weeks we were certainly slower but now we're back to normal"* (Q22: Clerk 2, PSN). Our observations at PSS showed the opposite picture. This was due to the fact that PSS had to solve problems that were depending on knowledge about deep structures that was not readily available. Thus, this mechanism provides weak support for the different outcomes in PSS and PSN.

M4) Leveraging external communication: Another closely related mechanism is external communication. Here individuals are driven to interrupt their immediate work performances such as interactions with the ES artifact for interactions with individuals external to their work system for communication purposes.

Similar to M3, communication is effective if it results in new knowledge and updates of the ostensive aspect. Individuals in both work systems had the possibility to ask or get support from external change agents that had a lot of experience with LMS. However, they all faced the same problem that these change agents were a scarce resource and of course only had limited capacities to answer questions or solve complex problems instantly (see Q16). Thus, this mechanism was enacted in all work systems and does not support differences in outcomes.

M5) Exploring and gathering new knowledge: Individuals in our case were often not able to enact (parts) of their immediate work performances such as interactions with the ES artifact and had to explore new paths for their work performances or acquire additional knowledge/information to update their ostensive aspect. The updated ostensive aspect as cognition or documented in artifacts then served to solve the immediate problem or guided future performances. Individuals in both work systems were faced with the challenge to gather new knowledge and to overcome problems in their immediate work performances. The following statements suggest that individuals in PSN gained step-by-step access to the qualified knowledge to deal with their problems and start performing their work: *"Of course, it was a lot to sort out what we did not know so from the start"* (Q23: Clerk 1, PSN). This is also supported by another clerk: "*But otherwise, yes, so the first few days were just very slow, because you yourself had to muddle on and had to look where to enter what in the system and where to get the right information"* (Q24: Clerk 3, PSN). A third clerk adds: *"We then just tried it out, with the new process descriptions* [provided bit by bit after go-live by the process management department]*"* (Q25: Clerk 2, PSN).

Individuals in PSS lacked the knowledge to deal with their problems heavily depending on deep structures of the system. These could not be overcome easily and solutions (i.e., particularly knowledge for these problems) were harder to acquire (see Q14). This mechanism, particularly in combination with M1, provides support for the differences in outcomes.

M6) Exploiting existing knowledge: Individuals require knowledge available to them "stored" in their cognitions as ostensive aspect to guide immediate work performances such as interactions with the ES artifact. Individuals also rely on the ostensive aspect "stored" in artifacts that are available to them. Individuals, in both cases, need qualified knowledge in ostensive aspects of artifacts or cognition to effectively perform immediate work performance at hand. Individuals in PSN could readily apply the knowledge about surface structures they gained from the training sessions to guide their initial performances with LMS. There they had at least superficially learned how to navigate through the UI and how to interpret elements such as icons or data fields on the screen. Additionally they could initially rely on artifacts such as training materials and relatively soon on the newly created process descriptions to guide their work performances: *"The fact that we had the training before, we were well prepared […] This has somehow all worked very well"* (Q26: Clerk 1, PSN). This is supported by a second clerk: *"We then just tried it out, with the new process descriptions and the training materials. But I think we managed that quite well and it worked"* (Q27: Clerk 2, PSN).

Individuals in PSS neither were prepared by the trainings, nor were able to use knowledge in artifacts such as training materials or the process descriptions to guide their initial performances with LMS. These only addressed surface structures and processes not relevant for PSS (see Q4, Q15). Along the same lines: "[I would have wished for] *team tailored training materials, that's so logical. What do you give people from PSS training cases that are suited for PSN, that is, new loan contracts and disbursements?"* (Q28, Clerk 2, PSS). These statements underline that this mechanism supports the difference in outcomes between PSS and PSN.

Four principal adaptation modes for individuals as response to ES

With help of our CR theoretical scaffold, we identified six candidate mechanisms (M1-M6) in our case. In the following, we now attempt to answer our research question by deriving a new explanatory process theory (Langley 1999; Markus and Robey 1988) that employs these generic mechanisms. This theory then also helps us to further understand, why only four of these mechanisms had the power to explain the difference in outcomes for PSS and PSN. We acknowledge the CR principle that these basic mechanisms will not be activated chronologically and each at a time, but overlap each other and change over time (Wynn and Williams 2012).

