

REPAIRING ROUTINES IN ENTERPRISE SYSTEM
TRANSFORMATIONS
– A SOCIOMATERIAL PERSPECTIVE –

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Für meine Familie

Abstract

Today, large implementation projects introducing Enterprise System (ES) technology in organizations are a very common phenomenon, typically driven by the idea that a myriad of benefits can be realized. Yet, after implementation, organizations often face challenging problems due to misalignments between “best practices” embedded in ES technology and existing work practices. For the individual user implementation of new technology thus implies considerable effort in terms of cognitively accomplishing appropriation. This complex process of appropriation was found to result in very strong links between technology and individuals that is described as a sociomaterial entanglement by some scholars. In addition, ES technology implementations do often not ‘simply’ introduce a new technology into an organization, but will likely replace a similarly complex, integrated legacy system. Given the strong link between individuals and technology, established while appropriating the legacy system, replacing old technology will imply the breaking of old associations as much as the building of new ones. Consequently, the point of departure is as much characterized by an achieved sociomaterial entanglement with the old technology as it is by the need to integrate new technology into work practices. It has long been argued that organizational routines are key to understanding changes of work practices in organizations as well as the associated process of organizational learning. While the question how organizational routines emerge and evolve over time is extensively studied, little is known about what happens when routines are disrupted. In addition, the substitution of a legacy system raises the question, how exiting entanglements influence changes in routines triggered by ES technology implementation. Addressing this gap in the literature, this thesis aims to understand how sociomaterial routines are repaired after the implementation of ES technology.

To answer this question, a longitudinal interpretive case study of an ES technology implementation project in the retail banking division of a large German bank was conducted. The custom-built legacy system to be replaced by new ES technology due to technical and regulatory requirements had been in place for over thirty years before. Within the retail banking division the study focuses on the credit service unit, which offers back-office services to the bank’s customers and advisors. The case material consists of 57 semi-structured interviews and observation of 38 participants, collected at three different stages during the project (before go-live, immediately after go-live, and 6 month

later). Using narrative networks as an analytical device helped capturing the complexity of routine changes related to ES technology implementation and provided the conceptual link between organizational routines and sociomaterial entanglements. Based on a comparison of relevant routines at different points in time during (post-) implementation, five categories of practices individuals (in different positions/at different organizational levels) employed to repair routine performances were identified. Two of the practices aimed directly at adapting routines. But, individuals also developed additional support practices (i.e., work practices, which are performed in addition to, but share common fragments with, the supported routine). Two more repair practices targeted the sociomaterial background based on which routines are established, that is they changed the basis on which those actants are delineated, which are subsequently forming routine fragments. Thus, in line with other studies of post-implementation behavior, the findings show that repairing routines is a collaborative achievement of many, if not all, individuals directly and indirectly affected by the technological change. Yet, the repair practices employed at different levels do not operate independently, but are highly inter-related. Like researchers studying other phenomena using a sociomaterial lens, both physical (e.g., use of printouts) as well as digital (e.g., functionality of new ES technology) materiality were found to be important constituents of problems and repair practice. Furthermore, time was similarly important for repairing routines as both the timing of routine executions as well as the unfolding of repair practices over time had major effects on the final success of recreating routines. The findings also highlight that repair practices are different with respect to their persistence. While those practices employed to handle the situation of change were more likely to disappear again (yet did not necessarily do so), those required for adapting routines and accommodating the new system most likely persist.

In conclusion, repairing routines after ES technology implementation does not only involve replacing one routine fragment (related to the old technology) with a new fragment (based on new technology) and appropriately reincorporating this new fragment into an otherwise stable routine. To the contrary, repairing routines implicates far more profound changes to routines, which have to be negotiated both with the social and material environment, and further requires adjusting the sociomaterial background based on which routines are established. In addition, repair practices evolve over time and dif-

fer with respect to their persistence. Thus, repairing a routine has a social, material, and temporal dimension, which jointly have to be considered.

This doctoral thesis contributes to theory by providing a conceptual account of ES Transformation, which offers an explanation of how a working ES is reestablished by repairing routines after the implementation of ES technology. These findings are also valuable for practitioners as they allow them to better understand and consequently better plan and manage ES Transformations.

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List of Abbreviations

ANT	Actor-Network-Theory
CF	Credit Factory
CIO	Chief Information Officer
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
ES	Enterprise System
FDI	Fire Danger Index
IS	information System
IT	Information Technology
LMS	Loan Management System
MoP	Mangle of Practice
OLMS	Old Loan Management System
PSN	Production Service New
PSS	Production Service Stock
SSG	Sales Service Group

1 Introduction

The implementation of Enterprise System (ES) technology, such as an Enterprise Resource Planning (ERP) system, is typically driven by the idea that a myriad of benefits, like enabling new business models, efficiency gains, or increased productivity (Brynjolfsson and Hitt 1998; Shang and Seddon 2002) can be realized resulting in increased organizational performance (Markus and Tanis 2000; Strong and Volkoff 2004). But, even though the idea of technology having (beneficial) deterministic effects is in place for a considerable time already, it was empirically only partially supported so far and evidence rather indicates the existence of more complex sociotechnical processes (Leonardi 2013). Individuals are important in these processes as only they can actually establish working ES that integrate the newly implemented ES technology (Boudreau and Robey 2005; Orlikowski 2000). The associated process of making sense (Orlikowski and Gash 1994; Weick et al. 2005) of complex ES indicates interpretive flexibility of information technology (Boudreau and Robey 2005) and implies considerable effort by the individual in terms of cognitively accomplishing the appropriation of new systems (Ramiller 2013). This complex process of appropriation was found to result in very strong links between technology and individuals that is described as a sociomaterial entanglement by Orlikowski and Scott (2008).

Yet, while individual users need to develop their own interpretations of a system to meaningfully integrate it into their work, implementation of ES technology also requires organization wide interaction and coordination (Van Fenema et al. 2007). A major problem is the need to deal with misalignments between “best practices” embedded in the ES technology and the work practices established within the organization before the new technology was implemented (Sia and Soh 2007; Strong and Volkoff 2010). While implementation projects can considerably benefit from early detection of misalignments during product selection and configuration, more complicated misalignments may only become evident in the post-implementation phase (Sia and Soh 2007) and packaged software in general seems to postpone these kinds of conflicts to the phase after go-live (Van Fenema et al. 2007). Hence, many misalignments will need to be worked through after go-live (Wagner et al. 2010). In addition, ES technology implementations today do not simply introduce a new technology into an organization, but will likely replace a similarly complex legacy system. Given the strong link between individuals and tech-

nology established during appropriation, replacing a legacy system will imply the breaking of old associations as much as the building of new ones. Consequently, the point of departure is as much characterized by achieved sociomaterial entanglement with the old technology as it is by the need to integrate the new technology into work practices.

Thus, the change occurring in these kinds of situations may be better described as ES Transformation, that is, transforming the sociomaterial network lying at the heart of the (existing) ES by changing (part of) its technological basis rather than the "just" adopting or implementing new ES technology. It has long been argued that organizational routines are key to understanding changes of work practices in organizations as well as the associated process of organizational learning (Levitt and March 1988; Pentland and Feldman 2008). While the question how organizational routines emerge and evolve over time has been extensively studied, little is known about what happens when routines are disrupted (Brauer and Laamanen 2014). In addition, the substitution of a legacy system raises the question, how exiting entanglements influence changes in routines triggered by ES technology implementation. Or, put it differently, the remainder of this work aims to answer the following research question:

How are sociomaterial routines repaired during ES Transformations?

1.1 Research Goals

While the sociomaterial perspective hints towards the conceptualization of the process of ES technology post-implementation as the transformation of a relational phenomenon, this concept is not yet outlined in literature. Furthermore, a number of apparently different theoretical positions currently embody the sociomaterial paradigm. Each of these theoretical lenses serves as a sensitizing device to recognize and theorize the sociomaterial constitution of phenomena, but they do not necessarily share the meta-theoretical assumptions with one another (Mueller et al. 2012). Providing an overview and classification of currently discussed theoretical conceptualizations is thus the first step towards a sociomaterial understanding of ES Transformation. This sociomaterial understanding forms the basis for integrating the insights from literature on organizational routines and ES technology post-implementation. The resulting conceptualization

of the relational phenomenon of ES Transformation in turn allows the empirical investigation of the research question posted above. It supports the identification of the aspects of empirical reality relevant for answering the question and thus helps effectively capturing the complexity of this phenomenon. Thus, the doctoral thesis has three main research goals:

- (1) Providing an overview and classification of available theoretical lenses based on the sociomaterial paradigm
- (2) Conceptualizing the sociomaterial phenomenon of ES Transformation
- (3) Understanding how sociomaterial routines are repaired during ES Transformations

1.2 Structure of the Thesis

To answer the research question and to achieve these goals, the remainder of the doctoral thesis is structured as follows: **chapter two** provides an overview and discussion of the emerging meta-theoretical foundation of sociomaterial theorizing. Based on a review of the literature empirically engaging with sociomateriality, the theoretical lenses currently employed in sociomaterial studies are identified. For these lenses and combinations of them, the focal points and possible contributions are discussed.

Chapter three gives an overview of the conceptual foundations covering research on organizational routines as well as ES technology implementation. Building on these concepts and the meta-theoretical foundations established in chapter two, a framework for analyzing ES Transformations is developed.

The **fourth chapter** describes the research design starting with a description of the case investigated and the process of data collection. This is followed by an introduction of the narrative networks approach and a description how the approach is used for the analysis of the case material.

Chapter five presents the results of the case study. The routines identified at the case company and the issues employees faced when trying to perform the routines after the new ES technology was introduced are described. This is followed by an account of the

strategies participants, and the organization in general, employed for coping with these issues.

Chapter six discusses the findings in the light of the insights available in literature and establishes the concept of repair practices based on the framework developed in chapter three.

Finally, the doctoral thesis concludes by highlighting the theoretical and practical contribution and discussing the limitations of the research presented in **chapter seven**. The chapter closes with an overview of possible future work.

2 Meta-theoretical foundation of sociomaterial theorizing

Arguing against a technological determinist view prevalent in the early days of technology and organizational studies (e.g., Perrow 1967; Woodward 1958) and the resulting tendency to overstate the influence of the respective entities this approach frames the systems under investigation as a dualism with the social and the technological subsystem reciprocally influencing each other (Orlikowski and Scott 2008). While earlier work on socio-technical systems (e.g., Trist and Bamforth 1951) advocated the idea of ‘joint optimization’ of both subsystems, researchers building on their concepts departed from this view in one of the following ways. They tended to either resembled technological determinism, in that researchers wrote primarily about altering the social to fit the technical (Leonardi and Barley 2010). Or, they privileged the social, i.e. social construction of technology, in an attempt to avoid technological determinism (e.g., Barley 1986; Rice 1987) and eventually downplayed the role of technology in making it a mere trigger for the social processes under investigation (Leonardi and Barley 2010). While the latter approach was able to show that a technological determinist view was incompatible with empirically observable reality in organizations, it basically implied the same problem, as ignoring the effects technology had on companies did not reflect very well in actual experiences in practice (Orlikowski and Iacono 2001).

Similar changes can be observed in the history of the sociology of science studies. Like research on technology and organizing, sociology of science turned toward social construction in the 1980s. Eventually, however, scholars began to caution that such an orientation might be misguided because material phenomena (be they natural or technical) do things that cannot be attributed to social practice (Hutchby 2001; Pickering 2001) and have shown that attending to agency and social dynamics is not incompatible with an appreciation for material constraints and affordances (Latour and Woolgar 1979; Lynch 1985).

Leveraging the advances made by these scholars, the sociomateriality perspective currently discussed in the Information Systems and Organization communities (Cecez-Kecmanovic, Galliers, et al. 2014; Orlikowski and Scott 2008), aims at resolving the social/technological determinism issue for those disciplines.

By now, several different theoretical positions embody the sociomaterial paradigm, each serving as a sensitizing device to recognize and theorize the intertwining of the material

and the social, but not necessarily share the assumptions of the others (Mueller et al. 2012). Thus, it remains unclear what this paradigm actually implies and how it can be leveraged in empirical research. The following sections provide an overview and classification of currently discussed theoretical conceptualizations. This forms the basis for the reconceptualization of ES Transformation developed in the sections 3.4 and 3.5.

2.1 A framework for analyzing sociomateriality

2.1.1 Meta-theory and theoretical lenses

The notions of meta-theory and theoretical lens are key to the following analysis and classification of theoretical foundations applied in studies of sociomaterial phenomena. The theories identified in the following sections are best characterized as meta-theories. Such meta-theories differ from theories in the narrow sense, “in that they constitute a theory about theories” (Mueller and Raeth 2012, p. 3), while the latter are typically conceived as abstractions of the empirical (Furfey 1953).

Thus, similar to meta-models in software or process modeling, meta-theories can be understood as meta-models for theories. They are valuable as frameworks or guidelines for creating more context-specific models of empirically observable behavior, that is, for developing theories in the more narrow sense. Meta-theories help scholars to be conscious of the nature and context of the phenomenon they investigate and thus support the identification of meaningful constructs and relevant relations (Milton and Kazmierczak 2006). Due to this capacity, meta-theories can facilitate theory development (Bostrom et al. 2009) and provide “a way of thinking about other theories” (Gregor 2006, p. 616).

These meta-theories implicitly or explicitly build on certain philosophical assumptions concerning epistemology and ontology. Epistemology denotes the underlying theory of knowledge and includes beliefs about what knowledge is, and how valid knowledge can be obtained (Hirschheim 1985). Ontology refers to the concept of reality and includes assumptions about the essence and characteristics of the various entities and phenomena

that exist in the world, as well as questions like whether this reality has an exists independent of humans (i.e., objectively) or only in relation to them (i.e., subjectively) (Orlikowski and Baroudi 1991). Prominent examples of general philosophical perspectives offering a consistent position on these issues are positivism and interpretivism (Klein and Myers 1999; Lee 1991). More recent examples include Agential Realism (Barad 2007) and Critical Realism (Wynn and Williams 2012).