From our mechanisms, we suggest that exploration and exploitation of knowledge in combination with external and internal communication to make new knowledge available are important dimensions of individuals' adaptations towards effective use. Knowledge was mainly needed for problems caused by (deep) structures of LMS as another dimension. For this reason we combine these three dimensions and derive four generic adap-

tation modes for individuals in their responses to ES (Figure 3). We use this representation for the purpose of simplicity, but point to the fact that communication, knowledge and structures are continuous and not dichotomous concepts, that is, we can expect various forms of adaptation modes. Individuals in PSN were able to successfully adapt as response to LMS in a way that they could use it effectively after a short period of time. This enabled their whole work system to achieve a relatively high degree of assimilation. As we have described before, individuals in PSS developed differently. They had not reached a sufficient degree of effective use until end of February (t_3), which also left the work system with a low degree of assimilation or even close to inertia. In the following, we explain why that was the case by drawing on visual mapping with a state transition representation (Ilgun et al. 1995), the four different adaptation modes (states), and the underlying six mechanisms (transitions) to explain different adaptation patterns (see Figure 4) for PSS and PSN (Adomavicius et al. 2008; Langley 1999) along the timeline of Figure 2.

We found that M1 was a main source of causing problems for individuals in PSS, hindering them to adapt successfully towards effective use of LMS. Technical constraints from deep structures and a lack of knowledge about them were causes (M1). For similar reasons M2 was enacted, but knowledge was available for both PSS and PSN. So M1 and M2 as mechanisms referring to structures, influence the knowledge dimension of our theory, but in our case only M1 has the power to support differences in outcomes.

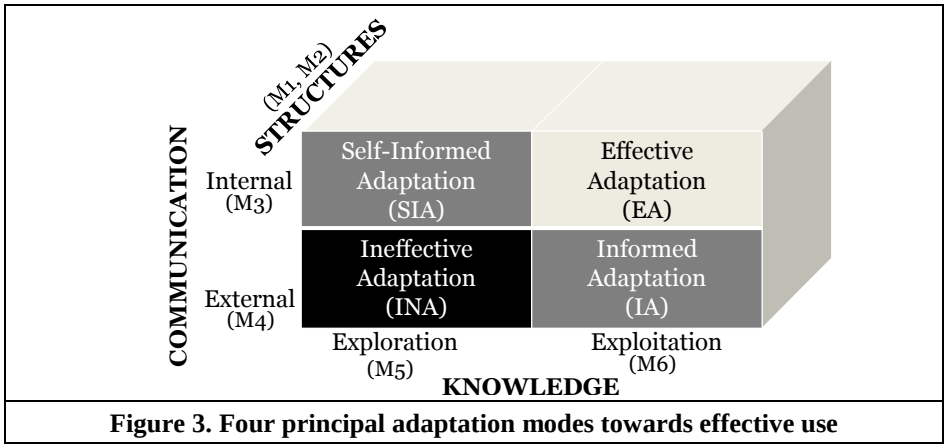

Figure 3. Four principal adaptation modes towards effective use

Individuals in PSS and PSN started out directly after go-live (t_1) to gather the missing knowledge by exploring or engaging with the new system (e.g., observing its behavior) or trying to find the respective information in artifacts such as training materials or process descriptions (M5). Additionally in this situation it was not sufficient to just communicate intensively with peers or managers in their work system to solve problems, but also with externals to attain missing knowledge (M4). Consequently, in PSS and PSN directly after go-live (t_1) individuals started out in modes of *ineffective adaptation (INA)*, that is, they could not perform their work effectively with LMS. In these modes the individual effort to perform adaptations towards effective use is higher. For example it generally takes longer to acquire required knowledge, or to solve problems that arise while using the system, from an external change agent. In our case change agents were not always available for questions during the day as compared to co-workers. Cumulated, these ineffective adaptations towards effective use caused a state close to inertia for both work systems.