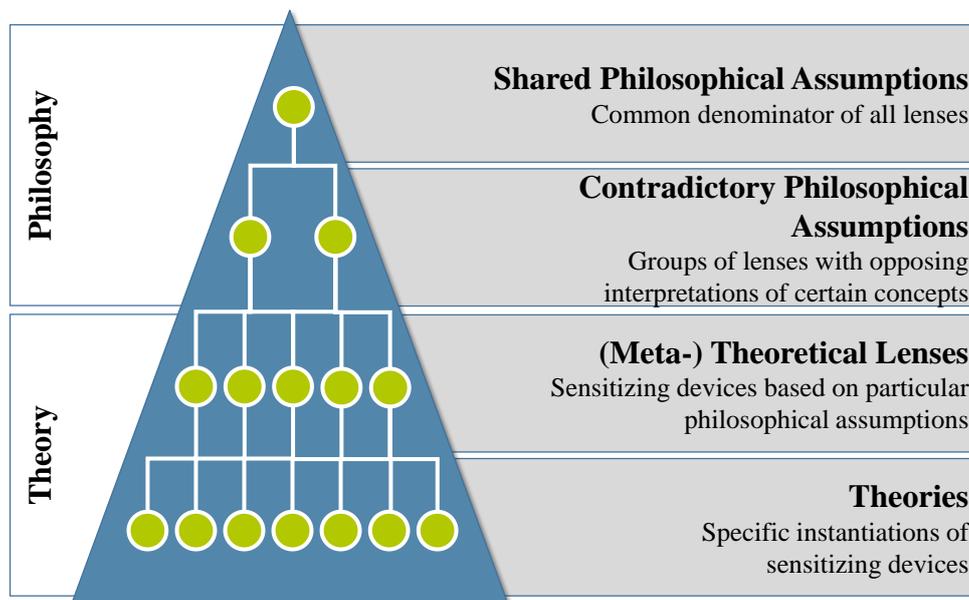


Figure 1: Framework for analysing sociomateriality

Similarly, as will be discussed in the next section, current applications of the concepts related to sociomateriality agree on several philosophical assumptions or essential concepts. Still, there is also considerable debate regarding the interpretation of these concepts. Building on the notion outlined above, the categories presented subsequently are understood as sensitizing devices or theoretical lenses. These lenses form an additional layer between theories and fundamental philosophical positions (Figure 1), and are key to studies of sociomateriality in two ways. First, they help identifying relevant phenomena, that is, allow focusing the empirical investigations on aspects relevant to the phenomenon under investigation. Second, these lenses offer the meta-theoretical basis for building conceptual models and theories of the phenomena observed empirically. Before turning to the review of the literature, existing classifications of the sociomateriality literature will briefly be discussed in the following section.

2.1.2 Related work

By now, several attempts were made to provide an overview of the different positions related to sociomateriality.

Based on a comprehensive review of the literature employing a sociomaterial perspective, Jones (2014) discusses two forms of sociomaterial theorizing and also offers a list of notions, which are characteristic for this line of reasoning (the shared assumptions). He analyzed the journal articles referring to the concept of sociomateriality, which appeared until end of 2013. The findings show that almost all authors cite Orlikowski's work (i.e., Orlikowski 2007, 2010; Orlikowski and Scott 2008) when discussing the concept. From these works he derived the central notions of sociomateriality, which are related to particular philosophical assumptions: materiality, inseparability, relationality, performativity, practices.

From a sociomaterial perspective *materiality* is central for understanding phenomena related to contemporary organizations. The notion of *inseparability* denotes the *view* that the social and the material are isolated phenomena, but inextricably intertwined or mutually interdependent. *Relationality* refers to the position that relations are an essential aspect of any contemporary phenomenon. *Performativity* implies that excreting agency is a situated performance and not a solely human capacity. And, finally sociomateriality is concerned with *practices*, instead of focusing on discourses or cognition.

Yet, far from being uncontested grounds these notions and assumptions are applied very differently in current sociomaterial studies. First, only a few of the articles identified by Jones (2014) address “all of the notions that Orlikowski suggests are entailed in sociomateriality”. Second, in addition to differences in the number of notions considered, the notions themselves can be interpreted and employed very differently. Thus, Jones (2014) suggest that “a number of variants are possible that take different positions on these notions”(p. 922). In particular, he distinguishes between strong and weak sociomateriality. Proponents of the latter argue that, while objects and humans are highly interdependent and able to produce effects only in concert, social and material phenomena can still be considered as separate yet interacting. In contrast, for scholars adhering to the former boundaries between and properties of objects and humans do not exist as such, but emerge from their relations in a particular situation.

This distinction resembles Leonardi's (2013) discussion of two different philosophical traditions valuable for and currently employed in sociomaterial theorizing. In a response to and elaborating on recent criticism on the idea of sociomateriality (Mutch 2013), Leonardi (2013) discusses the value of Agential and Critical Realism as theoretical foundation for studying sociomaterial phenomena. Strong sociomateriality can be said to build on the Agential Realist tradition, while weak sociomateriality is closer to Critical Realist thinking (Jones 2014).

Thus, the theoretical positions currently embodying the sociomaterial paradigm are very heterogeneous and build on very different (and seemingly contradictory) interpretations of the key notions proposed in the seminal works (Orlikowski 2007, 2010; Orlikowski and Scott 2008). While current attempts to address this issue are valuable in that they explicate and discuss the philosophical assumptions central to sociomaterial thinking, they also leave prospective sociomaterial scholars with considerable confusion regarding the implications for research practice. Furthermore, the current heterogeneity in perspectives makes it difficult to establish a common body of knowledge about sociomaterial phenomena and thus impedes further theorizing and the accumulation of knowledge (Corley and Gioia 2011).

The remainder of this chapter builds on the works presented above and extends them by offering an additional layer of classification – the meta-theoretical lenses – that attempts to bridge the current gap between available sociomaterial theories and recent discussions about the foundational philosophical positions.

2.2 Methodology of the literature review

The analysis started with reading the seminal publications on sociomateriality (e.g., Suchman 2007; Orlikowski and Scott 2008; Leonardi and Barley 2010; Leonardi 2013). Based on these works as well as selective backward and forward search (Webster and Watson 2002), an initial understanding or preconception (Sarker and Lee 2006) of this field of studies was established. More specifically, this included reading and analyzing the seminal works related to those theoretical positions (e.g., Barad 2003; Callon 1986; Latour 1992; Pickering 1993), which were identified as belonging under the “umbrella”

(Orlikowski and Scott 2008, p. 456) of sociomateriality. This understanding help orienting in the complexity of this emerging perspective and resulted in a shift in the study's objective in terms of focusing on how sociomateriality is currently applied in research practice instead of providing a general classification of all the theoretical positions related to the sociomaterial paradigm. In parallel, the orientation towards identifying theoretical lenses emerged at this stage of the review. Overall, this method is inspired by the approach suggested by Wolfswinkel and colleagues (2013), yet is closer aligned with hermeneutics (e.g., Cole and Avison 2007) rather than building on Grounded Theory as they propose.

The core concept in hermeneutics is the hermeneutic circle. It is a device of mind (Sarker and Lee 2006) that allows the reader of texts to comprehend the parts in terms of the whole and vice versa. Starting with an explicit articulation of the initial (pre-)understanding, the idea is to carefully read the text "looking for any apparent absurdities" (Sarker and Lee 2006, p. 133) or contradictions. Facing such absurdities the reader then "asks herself how a sensible person could have [expressed] them" (Lee 1991, p. 348). When the reader "comes across a plausible answer (however, tentative it might be)" (Sarker and Lee 2006, p. 133), this new understanding may also change the meanings of other parts of the text, the ones previously thought to have been understood, thus starting a new round through the circle. These iterations are discontinued once a satisfactory interpretation is achieved and no absurdities or contradictions are discovered any longer. Still, it is recognized that "further passes through the hermeneutic circle can result in an improved understanding" (Sarker and Lee 2006, p. 134). This iterative process was used both for the analysis of articles as well as for developing the classification of these articles according to their meta-theoretical foundations.

Equipped with the preconception established in the first step, the analysis was started based on the list of articles empirically engaging with sociomateriality identified by Jones (2014). As the list only includes articles published until the end of 2013, it was extended with studies published until September 2014. Because the sociomaterial perspective is not yet well accepted, and in line with the approach employed by Jones (2014), the search was not limited to particular journals to ensure that all articles referring to sociomateriality were found, even if they were not published in common journals. Instead, the inquiry was conducted by broadly searching for any paper using the terms "sociomaterial" and "sociomateriality" with or without hyphen. More specifically,

two online databases (ABI/Inform (ProQuest) and EBSCOhost) were queried using the following search term:

socio-material OR sociomaterial* OR "socio material*"*

The search included article titles, abstracts, keywords, and full texts (if available in the database). This resulted in a pool of 234 articles from which those works were extracted (relevant articles), which investigated phenomena related to organizational research and/or Information Systems and employed sociomateriality empirically¹ (Table 1).

Source	Publication year	# relevant articles	# excluded articles	Total
Jones (2014)	2007-2013	28	118	146
Database search	2014	16	72	88
Total		44	190	234

Table 1. Articles using terms related to sociomateriality

Several articles were excluded, because they only include a passing mention of socio-materiality (96 articles) or engage with sociomateriality conceptually without empirically grounding their considerations (56 articles). But, the initial search results for the year 2014 also included articles from fields like political geography, psychology, or agriculture, which were also omitted (31 articles). In addition, five articles had to be excluded, because full texts were not available. Furthermore, two articles from the list derived by Jones (2014) were reclassified and thus excluded, because they only offered a passing mention of sociomateriality in an otherwise traditional quantitative study (Cecez-Kecmanovic, Galliers, et al. 2014). The final list of relevant articles included 44 studies.

In line with the hermeneutic approach, this was followed by reading the relevant articles and identifying the concepts and language used by the authors to describe and disentangle the sociomaterial complexities. The lenses as well as the concept of multifaceted lenses, presented in the next section, iteratively emerged in this process. Using the lan-

¹ For a detailed list of articles excluded from the literature review see Appendix B.

guage of hermeneutics, the understanding of the whole (the classification of the sociomateriality literature) iteratively was established by analyzing the parts (the relevant articles), integrating the results of this analysis with the overall understanding, and revising the understanding if contradictions surfaced.

Once the lenses were identified, the analysis focused on the types of results that can be achieved with the respective lens. That is, the understanding of the whole was refined by again analyzing different aspects of the parts. In line with the hermeneutic idea, this step also implied a revision of the previous understanding. This revision did not affect the list of lenses, but some of the articles had to be reclassified as belonging to a lens different from the initial classification. In other words, the boundaries of the lenses were still emerging along with the articulation of the results of the review.

Furthermore, it became evident that the different articles belonging to a particular lenses can be differentiated in terms of their affinity to the concepts proposed by ‘neighboring’ lenses. Thus, the final iteration of the hermeneutic circle implied an analysis of the articles regarding their relationship to the lenses they are not directly associated with.

2.3 Results: theoretical lenses in sociomaterial research practice

The hermeneutic process resulted in six theoretical lenses: actor-network-theory (ANT), reconfiguration, sociomateriality (narrowly conceived), affordances, the mangle of practice (MoP), and imbrication. The following sections, briefly introduce each lens and its key concepts followed by an overview of articles employing the respective lens. Most studies either employed a sociomateriality, ANT, or reconfiguration lens. Thus, these three lenses are described in separate sections first. Because of the larger number of articles associated to these lenses the articles are further clustered by the phenomenon they investigate. This is followed by the description of the other three lenses in one combined section. The final section describes those articles, which do not restrict their theorizing to a single lens, but employ multiple ones.

2.3.1 Actor-network-theory

ANT originated within science and technology studies and is typically associated with Bruno Latour, Michel Callon and John Law, but by now has been applied and further developed by many others (e.g. Hanseth and Monteiro 1997; Mitev and Howcroft 2011; Mol 1999, 2002). A distinguishing feature of ANT is the extension of the notion of an actor to include both humans and non-humans. Callon and Latour define an actor as “any element which bends space around itself, makes other elements dependent upon itself and translates their will into a language of its own” (Callon and Latour 1981; p.286). Examples of actors include but are not limited to people, groups of people, ideas, methodologies, texts, graphics, computers and other technical items (Sarker et al. 2006). The term actants is often used instead of actor, to highlight the inclusion of humans and nonhumans and distinguish the concept from common conceptualizations of actors being humans only.

One of the most distinguishing as well as controversial characteristics of ANT is that it treats human and non-human actors in the same way. While many critics oppose to the theoretical stance that non-human actors (e.g. a computer system) can have their own interests, others maintain that such a position can provide researchers with a powerful tool for analyzing intricate sociotechnical networks. It is important to note that the interests of a non-human actor can be equated to the interests inscribed in it (Sarker et al. 2006).

An important feature of ANT is that a network can be analyzed at different levels of complexity. Often, in order to simplify the analysis, analysts treat a network as a single actor. Such a simplification can be accomplished because the behavior of single actors can be taken for granted and encapsulated in a “network package” (Law 1992). This is called punctualization or black boxing. Law points out that punctualization is always dangerous because analysts often overlook complexities in a failing punctualized network. When there is the possibility of degeneration of a punctualized network, Law advises analysts to turn their attention to individual network elements. For example, the human body of a healthy person is usually seen as a distinct entity, yet a sick person’s body is usually viewed as complex system of interacting elements (Law 1992). ANT focuses on the relations that constitute actor networks and perform and temporally stabilize social arrangements; social arrangements are thus relational effects rather than entities with predefined qualities (Law 2008). Translation is the process whereby the differ-

ent actors' interests, meanings, and values are aligned, thus developing and stabilizing the network. During translation actors negotiate or maneuver others' interests towards their own with the aim of enrolling actors into the network (Rodon et al. 2008). Law (1992) suggests that there can be no standard way of ensuring effective translation and that it is essentially local and depends on the situation.