Individuals in PSN in the first two weeks (from t_1 to t_2) were able to overcome the initial situation relatively fast, because they could explore knowledge successfully (M5!; the exclamation mark and red color in Figure 4 is referring to the enactment of the powerful mechanisms that explain differences in outcomes for PSS and PSN) that was internally available in their work system in artifacts such as training materials provided before go-live (t_0). As a consequence, they relatively soon were able to switch to modes of self-*informed adaptation (SIA)* for some of their work performances. For these work performances, they then also could rely on internal vertical and horizontal communication to exchange knowledge in the work system, since the respective knowledge codified in artifacts was accessible for everyone. At the same time for some work performances they were in modes of *informed adaptation (IA)*. For some instances they still had to rely on knowledge from external change agents (M4). However, they were also able to exploit the experiences they had already made with the system in trainings and could use training cases from the training materials to guide their work with LMS (M6!). The difference between exploration and exploitation here might not be

obvious and needs explanation. For example documents such as training materials might be available to individuals. However, as the individual encounters a problem with the system, s/he might not know if this problem can solved with information available in the respective documentation. Therefore browsing through the document is required, thus it needs to be explored. Next time, when the user faces the same or a similar problem, he might either know what to do from his experience (cognitive ostensive aspect) or knows where to find that information in the document and can exploit it. In both cases this "exploitation mode" requires less effort and is more effective and leads faster to the desired end result (e.g., effective use of the system).

After the first two weeks (from t_2 to t_3) problems in PSN were increasingly clarified and more knowledge became available (such as revised process descriptions) in their work system. Individuals could extensively exploit the experiences they had made with the system (M6). Individuals in PSN evolved towards *effective adaptation (EA)* for most of their work performances. Here they could limit external communication activities (M3! instead of M4) and had reached a relatively high degree of effective use in most of their work by exploiting knowledge readily available.

Individuals in PSS (as opposed to PSN) were not able to overcome the initial modes of *INA* (M4 and M5!) in the first two weeks (from t_1 to t_2). Individuals here also tried to explore relevant knowledge to overcome problems and constraints that came from deep structure issues (M5). This was not possible in modes of *SIA*, since artifacts internal to their work system, such as training cases or process descriptions, did not contain the relevant knowledge (M1). Also exploring deep structures by observing system behavior was more time consuming than for PSS (M5 and M1). Also, as we suggested before, there was no way to exploit experiences from trainings (no M6). So individuals remained relatively long in *INA* modes and only slowly were able to switch to modes of *SIA*, by gathering knowledge from external change agents and new process documentation provided by external sources (process management) (M4 and M5).

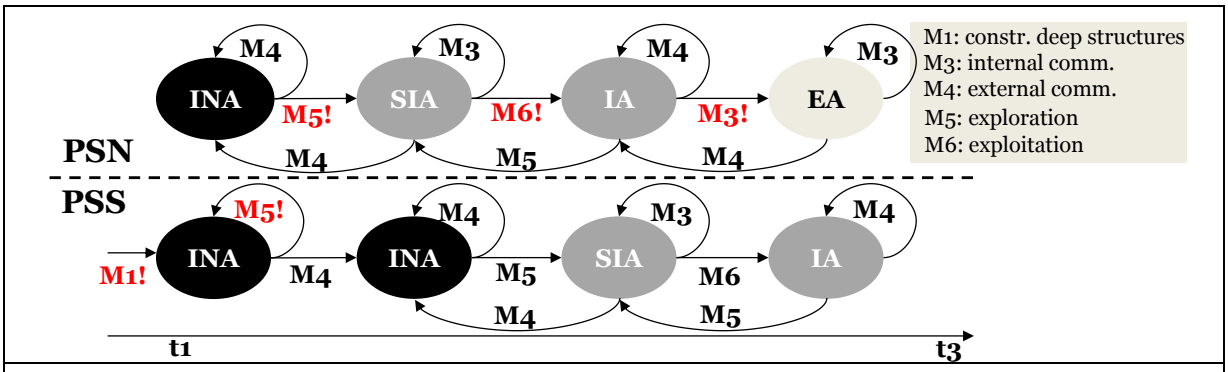

Figure 4. Adaptation Patterns for PSS and PSN

In the time period after the initial two weeks (from t_2 to t_3), individuals in PSS switched between modes of *INA*, *SIA, and IA* respectively. They were not able to break through these "transition modes" towards *EA* since not all required knowledge about deep structures had been provided (M1) e.g., in form of artifacts through communication from outside PSS (M4). Thus, for many work performances there was no way to exploit experiences (almost no M6), which restricted also effective internal communication (no M3) and still required high exploration effort and externally induced knowledge (M4 and M5). Consequently, individuals in PSS were less successful in their adaptations towards effective use of LMS as compared to PSN.

Conclusion

We performed a critical realist case study at BANK in order to better understand employees' adaptation behavior towards effective use in an ES implementation. We found evidence that individuals applied four principal adaptation modes based on six mechanisms referring to exploration or exploitation of knowledge, communication and structures of the ES. In modes of *ineffective adaptation,* directly after go-live, users for most of their work performances were faced with high external communication and exploration efforts to gather knowledge. Knowledge was needed for example to learn about system deep structures and to solve problems. In these modes it took longer to successfully establish effective use of the system for performing work. From there, users in one work system gained experience with the new technology and exploited avail-

able knowledge from trainings or made available to them through external communication in modes of *informed adaptation*. Alternatively they engaged in exploring available sources of knowledge such as process descriptions and sharing that knowledge within their work system in modes of *self-informed adaptation*. As soon as they were able to exploit existing experience and knowledge and were able to limit external work system communication for problem solving and knowledge acquisition, users moved towards modes of *effective adaptation* for an increasing number of their work performances. This enabled them to move faster towards effective use of the system in their work. For the second work system, we observed that individuals lacked the required knowledge, particularly about deep structures, from the beginning and had difficulties to gain it. Thus, they never moved beyond modes of *(self-) informed adaptation* and consequently had still not achieved a desired degree of effective use of the system after two months. We also found evidence that these adaptation behaviors towards effective use have cumulative effects. As users became more effective with the system this effectiveness spread across processes in the work system. In the first case this successful work system assimilation lead to a state where the work system performance reached levels similar to those before go-live. In the second case, where adaptations towards effective use were less successful, the work system remained in a state close to inertia.

In the light of these findings we, however, also need to acknowledge the limitations of our research. First, our study is generalizable beyond this specific case only analytically (Lee and Baskerville 2003). This analytical generalizability is further supported by our intensive study of the context of the ES implementation program in which our case was located. Also, we conducted an initial exploration phase to identify a part of the program most suitable for studying our phenomenon of interest. Second, LMS, the technology that was implemented in our case, is specific to the banking industry. While, too, limited in generalizability, we believe that the core mechanisms we identify in our study can also be applied to other types of ES. Third, we suggest a link between adaptation behavior towards effective use and work system outcomes such as performance. From our case data this link was evident, however, further research for example with other methods is needed to strengthen and validate that finding. Fourth, the purpose of our study was theory development. As the philosophical assumptions of CR suggest, we developed theory for explanation, not prediction. Thus, we believe that our theory needs to further evolve and also must be tested in other organizational contexts, industries and with other technologies. Such an expansion of the theory's summative validity over time might, in the future, help to improve the generalizability of our findings.

Keeping these limitations in mind, we suggest that our work contributes in several ways to existing research. First, we contribute by explaining how and why individuals change their behavior in response to the implementation of a new technology in a work context to re-establish effective use over time. In doing so, we follow the call for research to go beyond conceptualizations of "shallow system usage" (Burton-Jones and Grange 2013; Burton-Jones and Straub 2006; Chin and Marcolin 2001) by providing a new perspective on adaptation behavior towards effective use in the ES implementation context. Also, our paper is one of the first to provide a new and powerful perspective on this important phenomenon of IS research, by applying a CR stance. As suggested by others, CR provided us with the ability to leverage elements of positivist and interpretive paradigms. This enabled us to acknowledge the subjectivity of individuals in their responses to new IT as well as the constraining independent structures such as those of the ES (Wynn and Williams 2012). From this we could develop causal explanations of why certain adaptation behaviors as response to ES are more successful in achieving effective use than others. We also provide initial evidence for the link between adaptation behavior towards effective use and outcomes for work systems within organizations. It has been found by others that assimilation is one of the prerequisites for creating benefits from ES (Seddon et al. 2010). We suggest that linking individual adaptations to the assimilation of ES (e.g, Liang et al. 2007; Purvis et al. 2001) in work systems provides an initial step towards a better understanding of how organizational benefits from ESs emerge.