Article	Phenomenon investigated	Data collection approach
Constantinides and Barrett (2012)	emergency response	interviews, observations
Güney and Cresswell (2012)	IT governance	interviews, observations, documents
Monteiro and Rolland (2012)	organizational routines and practices	semi-structured interviews, participant observation, documents
Pentland et al. (2012)	organizational routines	simulation
Pierides and Woodman (2012)	emergency response	document analysis (archival data)
Thompson (2012)	technology-supported learning	interviews, documents
Boll (2014)	tax compliance	interviews, observations
Cecez-Kecmanovic (2014)	IS project success/failure	observation, interviews, informal discussion, documents
Effah (2014)	dot-com success/failure	semi-structured interviews, informal conversations, document analysis/archival data
Habib et al. (2014)	technology-supported learning	semi-structured interviews
Müller (2014)	governance of large-scale projects	observation, semi-structured interviews, documents

Table 2: Articles employing an ANT lens.

The ANT lens was employed or extended in eleven articles investigating a broad range of phenomena (Table 2). The phenomena studied include emergency response, IT-related success and failure, technology-supported learning, compliance and governance, as well as organizational routines and practices. These will be presented subsequently in more detail.

Emergency response

Using an ANT lens, Pierides & Woodman (2012) study organizing in the face of disaster. Their analysis is based on archival data on the 2009 bushfires in Victoria, Australia. Extending ANT with the concept of withdrawnness from Graham Harman's object-oriented philosophy, they analyze the role of both the Fire Danger Index (FDI) and surprises in the organization of emergency responses during the crisis. The FDI was introduced for the prediction of fire behavior (including chances of a fire igniting, rate of spread, intensity, and difficulty of suppression) and is used for issuing fire warnings. The findings highlight that, while it is not possible to fully determine the final orders of nature and capture them in indices, there are knowledge practices that allow emergency management to better handle unforeseen situation. In the case of fire emergencies the FDI index can be the basis of such practices, as it “has its own emergent capacity to partially register the surprises that [emerge] during the bushfire” (p. 676), as it can generate numbers that are larger than those originally expected and thus can render the original classification of types of fire emergency problematic. Yet, if emergency management sticks to established routines to control the situation, this capacity cannot translate into a positive effect.

Similarly, Constantinides and Barrett (2012), in their study the temporal and situated nature of coordination in emergency response, employ an approach, which builds on ANT, but conceptually extends it. They use the analytical device of narrative networks (Pentland and Feldman 2007), which in addition to ANT builds on the theory of organizational routines (Feldman and Pentland 2003). Data is gathered with interviews and observations. Their findings show that both shared cognitive models and improvised coordination co-exist in practice. Coordinating practices were performed in an effort to deal with the relationality of temporal action–events. Temporal action-events are the actions performed at a particular time by multiple actants (like rescue staff, IT, medical devices, medication, and disposable items), for example an emergency dispatcher using radio equipment to inform the ambulance crew of an alternative pick-up point.

“Relationality refers to the way practices performed in one temporal action–event had direct implications for the next as the incident's trajectory unfolded.” (p.290)

In one of the incidents described for example, the ‘golden time’ (i.e., the time during which there is the highest likelihood that immediate emergency care prevents the death

of the patient) was a key concern in the relationality between the temporal action–events of the dispatcher selecting an alternative pick-up point because of the limitations of the geographical information system and the ambulance crew arriving there just in time and providing immediate care to the patient by improvising protocols (i.e., giving an adrenaline shot even though no doctor was present). In addition, the findings highlight the “non-locality” (p.291) of incidents, that is, practices at different physical location are not disconnected, but – facilitated by technology – are performed in concert.

IT-related success and failure

Being interested in the mechanisms by which different and potentially competing assessments of an information system (IS) and an IS project arise from different socio-material practices, Cecez-Kecmanovic (2014) studied the implementation of a highly innovative information system in an insurance company. Their case data includes observation, interviews, informal discussion, and documents. The findings highlight, that “IS projects and the implemented systems as objects of assessment are not given and fixed, but are performed by the agencies of assessment together with the assessment outcomes of success and failure”(p.561). This implies that an IS and the corresponding project can simultaneously be perceived (or assessed) as a success and a failure when an IS project actor-network decomposes into multiple, disconnected actor-networks.

Effah (2014) use ANT to study the rise and fall of a dot-com pioneer in a developing country. He collected data in semi-structured interviews, informal conversations, and by analyzing archival data. The aim of the study was to understand the experience of a dot-com pioneer in Ghana, whose company went from formation via initial success to final failure. His findings underscore that the infrastructure required for e-business is not only digital. The underdeveloped local infrastructure required the technology to be adapted to local context. Key challenges were the lack of e-business facilities (e.g., both procurement as well as payment process had to be handled manually as partner companies did not support electronic exchange) as well as specific geographic challenges (e.g., the lack of reliable location infrastructure including maps, street names, and house numbers). But required non-digital infrastructure also extends beyond the local context. While the entrepreneur was able to creatively handle the above limitations (i.e., successfully enrolled other relevant actors), it eventually was the spiraling inflation “which rendered its

stockless business model with purchasing on order to deliver economically unfeasible as purchasing prices outrun sales prices” (p. 237).

Technology-supported learning

Thompson (2012)’s field study of online learning, investigates how work-learning is enacted in informal online communities. The draws on data from interviews as well as (web)documents, and finds that online communities are not static “containers for online activities” (p.264) or “singular networks”. Rather, these communities are networks of constantly shifting relations and the informal learning enacted online is the effect of multiple networks (online and offline) and attempts to stabilize the fluidity of these networks. An example for the latter is the translation of a posting from its initial creation in a conversation to a digest version and back to the original context:

“Each shift, from dialogue to digest and back again, is a translation, which necessarily entails recruiting other actants. When postings are packaged into the digest version, conversations are translated into snippets. Therefore, additional actants, such as the archives, must be recruited to re-construct the dialogue.” (p. 259)

This multiplicity and fluidity of network relations allows for multiple forms of associations with knowledge and novel enactments of knowing. One example is the use of the search function to find a valuable posting in the archives and the subsequent reconstruction of the associate dialogue by engaging with related posts. Another example is the active engagement in a problem-solving session together with a community of other actors, which enables learning in dialogue, but also creates the digital traces that subsequently can be found using search functionality.

Habib (2014) investigate the use of virtual learning environments by international students. Their findings are based on semi-structured interviews and highlight that “technology as a socio-material assemblage may encapsulate cultural codes that can be alienating for international students” (p. 196).

In their case the socio-material assemblage especially promoted use of learning practices based on reading and writing. This included dissemination of student texts in advance and subsequent discussion in class, which made it considerably more difficult for non-native speakers to fully participate in and benefit from these practices. On the other

hand, the data also shows how such technologies also can “equip students with tools that are empowering to them, for example by facilitating non-text-based forms of documentation” (p.204), for example those putting more emphasis on a combination of texts and pictures like digital storytelling. Furthermore they found the general institutional strategy to strengthen computer-supported learning to be translated very differently by different faculty and in different programs. In faculties where the web was used in teaching for a long time already, teachers tended to use the virtual learning environment predominantly as a “gateway to their own websites, where all the content used to support their teaching actually resides” (p. 202). As these websites were more tailored towards the needs of a particular course and group of students, this made teaching materials better accessible for international students.

Compliance and Governances

Boll (2014) studies tax compliance based on an ethnographic inquiry (including observations and interviews). She is particularly interested in how the means to comply are put together, as opposed to how the will to comply is constructed, which was the predominant focus of previous approaches. The findings underscore that both tax compliance and noncompliance are socio-material assemblages and “that complying is a distributed action” (p.293). The example of a carpentry business reveal how tax compliance “is an effect of the enrolment and coordination of various human and non-human actors” (p.301), like the bookkeeper, assistants that have to report travel expenses, IT systems, colored pens and electronic reminders. Similarly, noncompliance in a failed kitchen remodeling company emerges from elements such as the procedures for receiving social benefits (the owner was not eligible for receiving aid based on either of the two established social security systems in his country), the resulting activity of issuing invoices without reporting the value-added tax, and the tax inspection, during which the inspector needed “to piece together his judgment with the fallacies of counter argumentation and of counter evidence” (p. 299).

Müller (2014) studies another form of compliance, which is implicated in governing a large-scale international projects. His data sources include observation, semi-structured interviews, and documents and focused on how the International Olympic Committee governs the preparation for the Olympic Games from their headquarters, that is, at a

distance. Key to the attempts to coordinate preparation is the circulating of knowledge, which helps “aligning and formatting the actions” (p.336) in the heterogeneous network of actors involved. The process of circulating knowledge involves the three steps of rendering information mobile through a network wide program for documenting and managing knowledge, “casting it into stable material form by combining and processing information, and then recirculating knowledge with the help of intermediaries to the organizing committees around the world” (p.336). Material objects, like plans, manuals, and maps, are essential in the process as they allow temporarily stabilizing a network “to create power effects and draw the far-off into close reach” (p.336). Yet, in parallel separate networks and flows of knowledge exist, which bypass the International Olympic Committee and thus render enrollment of relevant actors partial and selective.

Güney and Cresswell (2012), like Constantinides & Barrett (2012), do not directly apply an ANT lens, but build on the related Technology-as-Text concept. This concept uses the metaphor of text to describe organizational structure and technology and their relationship to actors. According to this view two actors

“A and B need a text to give global meaning to their local actions [...] and to legitimate their agency relationships with each other. Technology becomes part of this text by enabling a particular mode of ordering for the precedence between A and B” (p.164).

Based on a case study of IT governance in a state government they studied how organization forms in the practice of governance. Empirical material was gathered using interviews, observations, and by analyzing documents.

They found that material properties of technology provided the basis for symbolic acts to renegotiate the authority relationship between actors and constitute organization. In their study the process of deciding for an information system based on an architecture preferred by a network of agency Chief Information Officers (CIOs) as opposed to the one preferred by the newly appointed State CIO. In other words,

“[O]rganizational actors mobilized the text embedded in technology to (re)write their agency relationships in order to keep the upper hand” (p.164).

Furthermore, the informal network of agency CIOs was transformed into a formal council in the course of negotiations with the State CIO.

Organizational routines and practices

Like Constantinides and Barrett (2012), Pentland and colleagues (2012) build on the concepts two of the authors established in their work on narrative networks (Pentland and Feldman 2007). They use a simulation based on a first order Markov transition matrix (Anderson and Goodman 1957) and want to show that “variation and selective retention of patterns of action are necessary and sufficient to explain the features of organizational routines” (p. 1484). Their findings indicate, that by focusing on patterns of actions and their reputation the characteristics of routines documented by empirical research (like formation through repetition, inertia, endogenous change, and improvement through learning) can be explained. The features and motives of the actants involved in routines or their relations do not necessarily need to be considered to explain these phenomena.

Similarly, Monteiro and Rolland (2012) do not primarily focus on actor-networks, but on practices enacted by these networks during implementation and use of an integrated information system. Their particular focus is on how similarities in work practice, which are separated in space and/or time emerge. Their analyses are based on data collected in semi-structured interviews, participant observation, and by analyzing documents. The findings show that a sufficient degree of similarity between technologically mediated, geographically dispersed work practices is an effortful accomplishment achieved through a process of commensurability consisting of standardization and heterogeneity. Standardization refers to the interdependencies between several instances of a work practice, which are performed in a ‘similar enough’ way at different (globally distributed) locations. The notion of practices being ‘similar enough’, is supposed to highlight that these practices are never enacted in exactly the same way at different locations and in different situations, but are performed in a sufficiently similar manner with regard to the purpose of the work practice at hand. In contrast, heterogeneity refers to the entanglement of these work practice with other local practices and technologies that are apparently unrelated.

2.3.2 Reconfigurations

Similar to the ANT lens, the reconfigurations lens is based on a performative and relational conceptualization of materiality (Nyberg 2009), yet describes or analytically disentangles sociomaterial unity from a different perspective. This lens is essentially based on the work of (Barad 2003), who developed what she calls “agential realism” based on Bohr’s philosophical account of quantum physics and Foucault’s (1970) concept of discourse. On this view, reality is not composed of stable, interacting entities, but phenomena within which the distinction between subject and object, words and things, etc. is locally resolved. This implies, that phenomena (not entities) are the ontologically primitive relations to start with, they are “relations without preexisting relata” (p.815). For the example of Bohr’s struggle with the seemingly contradictory findings of quantum physics this means that the observer, the instruments of observation and the objects observed are an ontologically inseparable unity (Introna 2007), resolved into its ‘component parts’ in the phenomenon of observing physical activity. Thus instead of preexisting entities (or relata) *inter*-acting to create phenomena this view maintains that relata emerge through *intra*-actions within phenomena. But, given relata do not exist a priori, how do they come into being, i.e. how does the ‘deed’ manages to constitute the ‘doer’ and his ‘target’.