Our findings could enable practitioners such as sponsors or project managers of ES implementations to think beyond go-live of the ES. This can improve change management such as the design of user trainings. For example, designing training cases that specifically address deep structure knowledge for certain user groups might be helpful in enabling these users to better understand and anticipate system behavior in the early post-adoption phase. This could in turn enhance and facilitate their adaptations towards effective use of the ES. Applying the knowledge from our research in practice could also help ES implementation projects to realize "what actually makes the system tick", in that they find out sooner, what users need to adapt to the new system. Developing interventions to foster these user needs is important in the attempt to early reach a state of stabilization. This in turn will enable the organization to earlier leverage benefits and create value from new IS.

References

Adomavicius, G., Bockstedt, J., Gupta, A., and Kauffman, R. 2008. "Making sense of technology trends in the information technology landscape: A design science approach," *MIS Quarterly* (32:4), pp. 779–809.

Ajzen, I. 1985. "From intentions to actions: A theory of planned behavior," in *Action Control From Cognition to Behavior*, (Vol. 2) Berlin, Heidelberg: Springer, pp. 11–39.

Ajzen, I., and Fishbein, M. 1980. *Understanding attitudes and predicting social behaviour*, (E. Cliffs, ed.), New Jersey: Prentice-Hall.

Akhlaghpour, S., Wu, J., Lapointe, L., and Pinsonneault, A. 2013. "The ongoing quest for the IT artifact: Looking back, moving forward," *Journal of Information Technology* (28:2), pp. 150–166.

Alter, S. 2012. "Work System Theory: Overview of Core Concepts, Extensions, and Challenges for the Future," *Journal of the Association for Information Systems* (14:2), pp. 72–121.

Andersen, E. S. 2006. "Toward a project management theory for renewal projects," *Project Management Journal* (37:4), pp. 15–31.

Barki, H., Titah, R., and Boffo, C. 2007. "Information System Use-Related Activity: An Expanded Behavioral Conceptualization of Individual-Level Information System Use," *Information Systems Research* (18:2), pp. 173–192.

Beaudry, A., and Pinsonneault, A. 2005. "Understanding User Responses to Information Technology: A Coping Model of User Adaptation," *MIS Quarterly* (29:3), pp. 493–524.

Benbasat, I., and Barki, H. 2007. "Quo Vadis TAM?," *Journal of the Association for Information* (8:4), pp. 211–218.

Brynjolfsson, E., and Hitt, L. 2000. "Beyond computation: Information technology, organizational transformation and business performance," *The Journal of Economic Perspectives* (14:4), pp. 23–48.

Bulkeley, W. M. 1996. "'Working Together When Things Go Wrong: FoxMeyer Drug took a huge High-tech gamble; It didn't work,'" *The Wall Street Journal* New York, NY, p. 25.

Burton-Jones, A., and Grange, C. 2013. "From Use to Effective Use: A Representation Theory Perspective," *Information Systems Research* (24:3), pp. 632–658.

Burton-Jones, A., and Straub, D. W. 2006. "Reconceptualizing System Usage: An Approach and Empirical Test," *Information Systems Research* (17:3), pp. 228–246.

Chin, W., and Marcolin, B. 2001. "The future of diffusion research," *ACM Sigmis Database* (32:3), pp. 7–12.

Cooper, R. B., and Zmud, R. W. 1990. "Information Technology Implementation Research: A Technological Diffusion Approach," *Management Science* (36:2), pp. 123–139.

Damanpour, F., and Schneider, M. 2006. "Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization and Top Managers," *British Journal of Management* (17:3), pp. 215–236.

Davis, F. D. F. 1989. "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly* (13), pp. 319–340.