To answer this question Barad builds on the Foucault’s (1970) concepts of discourse and discursive practices. For Foucault, and hence for Barad, discourse is not just another term for language or conversations. Discourses are that which enables and constraints what can be expressed in a conversation. In other words, discursive practices define what is accepted as meaningful statement and thus demarcate the field of possibilities from which statements (and subjects) emerge. Yet, these definitions or demarcations are not a static, transcendental laws but “rather they are actual historically situated social conditions” (p.819). Similarly, yet with a focus on the concepts of physics, Bohr’s account of apparatuses is concerned with the creation of meaning (and material objects) through scientific practice. On his account, it is the specific material setup of an experiment that make the concepts based on it meaningful. Thus, apparatuses are “particular physical arrangements that give meaning to certain concepts to the exclusion of others” (p. 819). But, this does not only imply that one is never able to see “full-fledged reality” through an apparatus because it necessarily “filters out” a major part of that reality. More profoundly, the apparatus actually takes an active part in producing the very “objects” it is

designed to detect. Thus on this view concepts are not purely ideational but are actual physical arrangements and both these concepts as well as the objects they describe do not have determinate boundaries, properties, or meanings apart from their mutual interaction in the apparatus. Barad elaborates on this account of apparatuses by shifting the “focus from linguistic concepts to discursive practices” (p. 820) and reconceptualizing apparatuses as material-discursive practices. This implies a slide shift in meaning of the three key concepts - apparatus, discursive practice, materiality - discussed before, which are no longer thought of as separate, mutually exclusive concepts but are a way of conceptualizing the sociomaterial unity of reality by means of agential cuts (i.e., boundary making practices).

Article	Phenomenon investigated	Data collection approach
Johri (2012)	identity construction and learning at the workplace	interviews, observations, documents, participant diaries
Østerlie et al. (2012)	emergence of organizational practices	observation, field talks (informal)
Scott and Orlikowski (2012)	effects of social media	interviews, documents, observations
Oborn et al. (2013)	development of health policy	observation, semi-structured interviews
Panourgias et al. (2013)	development of digital technology	interviews, observations, documents
Porter (2013)	emergence of organizational practices	Interviews (ex post) and Observations (of post-response meetings), Documents
Mazmanian et al. (2014)	emergence of organizational practices	semi-structured interviews, participant observation, informal conversations, software walk-throughs, software mapping
Orlikowski and Scott (2014)	effects of social media	interviews, documents, observations
Schultze (2014)	identity construction in virtual worlds	interviews and photo-diary interviews
Scott and Orlikowski (2014)	effects of social media	interviews, observations, documents, web content

Table 3: Articles employing a reconfiguration lens.

Ten articles build their empirical studies on a reconfiguration lens (Table 3). The phenomena studied include effects of social media, identity construction and learning, emergence of organizational practices, and the development of technological and social artifacts. These will be presented in detail below.

Effects of social media

Being interested in online rating and ranking mechanisms and their impact on accountability Scott and Orlikowski (2012) employ a reconfiguration lens to analyze the contemporary phenomenon of online accountability. They conducted what they call “systematic field work” (including interviews, observations, and document analysis) studying the online travel community TripAdvisor. In addition to allow members to post and access reviews on hotels, the website also includes an algorithmic ranking mechanism, which allows sorting hotels by popularity. The objective of the study of TripAdvisor and its ranking mechanism was to understand “how accountability is performed online using social media websites”(p. 26) as well as the moral and strategic implication of this performance.

Their findings highlight the sociomaterial (as opposed to a predominantly social) nature of accountability. For example, the position of a hotel on the popularity ranking is not only depending on the rating of members, but also heavily depends on the (proprietary and undisclosed) algorithm used to calculate the ranking from diverse user-generated content. If the “algorithm is changed it moves some hotels up the ranking and others down which can, and does, affect hotel practices and performance” (p. 36). The specific material configuration of TripAdvisor thus in parallel allows easy to handle access of reviews while simultaneously “obscuring the crucial ranking mechanism at work.” (p.39). Furthermore, they show, the performativity of online rankings and the entanglement of online and offline accountability. For example, hotelier revise their practices and manage their staff in relation to TripAdvisor reviews, which in turn influences the reviews. Thus, the popularity ranking, is perceived and “serves as a stable basis for conduct even though it is thoroughly dependent upon databases and algorithms that are continually updated and management practices in contexts that are highly dynamic” (p. 39).

Similarly, Orlikowski and Scott (2014) study TripAdvisor with a focus on the difference between online and offline evaluation of products and services. The question they are interested in is “how valuations change when they are produced online by consumers and what outcomes they generate for the organizations being evaluated” (p. 868). In order to answer this question, they compare the formulaic and algorithmic apparatuses of valuation related to a traditional accreditation scheme (an Automobile Association) and TripAdvisor respectively. The comparison shows how valuations are actively produced in ongoing practice, which are material-discursive in nature.

“[I]t makes a difference to valuation processes and outcomes whether valuations are produced through the trained bodies of professional inspectors annually examining the quality of the bed linen and assessing it against an explicit standard inscribed in a spreadsheet or whether valuations are produced by algorithmic aggregation of travelers’ ongoing and anonymous online descriptions of personal encounters with rude service and noisy corridors.” (p. 888)

Furthermore, valuation practices are organized in performative apparatuses, which enact different phenomena in practice by making agential cuts. While traditional valuation apparatuses typically exclude everyday consumer experiences online apparatuses are especially build to provide insights into these. Yet, at the same time the latter (have to) exclude the standardized criteria and professional expertise associated with traditional apparatuses. Thus, while traditional apparatuses steer “hotels toward industry-wide compliance with evaluation criteria to align them with a standard formula, TripAdvisor’s steady stream of reviews and dynamically computed rankings pixelates organizational practice and business development strategies”, as “managers subject to online valuations are being micromanaged by reviews”. These cuts in turn produce “different hotels, hoteliers, travelers, and indeed, different phenomena of travel” (p. 888) and significantly reconfigure the everyday practices of those involved.

Again studying TripAdvisor by means of a field study and comparing the above mentioned apparatuses of valuation, Scott and Orlikowski (2014) examine the production of anonymity in practices of hotel evaluation. They find that anonymity is not a social and singular attribute of some agent or system, but actively constituted in ongoing material-discursive practices. Anonymity is performed very differently in the two apparatuses of valuation studied. The effectiveness of the traditional valuation scheme, critically relies on the anonymity of the inspector during his visit “so as to ensure, as much as possible, an experience of the hotel as would the average person.” (p.886). After the inspection however, the inspector reveals his identity and thus produces an agential cut, “through which the inspector enacts a professional relationship with the hotel staff, reporting formally on the hotel’s assessment, offering guidance on its improvement, and being accountable for the star rating assigned and the official hotel description published in the hotel guides.” (p. 886)

In relation to the TripAdvisor apparatus, anonymity is relevant and performed the other way around.

“Travelers experience the hotel as named individuals, and only obscure their identities afterward, when publishing their reviews online” (p.886). Anonymity thus is enacted once the assessment is completed producing an agential cut “that allows for posting a wide variety of opinions online, but making verification and accountability difficult to achieve” (p.886).

Emergence of organizational practices

In addition to studies examining the effects of social media, several researchers employed a reconfiguration lens for studying organizational practices in settings as diverse as space agencies, petroleum production, and ad-hoc organization in response to crisis.

Mazmanian and colleagues (2014) examine the organizational practice of a NASA mission in outer space with the aim of “exploring how physical, social, material, technological, and organizational arrangements dynamically reconfigure each other in the duration of organizational practice” (p.831). They conducted an ethnographic study and collected data in semi-structured interviews, participant observation, and informal conversations as well as using software walk-throughs and software mapping.

Their empirical material illustrates “how the bounded categories of the social and the material are coconstituted and called into being” (p.843) by a number of triggers, but also in response to figures and figuring processes, which are an inherent element of organizational practices. Triggers include organizational mandate (e.g. implementation of a new software), physical breakdown (e.g. of a technical component in the aircraft), or movement of individuals (e.g. a person leaving the project). Relevant figures are for example organizational charts and threshold marks and figuring processes include both enacted routines as well as software. By analyzing these constitutive elements and their relations they are able to “show how such social and material considerations are mobilized, become relevant, and are rendered invisible in the various processes of dynamic reconfiguration” (p.843).

Being interested in the role of sensor networks and data in knowledge practices in petroleum production, Østerlie and colleagues (2012) conducted an ethnographic study in a petroleum company. Their empirical material consists of field notes from observations and informal discussion. They focus their discussion on the practices of detecting sand (which can create problems in production equipment) in the flows of liquids, gases and

solid particles streaming out of oil wells. They identify three entangled modes of knowing: instrumentation, interpretation, and learning. Instrumentation includes material differentiation (i.e., singling out an aspect from this multitude of potentialities contained in well flows) and temporal punctuation (i.e., taking measures at predefined time intervals) by performed by sensors as well as property numeration by software (i.e., the process of assigning a numerical value to the well flow through a series of algorithmic transformations which accumulate and quantify electric signals received from sensors). These measures are then interpreted by engineers through practices of visualized pattern decoding (i.e., naming and relating patterns in the visual data produced by software to generic models of well behavior, thus linking data and appropriate actions to handle the situation). Interpretation further requires sorting out inferences, a practice triggered when anomalies in visualized data are recognized, but also routinely enacted when assessing a potential incident. Sorting out inferences crucially builds on background information (e.g., information about ongoing activities, 'biographical' information about wells and equipment) frequently circulated in the organization.

Finally, learning includes both bottom up sedimenting of local knowing (e.g., through local problem solving and related software development by production engineers) as well as more top-down formalizing of domain knowledge (e.g. through research-based projects, which are part of the ongoing effort to develop a scientific basis for the corporation's operations).

In addition the findings highlight the dual materiality of material phenomena and instruments, which (building on Barad's concept of apparatus) means that the materiality of an information system "plays an integral part in creating, not simply representing, the materiality of the physical world" (p. 102).

And, Porter (2012) studied the emergence of organization and technology at a shelter during Hurricane Katrina. She conducted interviews and observations and analyzed related documents. The study's objective was to identify how "situational boundary-making occur[s] in emergent disaster response efforts" (p.7) and how related practices shape the design and use of technology. She found emergent organization at the shelter to occur as "situational entanglements consisting of three main elements: a salient moment in time, key actors, and boundary-making practices" (p.11). Key to the process of emergence was the inclusion and exclusion of organizational and technological actors. Both reactive volunteers and technologies became distinct from responsive volunteers

and technologies early in the process. As a result, responsive technologies and responsive volunteers “co-emerged to gain control of the situation at the shelter” (p.19), as volunteers in the course of establishing a working organization, were required to fix responsive technologies in response to emerging problems. The latter was especially relevant as meanings, rather than being inherent to an organizational or technological actor, were initially undetermined and had to be actively enacted in the “making of boundaries between actors through response practices in time”(p. 21). Thus, the value of organizational and technical actors should continuously to be assessed during crisis response. This also implies that technology, far from being a neutral coordinating mechanism, may at any point in time be part of the situational problem as likely as part of the solution.

Identity construction and learning

The reconfiguration lens is further used to investigate identity construction in virtual worlds and in the workplace. Schultze (2014) studies the performance of identity in virtual worlds. She uses interviews and photo-diary interviews to capture and examine “the role that users’ physical and digital bodies play in their online identity performance, the relationships between these bodies and the implications of this performance for the user’s embodied identity” (p.85). Her findings show two forms of identity performance: personhood and individuality. Interviewees relied on both representational and performative logics to describe and enact their identity performances. An example for the former is the intentional and “more or less faithful re-presentation” (p. 85) of some attributes of physical bodies in their avatars. But, they also unconsciously enact “embodied identities in both their ‘real’ and virtual lives” (p.84) as they engage in habitual practices originally acquired both online and offline. Thus, a significant part of their identities is performed as well. Both examples also show that the boundaries between actual and virtual reality, between human and technological agency, and between offline and online identities are not fixed and stable, but performatively enacted and entangled.

Johri (2012) studied how newcomers become accepted researchers by means of an ethnographically informed case study in the context of engineering research. As for most studies discussed so far, data sources include interviews, observations, and documents, but additionally he used participant diaries to get more in-depth insights of the practices

and perceptions of newcomers. The study aimed at understanding the relationship between the practices performed by newcomers and their integration, that is, “provide details of what newcomers do as they socialize and what this participation means to them” (p. 2). His findings indicate, that engineers as they “move from being novices toward fuller participation, they need to become [...] both socially adept and proficient at using materiality in conjunction with each other”(p.1). A key practice identified is the development and use of prototypes to communicate research outcomes in a demoing session. These sessions often serve as the key indicator of competency, both disciplinary and technical, among engineering researchers. They combine

“the technical competence required to build a working system with the social competence to understand the audience and users of the system and to present a working prototype to other researchers.” (p. 18)

Yet, the distinction between social and material is analytical only, because in the practice and perceptions of participants both the social and the material are mutually constitutive enactments. Furthermore, the entanglement of these categories is not limited to the preparation and execution of the demoing session, but continues with feedback on the demo and subsequent refinement of the prototype and corresponding knowledge construction.

Development of technological and social artifacts

Finally, the development of computer games and health policy was investigated using a reconfiguration lens. Panourgias and colleagues (2014) use a reconfiguration lens for studying creativity in relation to the development of digital technology. Empirical material was gathered using interviews, observations, and by analyzing documents. They found creativity to be performed through processes of materialization. A core element of this process is the game engine, “the software that interacts with the hardware of the platform (e.g. console, personal computer) on which the game will be played”(p.112). An initial ‘creative impulse’ and the attempt to realize the related by established means, is often followed by interactions with both the game engine (in terms of experimentation) and its developers. In this process the initial impulse is as likely to be altered as are the organization’s development techniques or the game engine. As the developers of the engine are in most cases as important as the engine itself, creative agency is best de-

scribed as being “located in the dynamics of agents’ ‘creative knowledge and expertise’ and their ability to ‘liaise with experts in other fields’ ”(p. 122). Thus, the digital technologies that are commonly described as “fundamentally changing creative processes and modes of production” (p.122) are actually developed in concert with the “affective and cultural concerns associated with creativity and cultural production” (p.122).

Being interested in leadership in policy formulation, Oborn and colleagues (2013) study the development of a health policy in the UK. Data was gathered by observation and semi-structured interviews. Their findings show that leadership in policy development is “constituted by experts in an organizational field through a sociomaterial entanglement of polls, statistics, technologies and coalitions” (p. 273). That is, leadership is not an attribute or enactment of a single individual, but is “distributed across multiple socio-material practices” (p. 269), which incorporate a diverse set of materials (like public polls, which can be used for legitimating decisions), social structures (like protocols and schedules in different medical institutions) and individuals (like the formal leader, clinicians, health executives, etc.). Both trust and legitimacy are performatively enabled by these practices and in turn shape the policy process and leadership.

2.3.3 Sociomateriality

Several articles directly build their theoretical accounts on the meta-theoretical foundations outlined by Orlikowski (2007, 2010), Orlikowski and Scott (2008) or other conceptual works building on these seminal articles (e.g., Fenwick 2010). Essentially this means that they use at least one of the notions established in these works (cf. section 2.1.2) for theorizing.

Ten articles employ a sociomateriality lens in their studies (Table 4). These articles investigate the following phenomena: the emergence of work practices and routines, the effects of social media, the effects of mobile devices, knowing in practice, financial markets and their effects, and the emergence of organizing visions. The phenomena are described in detail below.

Article	Phenomenon investigated	Data collection approach
Johri (2011)	emergence of work practices	Interviews, observation, documents
Cacciatori (2012)	Emergence of organizational routines	interviews, observation, documents
Bansal and Knox-Hayes (2013)	Financial markets and their effects	documents(, interviews)
DeVaujany et al. (2013)	Emergence of organizing visions	observations, semi-structured interviews, questionnaires, documents, photos
Hauptmann and Steger (2013)	Effects of social media	documents (microblog logs), interviews, observations
Jarrahi and Sawyer (2013)	Effects of social media	interviews, documents
Mazmanian et al. (2013)	Effects of mobile devices	interviews
Pritchard and Symon (2013)	Effects of mobile devices	semi-structured interviews, observation
Gherardi and Perrotta (2014)	Knowing in practice	on-site interviews
Langemeyer (2014)	Knowing in practice	interviews, observations, video-analysis

Table 4: Articles employing a sociomateriality lens

Emergence of work practices and routines

Johri (2011) studied software development in global teams with the aim to “understand how workers develop practices that allow them to function effectively across geographically dispersed locations.” (p. 955). He collected data in interviews, during observations and by analyzing documents. The findings shows, that the emergence of new practices was triggered by the need to achieve work-life balance, which was significantly disrupted by working in a globally distributed team. Key to the creation of these new practices was the inventive use of both material and social resources. In particular, “two facets of technology use were necessary [...]: multiplicity of media and relational personalization at dyadic and team levels” (p. 955). Multiplicity means that multiple communication technologies are available and used for interaction. Relational personalization refers a dyad’s or team’s ability to “reach a mutually acceptable norm” (p.960) for the use of communication technology. An example is the practice of communicating more and also redundantly “as it was hard for anyone to assess the value of information from someone else’s perspective” (p.960). This inventive use and combination of avail-

able resources resembles the concept bricolage developed by (Levi-Strauss 1966). Yet, the emergence of practices cannot be explained by accounting for the creative application of available technological resources alone, but is significantly influenced by relational personalization. Thus, Johri proposes the concept of sociomaterial bricolage, which “encapsulates the idea that practices emerge through the ad hoc use of available artifacts by people often in conjunction with others and while participating in situated activities” (p.963).

Similarly, Cacciatori (2012) studies the development process of a new bidding routine in an organization. The empirical material comprises data from interviews, observations, and the analysis of documents. Her findings show that “material resources, in the form of systems of interacting artefacts, are [...] important mediators in the institutionalization of individual agency into new routines” (p. 1578). For a bidding routine these artifacts include, for example, different occupation-specific product or process representations. These artifacts are occupation-specific in that they embody knowledge and assumptions related to a particular occupation as well as the expertise of their creators. Furthermore, they support specific actions, while constraining others. Thus, occupational groups can influence the development of organization-wide routines by generating occupation-specific artifacts that sit at the core of the routine. This in turn allows them to modify the relations of power linking their community to other ones.

But this effect is not limited to single artifacts. By bundling different kinds of artifacts, for example product representations and process representations, it is even possible to “reinforce and extend the patterns of action that individual artefacts support” (p. 1467).

Effects of social media

Hauptmann and Steger (2013) are interested in the effects of social media on Human Resource Management and the everyday life of organizational members in general. They study the in-house use of microblogging in an organization and collected data by analyzing documents, in interviews and through observations. Their findings indicate that “organizational and individual activities may alter when taking place in virtual environments” (p. 43). First, the design of social media (i.e., its technical configuration) constraints certain activities while enabling others. Thus, with social media, new patterns of interaction between members of the organization are established. But these new

forms of interacting do not completely differ from traditional ones, rather they mimic them. Still, they are different for example in that social media allows for a delay in interactions and consequently for strategic planning of actions. Second, part of the employees of an organization may use social media intensely, while others do not. In particular, different birth cohorts differ with respect to their use of social media. This leads to the creation of parallel worlds with some employees “acting within a closed environment with its own rules of behavior” (p.43) from which others are excluded or exclude themselves.

Similarly, Jarrahi and Sawyer (2013) study social technologies, yet with a focus on informal knowledge sharing and the related practices. The objective of their study was to understand how social technologies facilitate the performance of informal knowledge practices within and across organizations. Their findings are derived from empirical material collected in interviews and by analyzing documents. They identified five knowledge practices (expertise locating, expert locating, reaching out for problem solving, socializing, horizon broadening), which differ with respect to the social technologies incorporated. But, a particular social technology is typically not bound to a single practice, but used in different practices. In addition, a single social technology is often not sufficient to support a knowledge practice and these technologies are also frequently used in concert with other information and communication technologies. Furthermore, the relationship between knowledge practices and social technologies is not a stable one. In contrast, knowledge workers constantly compare the functionality offered by social technologies and use those with properties most relevant and valuable for the practice to be performed. Thus, social technologies should be conceptualized as an assemblage in knowledge practices, that is, an emerging collection of specific technologies that interact with each other.

Effects of mobile devices

Being interested in the use of mobile email devices and its implications for the autonomy of knowledge professionals, Mazmanian and colleagues (2013) studied the daily work practices of professionals from multiple professional service firms. Empirical data was collected using interviews. The analysis of this data revealed a paradoxical situation they labeled autonomy paradox. In the short term mobile email devices offer profes-

sionals an increase in personal autonomy. But, these devices also raise expectations regarding their availability in their professional communities and thus essentially limit their autonomy in practice over time. Thus, daily use of mobile email by professionals gradually shifts the cultural norms of the professional communities they are a part of, resulting in “a spiral of escalating engagement and diminishing autonomy” (p. 1350) that generates the autonomy paradox.

Also focusing on mobile devices, Pritchard and Symon (2013) study the use of smartphones for knowledge sharing by rail engineers in incident resolution. More specifically, they focus on the effects smartphone photography has on practices of sharing knowledge between engineers in the field and their managers as well as technical experts in the office. Their case material comprises data from semi-structured interviews and observations. Their findings emphasize that the availability of smartphones and their functionality of taking and sending digital pictures prompts the negotiation of new knowledge sharing practices. This implies a renegotiation of distance, offering the opportunity to bring remote groups closer to a particular situation and thus, for example, supporting collaborative problem-solving of engineers and technical experts. On the other hand, smartphone photography also prompts a “renegotiation of notions of ‘truth’, knowledge and agency by all those involved” (p.13). For example, when the smartphone was available, engineers often delivered digital pictures to support their verbal accounts. But, managers soon started to solely rely on, and often explicitly prefer, digital pictures as evidence, despite their limited capacity of representing the local situation in the field comprehensively. Thus, digital pictures not only impact knowledge sharing practices, but become implicated in the power relations between engineers and other staff as boundary objects.

Knowing in practice

Gherardi and Perrotta (2014) are interested in creativity as it is practiced by craftspeople and its relation to knowledge. They conducted on-site interviews to investigate “how craft knowledge is performed and situationally invented in the course of working practices” (p. 138). Based on the findings of their case study, they develop the concept of formativeness, which is defined as “a ‘doing’ such that while it does, it invents the ‘way of doing’ (p.145). In more detail this means that an object of a crafts practice is realized

in a formative process that implies the co-emergence of the (mental) image of the final object and the (physical) object itself. Thus, dialectic iteration between image and object as well as improvisation and reflection are an integral part of the process and do not arise from a breakdown or from pausing to introduce distance for reflection. Knowing from this perspective is perceiving the object as it is formed. Consequently, “[d]oing and knowing are not separate; neither does the one follow the other, nor does the one constitute an application of the other” (p. 146).

Langemeyer (2014) focuses on simulation-based training in medicine. In particular, she is interested in how work process knowledge related to surgical operation is developed in simulations. Her empirical material comprises data from interviews, observations, and video-analysis. Her findings show that work process knowledge is rooted in different activities of co-constructing and collectively framing the task at hand and the object of work. In the case, the problems that occurred in training sessions were not caused by the (mis)functioning of technical devices or problems in communication only. Problems arose if training groups could not maintain “a professional, mutually shared way of thinking” (p. 295) in terms of holding relevant aspects and processes of the operation present in the team. This collective way of thinking was a prerequisite for each member to be able to make sense of all the information available at any moment during the operation and also supported the critical examination and correct prioritization of the different activities to be performed. Consequently, it is not only skills in communication that influence the quality of professional activities, but, in addition, the “socio-material enactment of professional roles” (p. 284) is important.

Other phenomena

Being interested in the relationship between organizations and the natural environment, Bansal and Knox-Hayes (2013) study carbon markets and their effects on carbon emission. They draw their findings from documents and interviews. Their results show the difference between physical materiality and sociomateriality by highlighting that the “natural world is less amenable to time-space compression than the social world” (p. 76). While sociomaterial financial markets and instruments can compress time (e.g., trading futures) and space (e.g., trading carbon emission at a particular market, which actually occur far away), carbon moves through “short-term and long-term cycles

among three reservoirs” (p. 67) (atmospheric, oceanic, and terrestrial). Thus, financial markets, by compressing time and space, contribute to a “loss of information embodied in the natural environment” (p. 77). This in turn, sociomaterial process (e.g., trading) may lead to a “distortion of the instrument’s ‘real’ value” (p.62) and thus may hamper emissions reductions or even aggravate the environmental issues these markets are designed to solve.

De Vaujany and colleagues (2013) study the case of a trade show with the aim to reveal the everyday material and discursive practices that are involved in the fabric of organizing visions (Swanson and Ramiller 1997), that is, authorized ideas about IT like IT buzzwords and concepts. Their data from the case study includes observations, semi-structured interviews, documents and photos, as well as survey responses. They found that organizing visions are not generated at trade show, but rather existing ones are refined. Refined organizing visions are produced through the interrelation of discourse, practices, and artifacts in two ways. First, practices and artifacts establish physical and social boundaries, which help trade show visitors to focus on particular authorized ideas about IT, and thus contribute “to enclose the production of discourse” (p14). Second, artifacts and practices are used to materialize a particular technology and the discourse about it in terms of showing what the technology can offer or what a concept related to it actually means in practice.

Thus, the reproduction of organizing visions through discourses and practices at trade shows is “grounded in specific sociomaterial contexts” (p.14). Related to Swanson and Ramiller’s (1997) framework this implies that the practical activities and objects of layer 4 are highly interrelated with the interpretive-discursive activities of layer 2.

2.3.4 Affordances, the mangle of practice, and imbrications

In addition to the above lenses, which dominated in the extracted sample of articles, several other lenses were employed (Table 5): affordances, MoP, and imbrication.

These lenses are described in the following sub-sections.

Article	Lens	Phenomenon investigated	Data collection approach
Pollock and D'Adderio (2012)	Affordance	rankings/ratings in IT procurment	interviews, informal discussions, observations
Stein et al. (2013)	Affordance	construction of professional identity	semi-structured interviews (partly incl. video recording), observations
Hultin and Mähring (2014)	Affordance	role of artifacts in organizational change	interviews, informal discussions, observations, documents
Wagner et al. (2010)	MoP	IS/ES project turnaround	interviews, observations
Venters et al. (2014)	MoP	emergence of coordination practices	interviews, observations, documents
De Vaujany and Vaast (2014)	Imbrication	organizational space and legitimacy	interviews, observation, documents

Table 5: Articles employing other lenses.

Affordances

The concept of affordances was initially developed in ecological psychology by Gibson (1977), but more recently became relevant in the fields of design (e.g. Norman 1990), sociology (e.g., Hutchby, 2001, Stoffregen, 2003), and Information Systems (e.g., Markus and Silver 2008). While these authors all build their on the work original of Gibson, they considerably differ in how affordances are conceptualized.

Norman (1990), suggests that it is the task of designers to build technology in a way that implicitly suggests how it should be used, that is good designers “purposefully build affordances into a technology” (Leonardi, 2011). Affordances in his view “provide strong clues for the use of their materials” (Norman 1990, p. 9) and do not change over time or in relation to the context of use.

In contrast, Hutchby (2001) as well as Markus and Silver (2008) see affordances as being constituted in relationships between people and the materiality of the things, instead of an exclusive property of either people or technology. Thus, while materiality exists independent of people, affordances and constraints do not. Because people come to materiality with diverse goals, they perceive a technology as affording distinct possibilities for action. For Hutchby, the affordances of an artifact can change across different contexts even though its materiality does not. Similarly, people may perceive that a tech-

nology offers no affordances for action, perceiving instead that it constraints their ability to carry out their goals.