DeSanctis, G., and Poole, M. 1994. "Capturing the complexity in advanced technology use: Adaptive structuration theory," *Organization Science* (5:2), pp. 121–147.

Devadoss, P., and Pan, S. 2007. "Enterprise systems use: towards a structurational analysis of enterprise systems induced organizational transformation," *Communications of the Association for Information Systems* (19:17), pp. 351–385.

Elie-Dit-Cosaque, C. M., and Straub, D. W. 2011. "Opening the black box of system usage: user adaptation to disruptive IT," *European Journal of Information Systems* (20:5), pp. 589–607.

Fadel, K. 2012. "User Adaptation and Infusion of Information Systems," *Journal of Computer Information Systems* (52:3), pp. 1–10.

Fichman, R. R. G., and Kemerer, C. C. F. 1997. "The assimilation of software process innovations: an organizational learning perspective," *Management Science* (43:10), pp. 1345–1363.

Giddens, A. 1984. "The Constitution of Society Outline of the Theory of Structuration," Berkeley and Los Angeles: University of California Press.

Glaser, B. G., and Strauss, A. L. 2008. *The discovery of grounded theory: Strategies for qualitative research*, New Jersey, NJ: Transaction Publishers.

Goodhue, D., and Thompson, R. 1995. "Task-technology fit and individual performance," *MIS Quarterly* (19:2), pp. 213–236.
Gregor, S. 2006. "The nature of theory in information systems," *MIS Quarterly* (30:3), pp. 611–642.
Hannan, M., and Freeman, J. 1984. "Structural inertia and organizational change," *American Sociological Review* (49:2), pp. 149–164.
Hsieh, J. J. P. -a., Rai, a., and Xu, S. X. 2011. "Extracting Business Value from IT: A Sensemaking Perspective of Post-Adoptive Use," *Management Science* (57:11), pp. 2018–2039.
Hsieh, P.-A. J., and Zmud, R. 2006. "Understanding post-adoptive usage behaviors: A two-dimensional view," in *DIGIT 2006 Proceedings*, .
Ilgun, K., Kemmerer, R., and Porras, P. 1995. "State transition analysis: A rule-based intrusion detection approach," *IEEE Tansactions on Software Engineering* (21:3), pp. 181–199.
Jasperson, J., Carter, P., and Zmud, R. 2005. "A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems," *MIS Quarterly* (29:3), pp. 525–557.
Jeyaraj, A., and Sabherwal, R. 2008. "Adoption of information systems innovations by individuals: A study of processes involving contextual, adopter, and influencer actions," *Information and Organization* (18:3), pp. 205–234.
Jones, M., and Karsten, H. 2008. "Giddens's structuration theory and information systems research," *MIS Quarterly* (32:1), pp. 127–157.
Kim, H., and Kankanhalli, A. 2009. "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *MIS Quarterly* (33:3), pp. 567–582.
Kohli, R., and Devaraj, S. 2003. "Measuring information technology payoff: A meta-analysis of structural variables in firm-level empirical research," *Information Systems Research* (14:2), pp. 127–145.
Krotov, V., and Ives, B. 2011. "ERP Implementation Gone Terribly Wrong: The Case of Natural Springs," *Communications of the Association for Information Systems* (28:18), pp. 277–282.
Langley, A. 1999. "Strategies for theorizing from process data," *Academy of Management Review* (24:4), pp. 691–710.
Lapointe, L., and Rivard, S. 2005. "A Multilevel Model of Resistance to Information Technology Implementation," *MIS Quarterly* (29:3), pp. 461–491.
Lee, A. S., and Baskerville, R. L. 2003. "Generalizing Generalizability in Information Systems Research," *Information Systems Research* (14:3), pp. 221–243.
Legris, P., Ingham, J., and Collerette, P. 2003. "Why do people use information technology? A critical review of the technology acceptance model," *Information & Management* (40:3), pp. 191–204.
Leonard-Barton, D. 1988. "Implementation as mutual Adaptation of Technology and Organization," *Research Policy* (17:5), pp. 251–267.
Liang, H., Saraf, N., Hu, Q., and Xue, Y. 2007. "Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management," *Mis Quarterly* (31:1), pp. 59–87.
Lucas, H. J., Swanson, E., and Zmud, R. 2007. "Implementation, Innovation, and Related Themes Over The Years In Information Systems Research," *Journal of the Association for Information Systems* (8:4), pp. 206–210.
Lyytinen, K., and Newman, M. 2008. "Explaining information systems change: a punctuated socio-technical change model," *European Journal of Information Systems* (17:6), pp. 589–613.
Markus, L., and Tanis, C. 2000. "The Enterprise System Experience— From Adoption to Success," in *In Framing the Domains of IT Management: Projecting the Future Through the Past*, (Vol. 173) , pp. 173–207.
Markus, M., and Robey, D. 1988. "Information technology and organizational change: causal structure in theory and research," *Management Science* (34:5), pp. 583–598.
Mingers, J. 2004. "Real-izing information systems: critical realism as an underpinning philosophy for information systems," *Information and Organization* (14:2), pp. 87–103.
Morton, P. 2006. "Using critical realism to explain strategic information systems planning," *Journal of Information Technology Theory and Application* (8:1), pp. 1–20.
Mueller, B., and Raeth, P. 2012. "What you see is what you get?–A comparison of theoretical lenses to study technology in organizations," in *Proceedings of the 33rd International Conference on Information Systems*, Orlando, FL, USA.
Mueller, B., and Urbach, N. 2013. "The Why, What, And How of Theories in IS Research," in *Proceedings of the 34th International Conference on Information Systems*, Milan, Italy.