Finally, authors like Stoffregen (2003) take this view one step further and build their understanding of affordances on a relational ontology, instead of highlighting the relational character of affordances only. In this view affordances are emergent “properties of the actor–environment system that determine what can be done” (Stoffregen, 2003, p. 124).

In their study of the effects of rankings in IT procurement markets Pollock and D'Adlerio (2012) used an affordance lens to examine if there are agential aspects within rankings that extend previous social accounts of this phenomenon. Their case material comprises data gathered in interviews, informal discussions, and during observations, which centered on the development and use of the Magic Quadrants of the industry analyst firm Gartner Inc. . Their findings show that “IT markets can be as much a product of the affordances and constraints of ranking devices as any other (non-material) aspects of the ranking” (p.565). Rankings assemble and counter pose certain vendors in a “competitive space” (p.570) by defining specific technological fields. In addition to vendors trying to influence their inclusion and/or position in certain rankings as well as organizational constraints on the discretion of individual rankers, they found the graph itself to place “limitations on how the competitive space could be captured and represented”(p.581). Rankers were thus required to define inclusion criteria for vendors in a way that matched the affordances and constraints of the graphical representation. This was required, because graphs only are valuable if an optimal number of vendors is presented and both too many as well as too few vendors make the graph less useful. Thus, rankers directly intervened in the market and even split markets (i.e., created entirely new competitive space) to arrive at an optimal number of vendors.

Being interested in the role of visualization artifacts in organizational change, Hultin and Mähring (2013) conducted a case study at the emergency general surgery ward of a university hospital. Using interviews, informal discussions, observations, and documents analysis they attempted to understand how visualization artifacts can “afford and constrain organizational change in institutionally complex contexts”(p.130). They found that visualization artifacts can facilitate the integration of a new institutional logics (e.g., Lean management practices in their case) with existing logics and in operational practice. Entangled in sociomaterial practices, these artifacts can aid integration because

they are capable of affording goals inscribed in multiple logics. Being implicated in practices based on the established logic they can thus shape focus of attention toward a new logic. But, the effects of artifacts are not limited to their immediate inclusion in sociomaterial practices, because perceived affordances are created from the experience of using several different artifacts. Thus, “an artifact that does not become embedded in practice and thus part of the organizational infrastructure long-term, may still influence actions and lead to development and use of other technologies and work routines”.(p.150). For example at the ward, the rejection of a physical reporting board shaped the attention and intentions of individuals that lead to the successful implementation of a digital reporting system. Thus, the “the rejection of one technology can simultaneously constitute another” (p. 130), and should not be seen as a failure only.

Stein and colleagues (2013) study the role of IT in professional identity construction in the workplace. They draw their findings from semi-structured interviews (some of which were video recorded) and observations. Based on Markus and Silver (2008) they conceptually distinguish a technology’s form (or intrinsic properties), functionality (or affordance) and symbolism (or symbolic meaning). Their findings indicate that technology is implicated “in professional identity performances by acting as landmarks in individuals’ self-narratives around which the self and others are positioned and a preferred professional identity is enacted” (p. 167). Technology becomes such a landmark, if personal preference and normative expectation coincide with the symbolic meaning or functional affordances of a technology. In the case, five types of identity could be identified focused on the creation (building new IT), translation (bridging IT and business), management (directing IT use), use (performing work through IT), and illustration (show others how to use IT). These different identities may also be expressed in specific patterns of technology use, which – while corresponding to identity types – do not necessarily relate to the work roles of individuals.

Mangle of practice

Pickering’s MoP lens, offers a theoretical account of agency importantly based on ANT and Giddens’ Structuration Theory (among others). Central to this account are the posthumanist position, that “human agents conspicuously do not call all the shots” (Pickering, 1993, p. 562), and the conceptualization of agency as temporally emergent.

Similar to ANT, non-human or material agency plays an important part in the constitution of practice, in that “material and human agencies are mutually and emergently productive of one another” (Pickering 1993, p. 567). Yet, the MoP does not require these two kinds of agency to be perfectly symmetric, but acknowledges that “humans differ from nonhumans precisely in that our actions have intentions behind them” (Pickering 1993, p. 565). On the other hand, Pickering retains a considerable degree of symmetry by arguing that both human and material agency are temporally emergent. The goals or intentions of humans are constructed based on the present situation in an open-ended process of modeling. A third form of agency – disciplinary agency – becomes relevant here. It captures the active influence of culture and conceptual knowledge (e.g., applying rules of algebra) on human agency (Pickering 1995). Disciplinary agency needs to be discerned from human agency, as it allows for no or only little discretion. Modeling thus links existing culture and future states and is open-ended in that “the choice of any particular model opens up an indefinite space of different goals” (Pickering 1993, p. 579). Similarly, the realization of these goals will typically not take the form of a simple implementation in material reality (e.g., in terms of constructing a machine), but will require a careful exploration of the contours of material agency as there will likely be unforeseen problems to be solved. Pickering uses the metaphor of tuning, as of a car engine or radio, to illustrate this process of mutual adjustment of human and material agency. Over time, the emergence of material resistance to human intentions and the resulting accommodations, in terms of adjusting or tuning the material and the original goals, results in interactive stabilization (Mueller and Raeth 2012). Thus, Pickering (1995) describes this progression as an open-ended, dialectic process of resistance and accommodation.

Wagner and colleagues (2010) study the turnaround process of a troubled IT project, based on a case study of the implementation of an ERP system at a University. Their data sources include interviews and observations. They found that work practices incorporating the ERP system are not permanently and systematically selected at any specific moment in time. To the contrary, they have to be negotiated through processes of resistance and accommodation. After implementation, resistance of both the new technology as well as members of different communities of practice have to be accommodated and accommodation can only be achieved when conflict occurring at the boundaries of different communities is resolved. Prerequisite for this resolution is recognizing the

boundaries between these communities, acknowledging the existence of alternative practices, and then working to create a solution that can support these different practices. The solution to be achieved is not limited to the adaptation of users way of working but may also include changes to the technology and the creation of new organizational units for example for dealing with some of the additional tasks imposed by a new system. Yet, “project survival does not depend on benevolently accommodating everyone” (p. 290). The concept of selective accommodation rather stresses the need to “distinguish the essential debates from issues of preference alone”(p.290), i.e. participants must collectively work towards a solution which moulds together “critical established practices and the aspects of the proposed best practices”(p.290).

Venters and colleagues (2014) study digital coordination of grid infrastructure at the European Council for Nuclear Research. Their analysis builds on data collected in interviews, observations, and from documents. The study was conducted with the objective to understand how “digital coordination [has] been performed in the development and use of the [...] grid infrastructure” (p. 928). They found three coordinating tensions related to material and human elements and associated with particular, yet interrelated, temporal realms (i.e., past, present, or future). At the present, coordination was concerned with the active management of grid transparency in a dialectic process of resistance and accommodation (or tuning). This process also implied an orientation towards the future, as solutions were modeled for prospective grid development, that is, both anticipated future needs and technical capabilities were considered in modelling. Similarly, social and material inertias, that is the past, influenced present tuning activities.

Imbrication

The concept of imbrication was initially used by Taylor (2001), Ciborra (2006), and Sassen (2006) and has recently been introduced in sociomaterial scholarship by Leonardi (2011). The concept describes the interrelation of human and material agency in organizations, which forms organizational structure. Thus, the concept has two main characteristics. First, it maintains the difference between the social and the material, while at the same time being able to describe their interdependence. In this view,

“[h]uman and material agencies, though both capabilities for action, differ phenomenologically with respect to intention.” (Leonardi 2011, p. 151)

Second, this enables accounting for the production of durable patterns, that is for how “[i]mbrications at one point in time create the possibility for (and set certain restrictions on) future imbrications” (Leonardi 2011, p. 152).

Being interested in the intersection of organizational space and legitimacy de Vaujany and Vaast (2014) study the history of a French University. They built their analysis on data from interviews, observations, and archival documents. In particular, focus on the question “how organizational space and legitimacy are mutually constituted over time as organizations experience shifts in work and institutional demands” (p. 713). Their findings indicate that three types of spatial practices interact differently with spatial legacies, that is, “traces of previous periods’ spaces and spatial practices” (p.725). Spatial practices of appropriation and reappropriation aim to maintain the alignment between organizational space and legitimacy claims by managing spatial legacies accordingly. For example making semiprivate spaces available to faculty and staff in an attempt to sustain the legitimacy of a “hybrid” university (i.e. an institution, which is publicly funded but prestigious and selective). In contrast, through practices of disappropriation organizational members attempt to realign the space to changing legitimacy claims by erasing or altering spatial legacies. An example related to the previous one, but situated in a period where the goal was to preserve the legitimacy of the university that is confronted with new and broader competition, is the creation of new public spaces that replaced the semiprivate office spaces mentioned above.

2.3.5 Multifaceted lenses

Finally, seven articles did not restrict their theorizing to a particular lens, but drew on several theoretical foundations (Table 6).

Nyberg (2009) conducted an ethnography in a call center to understand how “discrete categories of technology in the form of, for example, [...] a computer [are] brought into being” (p. 1181) in everyday practices. His findings are twofold.

Article	Lenses	Phenomenon investigated	Data collection approach
Nyberg (2009)	ANT, reconfiguration	work practices in call centers	observations
Doolin and McLeod (2012)	ANT, reconfiguration, MoP	boundary objects in IS/software development	observation, semi-structured interviews, documents
Introna and Hayes (2011)	ANT, reconfiguration, imbrication	plagiarism detection in higher education	interviews, software analysis, observations
Barrett et al. (2012)	MoP, reconfiguration	emergence of organizational practices and boundary relations	observation, interviews, informal discussion, documents
Almklov et al. (2014)	ANT, reconfiguration, imbrication	information infrastructures in petroleum production	observation, interviews
Stein (2014)	ANT, MoP	emotions in IS/ES implementation and use	interviews, observations, documents
Leonardi (2011)	affordances, imbrication	emergence of organizational practices	interviews, observations, artifacts (e.g., screenshots)

Table 6: Articles employing a multifaceted lens.

First, he described how, in a customer service call, the call center operators, computers, etc., appear as “one figure in relation to the customer” (p. 1193). In this situation the focus of actors was towards their practice and they became absorbed into their engagement, rather than orienting towards the parts performing it. Second, he showed how this assemblage “was cut into pieces, with meaningful actors materializing” (1194) in unexpected situations, like the appearance of a non-existent driver listed in a car insurance policy due to incompatibility of two computer systems. Thus,

“[t]he meaning of the actors and the sense-making of these actors depend on the practices they are the product of, and at the same time play a role in producing.”
(p. 1195)

Being interested in the role of boundary objects in organizational practices Doolin and McLeod (2012) study how a prototype is implicated in Information System (IS) development practices. They gathered data during observations, semi-structured interviews, and by analyzing documents. Their findings extend previous conceptualizations of boundary objects by highlighting their sociomaterial nature. First, they show the temporally emergent nature of these objects. Far from being stable entities, the prototype was

subject to considerable change during the development project. Second, organizational practices are key to establish a boundary object.

“To become a boundary object-in-use, the prototype needed to be jointly recognizable and meaningfully incorporated into the local practices of each project participant group” (p. 582)

Finally, sociomaterial assemblages, which constitute the boundary object, were performed differently in different context, that is they differ depending on situation, sites and participants. Thus, boundary objects are not singular object, which bridge different communities, but are multiple, diverse assemblages across time and space, which produce a range of effects.

Introna and Hayes (2011) study the implications of software for plagiarism detection for international students. Their analysis is based on data from interviews, software analysis, and observations. Their findings show that plagiarism emerges from the imbrication of human actors (e.g. a Greek student) and a non-human-actor (the plagiarism detection system). In such an imbrication “some assumptions and practices are rendered visible and others are rendered inconspicuous” (p. 107). The effect of these imbrications is that “Greek students are often unfairly constituted as ‘plagiaristic’ (which they mostly are not)” (p.120). This effect is produced by the interaction of their writing practices (which are influenced by their cultural background as well as their ability to express themselves in English) and the way the plagiarism detection system expresses plagiarism (it does so in form of a number called similarity index). But, this specific view of plagiarism does not emerge from the imbrication described above alone, but is also enacted by lecturers and their assistants who rely solely on the similarity index to detect plagiarists instead of performing other, potentially more time consuming, practices of checking texts based on a preliminary analysis with the detection system. The role of writing practices and cultural background in imbrications further indicates that transferring a non-human actor from one socio-cultural context to another is a complex endeavor. Both non-human as well as human actors may be constituted very differently in the new network with the outcome of the implementation being rather unpredictable and “not ‘in the hands’ of any single actor” (p. 120).

Barrett and colleagues (2012) study the effects of robotic innovation on pharmacy work by means of a field study. Their data sources include observations, interviews, informal

discussions, and documents. Their aim is in particular to understand the implications of using dispensing robots in terms of the effects on work practices, boundary relations between occupational groups. Overall, the robot's materiality had both negative as well as positive effects for the different groups in terms of status, control, and autonomy. Their findings further highlight, that, in contrast to Pickering's original formulation, actors and technologies implicated in the tuning process are both multiple and heterogeneous. In particular, two different forms of materiality – digital and mechanical in their case – are implicated in different ways in processes of resistance and accommodation and both were found to be emerging in practice rather than being a solely material characteristic and human strategy respectively. In addition, they show the shifting boundary relations that are enacted across groups as new materialities are mangled in work practices. These include both “more dramatic boundary relations of cooperation and conflict but also to the more subtle and less visible ones of strain and neglect” (p. 1464) and were not limited to dyadic relationships, but often were the result of the “ecology of interactions across different occupational groups” (p.1464-1465).

Almklov and colleagues (2014) study how petroleum engineers interact with sensors and information infrastructures when monitoring a remote, underground oil reservoir and the related production system. They build their analysis on five ethnographic studies of petroleum companies during which they collected data in interviews and observations. They found technology and knowledge about to be mutually constitutive. In petroleum production,

“[m]eaning about underground phenomena is not transported from sensors to humans on shore nor is it constructed by them, but emerges through the continued interaction between knowledgeable workers, digital sensors, and ICTs.” (p. 278)

Furthermore, petroleum engineers have to draw on the history of interaction with these technologies and specific oil reservoirs when interpreting data, for example sensors may have failed or the oil reservoir may have showed specific behavior before. Thus, the interpretive practices depend on “infrastructures that facilitate the recursive movements necessary to draw inferences based on combinations of sensor data” (p. 281). But, these infrastructures were not simply available from the start, but have developed together with extrapolation practices. Finally, the situated interpretation practices describe before, are not restricted to a local community of practice or a particular department, but may involve others, like external experts, which work with the same infrastructure.

Being interested in the role of emotions in packaged software implementation and use, Stein and colleagues (2014) studied implementation projects at two universities. The analyzed data was gathered in interviews, during observations, and from documents using both an ANT as well as MoP lens. Their findings show, that emotions should not be considered as solely subjective or intersubjective phenomena because that is emotional practices are as much materially contingent as they are not only socially contingent. Extending the above mentioned lenses they add the “felt quality of [...] socio-material configurations” (p. 172) to the conceptual toolkit of both. This implies that for understanding the mangling of human and material agencies it is not just relevant to account for plans, intentions, and constraints, but also for human emotions, social emotionologies and material affects. Similarly, the dynamics of actor–network theory do not relate only to actants, enrolments, translation, etc., but the overall felt quality of the network is also relevant.

Lastly, Leonardi (2011) studies the role of technology in organizational change. He conducted an ethnographic study on the use of simulation software in automotive design and collected data and artifacts (for example screenshots and printouts) in interviews, during observations. The primary focus of the study was the question how individuals decide “whether they should change the composition of their routines or the materiality of the technologies with which they work” (p. 147), if both routines and technology are, in principle, flexible. He found that “change in a technology at any given time is linked to the routines that came before it and will be linked to the routines that come after just as a change in routines is linked to the technologies that preceded and will follow it” (p.163). This result is derived by using the metaphor of imbrication. The metaphor highlights, that technology and routines, are similar in that both are established by past, interlocking material and human agencies, which form the infrastructure (i.e., routines and technology) people use in their work. Moreover, people do not only work with this infrastructure, but also construct perceptions of whether a technology constraints them in their pursuit of a work-related goal or offers new possibilities (i.e., affords achieving new goals). If routines and technology are both flexible, “perceptions of constraint lead people to change their technologies while perceptions of affordance lead people to change their routines.” (p. 147)

2.4 Focal points, combinations, and possible contributions

2.4.1 What can be seen with the different lenses?

As the results section shows, several different lenses can be employed for studying sociomaterial phenomena. As each lens offers a distinct perspective on the phenomenon, the kinds of questions that can be answered and the results that can be obtained differ considerably. In the following these differences will be discussed by offering an overview of the foci of the different lenses as well as their relationship. This overview is not meant to be complete, that is, it may not include all possible applications of the corresponding lens, but is an attempt to provide a summary of current applications.

The reconfiguration lens allows for the investigation of three areas of inquiry. First, researchers using a reconfiguration lens can investigate how material-discursive apparatuses and the phenomena, which they are a part of, are mutually constituted. Orlikowski and Scott, for example, show in their studies of the effects of social media how different apparatuses of valuation (online and offline) imply different kinds of accountability (Scott and Orlikowski 2012), evaluation (Orlikowski and Scott 2014), and anonymity (Scott and Orlikowski 2014). Similarly, Østerlie and colleagues (2012) as well as Mazmanian and colleagues (2014) highlight the mutual constitution of apparatuses for detecting sand in petroleum production systems and getting status information about a space craft in outer space respectively. Second, the lens can be employed for studying how sociomaterial practices emerge within and reconfigure the phenomena under study. Examples include the emergence of sociomaterial knowledge practices in petroleum production (Østerlie et al. 2012), organizational practices at NASA (Mazmanian et al. 2014), ad-hoc organization in response to an crisis (Porter 2012), as well as work practices and creativity in video game development (Panourgias et al. 2014). Similarly, Oborn and colleagues (2013) highlight the emergence and role of practices in policy formulation. Finally, the reconfiguration lens can also offer insights into the mutual constitution of a person's identity and the social and material factors, which are equally part of the phenomenon under study. This aspect is particularly prominent in Schultze's (2014) study of identity construction in virtual worlds as well as Johri's (2012) investigation of process of becoming a full member of a group of researchers in engineering.

But in part this theme also occurs in the study of Oborn and colleagues (2013) with regard to the identity of the formal leader of the policy formulation process.

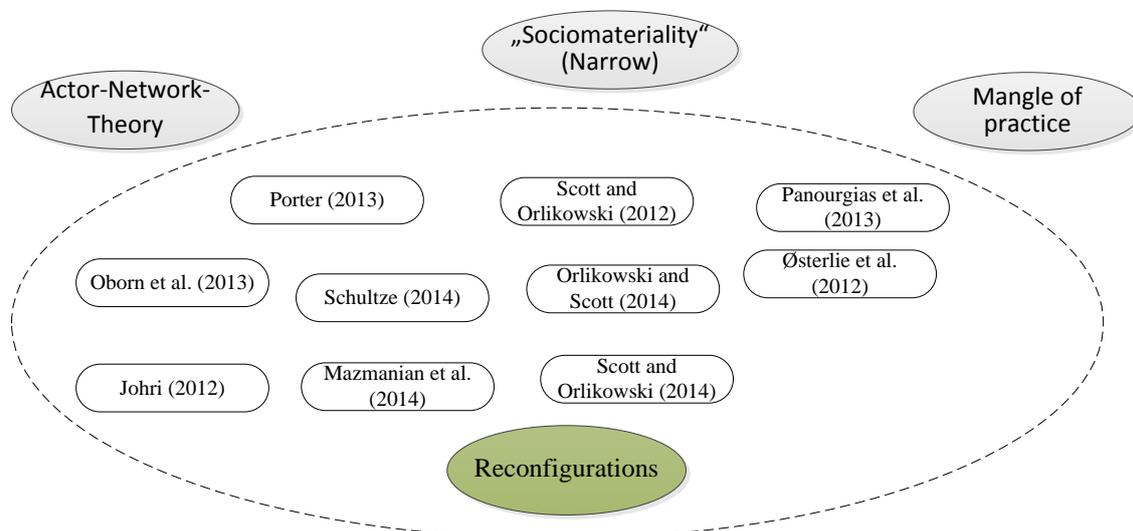


Figure 2: The reconfiguration lens and neighboring lenses.

In addition to the differences in terms of phenomena investigated, the studies using a reconfiguration lens also differ with respect to their affinity to the concepts established in other lenses. Figure 2 gives an overview of the positioning of the studies in relation to lenses that are conceptually close (ANT and MoP). Overall, four papers (Mazmanian et al. 2014; Orlikowski and Scott 2014; Scott and Orlikowski 2012, 2014) build their empirical investigations on an extended account of the concepts developed by Barad (2003, 2007), while the other works only partly apply these ideas. Most of the latter studies are conceptually close to the ideas established by ANT, while only two of these works (Østerlie et al. 2012; Panourgias et al. 2014) are oriented towards the MoP. Still, the articles do not explicitly use any concepts related to these neighboring lenses.

Similarly, ANT studies are interested in phenomena, which are constituted by human and non-human actors (or actants) and in turn constitute these. Yet, the key concern of most scholars using this lens is with the emergence of actor-networks in negotiations involving all kinds of actants. Here the (relational) effects emerging from these networks are typically the phenomenon to be explained. For example Thompson (2012), who investigated how diverse networks, with the ‘posting’ as the most prominent actant, are established in the pursuit of work-related learning and knowledge, which then

emerge as relational effects. Similarly, Cecez-Kecmanovic (2014) and Effah (2014) study the emergence of actor-networks, which result in the parallel evaluation of an IS implementation project as success and failure, and the consecutive success and failure of a dotcom pioneer respectively. Habib et al. (2014) described the process of translation, which established a virtual learning environment at a university, and the corresponding alienating conditions for international students. And, Müller (2014) investigates the development of a world spanning network for governing the preparation of the Olympic Games. While being similarly interested in the process by which the relational basis for an effect is established, Monteiro and Rolland (2012) do not primarily focus on the actants and translations involved. Instead, they study the practices enacted by heterogeneous networks and how trans-situated use emerges from the joint standardization and heterogeneity of networks of practices. This perspective has some affinity to the ideas related to the affordance lens.

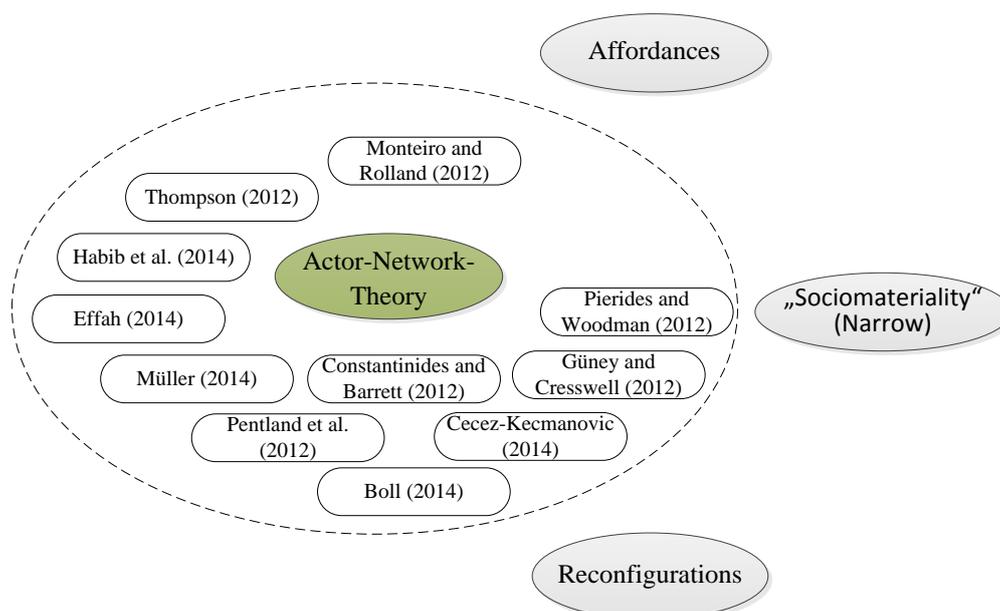


Figure 3: The ANT lens and neighboring lenses.

Being closer to the reconfiguration perspective, yet with more focus on the different actants involved, other studies investigate the emergence of (relational) effects from heterogeneous actor-networks, without tracing the emergence of these networks. Figure 3 provides an overview of the orientation of the different articles employing an ANT

lens. An example is Boll's (2014) of tax compliance, who highlights the networked and distributed nature of actions involved in the enactment of both tax compliance and non-compliance. In a similar way, but not directly using ANT concepts, Constantinides and Barrett (2012) as well as Pentland and colleagues (2012) study networks of actions, which constitute organizational routines. Both build on the concept of action nets (or narrative networks), which Pentland and Feldman (2007) developed based on ANT. Constantinides and Barrett (2012) investigate how coordination in emergency response emerges from a heterogeneous network of actants connected by routines and involving both shared cognitive models and improvised coordination. Pentland and colleagues (2012) in contrast even move one level of abstraction higher and focus solely on variation and selective retention of patterns of action instead of explaining routine characteristics with actors and their attributes or actants and relations. Thus, while highlighting the sociomaterial nature of routines their perspective actually embraces sociomateriality by being "indifferent to the relative mix of human and non-human actants", that is, it does not matter who or what takes the actions, the only thing that is relevant is that actions are taken and can be observed. Two more concepts build on the ideas of ANT, without directly applying the lens itself. Güney and Cresswell (2012) use the concept of technology-as-text and the metaphors of text and writing to highlight the dynamic and negotiated nature of IT governance, the role of technology (software with a particular architecture) in these negotiations as well as the emergence of new organizations (a council of agency CIOs). Finally, Pierides & Woodman (2012) extend the relational conceptualizations of objects in ANT with Graham Harman's concept of withdrawnness, to show how surprise caused by partly withdrawn (i.e. partly unknown and unknowable) objects can be captured by the emergent capacity of other (similarly partly withdrawn) objects, like the FDI index.

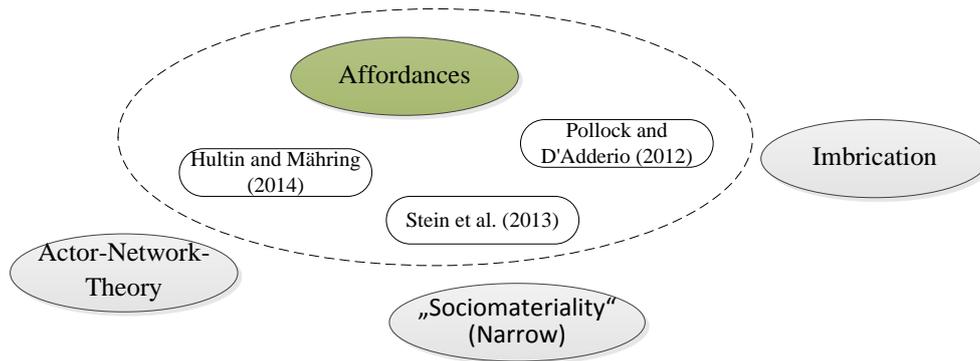


Figure 4: The affordance lens and neighboring lenses.