Mutch, A. 2002. "Actors and Networks or Agents and Structures: Towards a realist view of Information Systems," *Organization* (9:3), pp. 477–496.
Myers, M. D., and Newman, M. 2007. "The qualitative interview in IS research: Examining the craft," *Information and Organization* (17:1), pp. 2–26.
Nan, N. 2011. "Capturing Bottom-Up Information Technology Use Processes: A Complex Adaptive Systems Model.," *MIS Quarterly* (35:2), pp. 505–532.
Orlikowski, W. 2000. "Using technology and constituting structures: A practice lens for studying technology in organizations," *Organization science* (11:4), pp. 404–428.
Orlikowski, W., and Iacono, C. 2001. "Research commentary: Desperately seeking the' IT' in IT research—a call to theorizing the it artifact," *Information Systems Research* (12:2), pp. 121–134.
Orlikowski, W. J. 1996. "Improvising Organizational Transformation Over Time: A Situated Change Perspective," *Information Systems Research* (7:1), pp. 63–92.
Panorama. 2013. "'2013 ERP Report,'" Denver, Co.
Paul, R. J. 2007. "Challenges to information systems: time to change," *European Journal of Information Systems* (16:3), pp. 193–195.
Pentland, B. T., and Feldman, M. S. 2005. "Organizational routines as a unit of analysis," *Industrial and Corporate Change* (14:5), pp. 793–815.
Petter, S., DeLone, W., and McLean, E. 2008. "Measuring information systems success: models, dimensions, measures, and interrelationships," *European Journal of Information Systems* (17:3), pp. 236–263.
Purvis, R. L., Sambamurthy, V., and Zmud, R. W. 2001. "The assimilation of knowledge platforms in organizations: An empirical investigation," *Organization Science* (12:2), pp. 117–135.
Rivard, S., and Lapointe, L. 2012. "Information Technology Implementers' Responses to User Resistance: Nature and Effects," *MIS Quarterly* (36:3), pp. 897–920.
Rogers, E. M. 1983. *Diffusion of innovations*, (3rd ed.) New York, NY: The Free Press.
Rogers, E. M. 1995. *Diffusion of innovations*, (5th ed.) New York, NY: The Free Press.
Saraf, N., Liang, H., Xue, Y., and Hu, Q. 2013. "How does organisational absorptive capacity matter in the assimilation of enterprise information systems?," *Information Systems Journal* (23:3), pp. 245–267.
Schultze, U., and Avital, M. 2011. "Designing interviews to generate rich data for information systems research," *Information and Organization* (21:1), pp. 1–16.
Schultze, U., and Boland, Jr, R. J. 2000. "Knowledge management technology and the reproduction of knowledge work practices," *Journal of Strategic Information Systems* (9:2), pp. 193–212.
Schwarz, A., Chin, W. W., Hirschheim, R., and Schwarz, C. 2014. "Toward a process-based view of information technology acceptance," *Journal of Information Technology* (29:1), pp. 73–96.
Seddon, P., Calvert, C., and Yang, S. 2010. "A Multi-project model of key factors affecting organizational benefits from enterprise systems," *MIS Quarterly* (34:2), pp. 305–328.
Setia, P., and Setia, M. 2011. "The Effects of the Assimilation and Use of IT Applications on Financial Performance in Healthcare Organizations," *Journal of the Association for Information Systems* (12:3), pp. 274–298.
Shang, S., and Seddon, P. B. 2002. "Assessing and managing the benefits of enterprise systems: the business manager's perspective," *Information Systems Journal* (12:4), pp. 271–299.
Sia, S., and Soh, C. 2007. "An assessment of package–organisation misalignment: institutional and ontological structures," *European Journal of Information Systems* (16:5), pp. 568–583.
Soh, C., and Markus, M. L. 1995. "How IT creates business value: a process theory synthesis," in *Proceedings of the 13th International Conference on Information Systems, Paper 4.*, Amsterdam, Netherlands, pp. 29–41.
Strong, D., and Volkoff, O. 2010. "Understanding organization-enterprise system fit: a path to theorizing the information technology artifact," *MIS Quarterly* (34:4), pp. 731–756.
Sun, H. 2012. "Understanding User Revisions When Using Information System Features: Adaptive System Use and Triggers," *MIS Quarterly* (36:2), pp. 453–478.
Sykes, T., Venkatesh, V., and Gosain, S. 2009. "Model of acceptance with peer support: A social network perspective to understand employees' system use," *MIS Quarterly* (33:2), pp. 371–393.
Sykes, T., Venkatesh, V., and Johnson, J. 2014. "Enterprise system implementation and employee job performance: Understanding the role of advice networks," *MIS Quarterly* (38:1), pp. 51–72.

Turner, M., Kitchenham, B., Brereton, P., Charters, S., and Budgen, D. 2010. "Does the technology acceptance model predict actual use? A systematic literature review," *Information and Software Technology* (52:5), pp. 463–479.
Tyre, M. J., and Orlikowski, W. J. 1994. "Windows of Opportunity: Temporal Patterns of Technological Adaptation in Organizations," *Organization Science* (5:1), pp. 98–118.
Venkatesh, V., Morris, M., Davis, G., and Davis, F. 2003. "User acceptance of information technology: Toward a unified view," *MIS Quarterly* (27:3), pp. 425–478.
Volkoff, O., Strong, D., and Elmes, M. 2007. "Technological embeddedness and organizational change," *Organization Science* (18:5), pp. 832–848.
Volkoff, O., Strong, D. M., and Elmes, M. B. 2005. "Understanding enterprise systems-enabled integration," *European Journal of Information Systems* (14:2), pp. 110–120.
Wand, Y., and Weber, R. 1995. "On the deep structures of information systems," *Information Systems Journal* (5:3), pp. 202–223.
Weber, R. 1997. *Ontological foundations of information systems*, Melbourne: Coopers & Lybrand and the Accounting Association of Australia and New Zealand Melbourne.
Wen, C., Remus, U., and Mills, A. 2011. "Understanding and addressing user resistance to IS implementation in a lean context," in *Proceedings of the 19th European Conference on Information Systems, Paper 171*, Helsinki, Finnland.
Wynn, D., and Williams, C. 2012. "Principles for Conducting Critical Realist Case Study Research in Information Systems.," *MIS Quarterly* (36:3), pp. 787–810.
Yamauchi, Y., and Swanson, E. B. 2010. "Local assimilation of an enterprise system: Situated learning by means of familiarity pockets," *Information and Organization* (20:3-4), pp. 187–206.
Yin, R. 2008. *Case study research: Design and methods*, (5th ed.) London: Sage Publications.