In contrast to the two lenses discussed so far, the affordances lens, while also having a relational conceptualization of its focal phenomenon, shifts this focus towards the relationality of affordances (instead of actants, like in ANT, or the very boundaries of any entity, like in reconfiguration studies). Using this perspective authors are able to highlight the effects of affordances or their role in the phenomenon under investigation. The theoretical orientation of the articles employing this lens differs considerably (Figure 4). Pollock and D'Adderio (2012), for example, show the effects of perceived affordances and constraints on the work practices of industry analysts and the procurement markets, which are analyzed. Here affordances and constraints, while emerging in socially conditioned perceptions of analysts, are considered to be relatively rigid influencing factors. Similarly, Stein et al. (2013) affordances are equal to the functionality of technical artifacts as it is perceived by individuals. They highlight the role these perceived affordances in identity construction. This perspective is close to the imbrication lens. Finally, Hultin and Mähring (2014) offer a broader conceptualization of affordances, which is closer to the positions of ANT and reconfiguration scholars. They unravel the role of perceived affordances and constraints in organizational change, yet stress, that both current and past encounters with technology influence sociomaterial practices and the integration of new institutional logics in these practices. With their conceptualization of affordances, they are closer to the ideas of ANT.

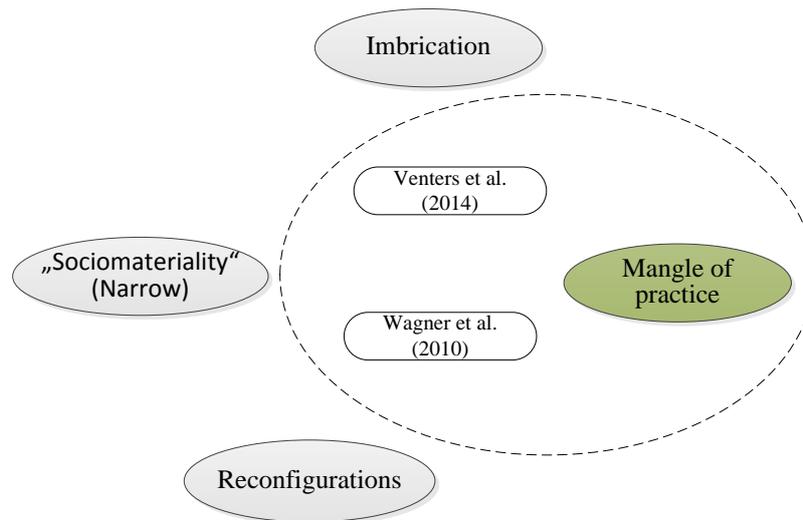


Figure 5: The Mangle of Practice lens and neighboring lenses.

Being inspired by ANT, the MoP lens turn again towards the relationship between human and non-human actors, yet with a particular focus on human and material agencies and their dialectical interaction, which produces unpredictable and undissolvable sociomaterial outcomes (hence the mangle metaphor). Wagner and colleagues (2010) show how the final selective accommodation of Enterprise System technology is achieved through a process of resistance and accommodation involving negotiations between communities of practices as well as change to the technology. Conceptually this perspective has some affinity to the ideas established in the reconfiguration lens (Figure 5). Venters and colleagues (2014) similarly highlight the process of resistance and accommodation, which constitutes coordination practices (at present). But, they also show how both past accommodations (i.e., inertia) as well as modeling towards the future impact present coordination practices. Thus, they are closer to the concept of imbrications.

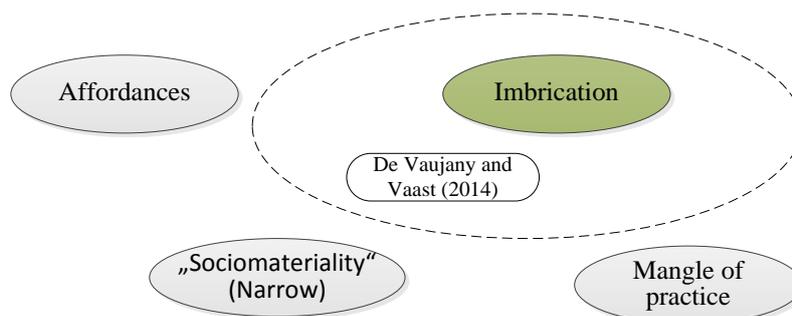


Figure 6: The imbrication lens and neighboring lenses.

Similarly, the imbrication lens investigates the interaction of human and material agencies over time, but stresses that both realms (the human and material) remain distinct, even though they only together can produce any effects. In particular, this lens highlights and investigates the material – that is, ‘lasting’ – effects, which are produced by this interaction. De Vaujany and Vaast (2014), for example, show how organizational space and legitimacy become imbricated create ‘lasting’ effects in terms spatial legacies. These legacies are both the targeted object of as well as basis for spatial and work practices. This is in part similar to the concepts of resistance and accommodation of the MoP lens (Figure 6), but also includes ideas related to the affordance lens (e.g., the symbolic function of spatial legacies).

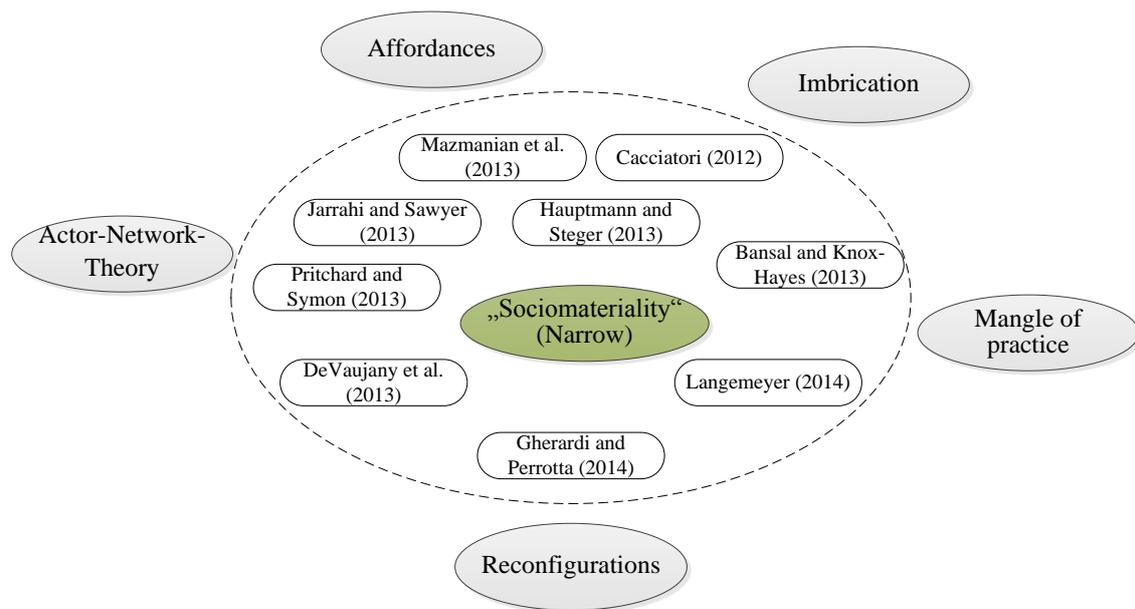


Figure 7: The sociomateriality lens and neighbouring lenses

Finally, most articles employing a sociomateriality lens (Table 4) basically to extend other theories and concepts by recognizing the role of materiality in the phenomena studied. Predominantly the theories being extended have a practice-theoretic background (e.g. structuration theory, boundary objects, theory of organizational routines). But, the lens is also used to develop new concepts (e.g., Gherardi and Perrotta 2014) or integrate it with concepts from other fields of research (Bansal and Knox-Hayes 2013).

Because the sociomateriality lens is an explicit aggregation of the concepts and ideas established by the other lenses, the articles employing this lens are to a certain degree similar to these foundational lenses. Still, like with the articles associated to the other lenses, the affinity to neighboring lenses differs from study to study (Figure 7).

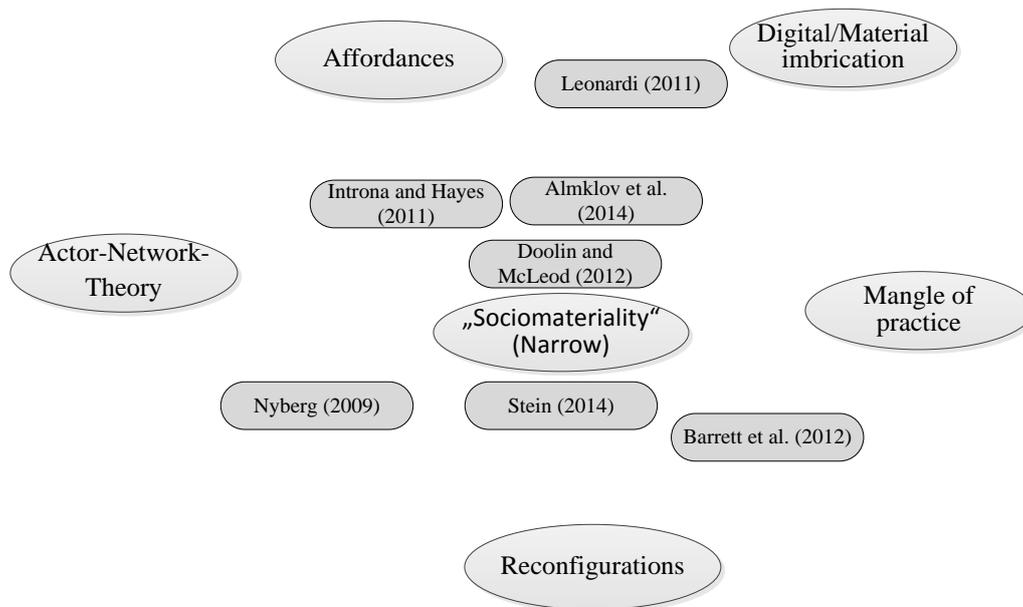


Figure 8: Multifaceted lenses in relation to the six core lenses.

So far the discussion showed that the different lens are capable of producing and limited to specific types of results. Furthermore, it became clear, that within the boundaries of a specific lens several forms of instantiation in research practice are possible, which differ in terms of their conceptual distance to other lenses. That sociomaterial research in practice is not limited to the application of a single lens is further underscored by those studies, which applied several lenses together (Figure 8). The application of several lenses can be observed both in early papers on sociomateriality (e.g., Nyberg 2009; Introna and Hayes 2011) as well as recent ones (e.g., Almklov et al. 2014; Stein et al. 2014). Yet, the way the different lenses are applied in these studies varies considerably. Several authors used the concepts and language from several lenses to show (and be able to describe) the sociomaterial nature of the phenomenon they are interested in. For example Nyberg (2009) demonstrated (based on an ANT lens) how a customer service call emerges as a relational effect of a network of human and non-human actors, which for

the customer appear as an integrated whole. Based on these considerations, they continue by highlighting the agential cuts implicated in delineation of specific elements of this network in practice (based on a reconfiguration lens). Similarly, Introna and Hayes (2011) build on concept associated with ANT, reconfiguration, and imbrication lens in their analysis of plagiarism detection in education. While using the imbrication metaphor, their analysis appears to be closer aligned with reconfiguration and ANT lens as they highlight the performativity nature of imbrications and the emergence of plagiarism as a relational effect of actor-networks.

Others establish new concepts under the umbrella of sociomateriality by integrating the corresponding perspective with sociomaterial ideas. Leonardi (2011) introduced the concepts of affordances and imbrications into the sociomateriality discourse. He used this combined lens to study the role of perceived affordances and constraints in organizational change (affordance lens), which he conceptualizes as being based on routines and technologies. The latter in turn are described as imbrications of material and human agencies (imbrication lens), which emerge from perceived affordances and constraints. Almklov and colleagues (2014), in contrast combine several established lenses for their account of the role of information infrastructures in petroleum production. The study highlights the imbrication of technology and knowledge practices in information infrastructures (imbrication lens), but also the performative nature of interpretation of sensor data (reconfiguration lens). Furthermore they show that this situated interpretation involves the interaction of numerous distributed, heterogeneous actors (ANT lens). Based on this account they develop the concept of extended situations, which emphasizes the specific character of situated interpretation in their case.

And finally, several authors combine the distinct perspectives offered by different lenses to investigate phenomena, which do not fit the “field of vision” of any single lens. Doolin and McLeod (2012) combines concepts of the MoP, reconfiguration and ANT lenses in his account of boundary objects in IS development. This way they are able to account for the temporal emergence (MoP), performed nature (reconfiguration) as well as heterogeneity and multiplicity (ANT) of boundary objects. Similarly, but investigating the introduction of robotic technology, Barrett and colleagues (2012) show how changes in work practices emerge in a process of resistance and accommodation (MoP lens), but also highlight that the particular digital materialities are actualized in situated practices and that this actualization is “neither inevitable nor necessarily associated with some

predetermined outcomes”(p. 1464). Furthermore their findings account for the reconfiguration of boundary relations between occupational groups due to the introduction of the dispensing robot (reconfiguration lens). Finally, Stein and colleagues (2014) compare two distinct lenses, MoP and ANT, in terms of their capacity to account for the role of emotions in ES implementation and use. They highlight that both lenses can accommodate emotional aspects, yet in different ways. While the MoP can be extended by including human emotions, social emotionologies, and material affects in the process of resistance and accommodation, ANT can be extended with the concept of overall felt quality of actor-networks.

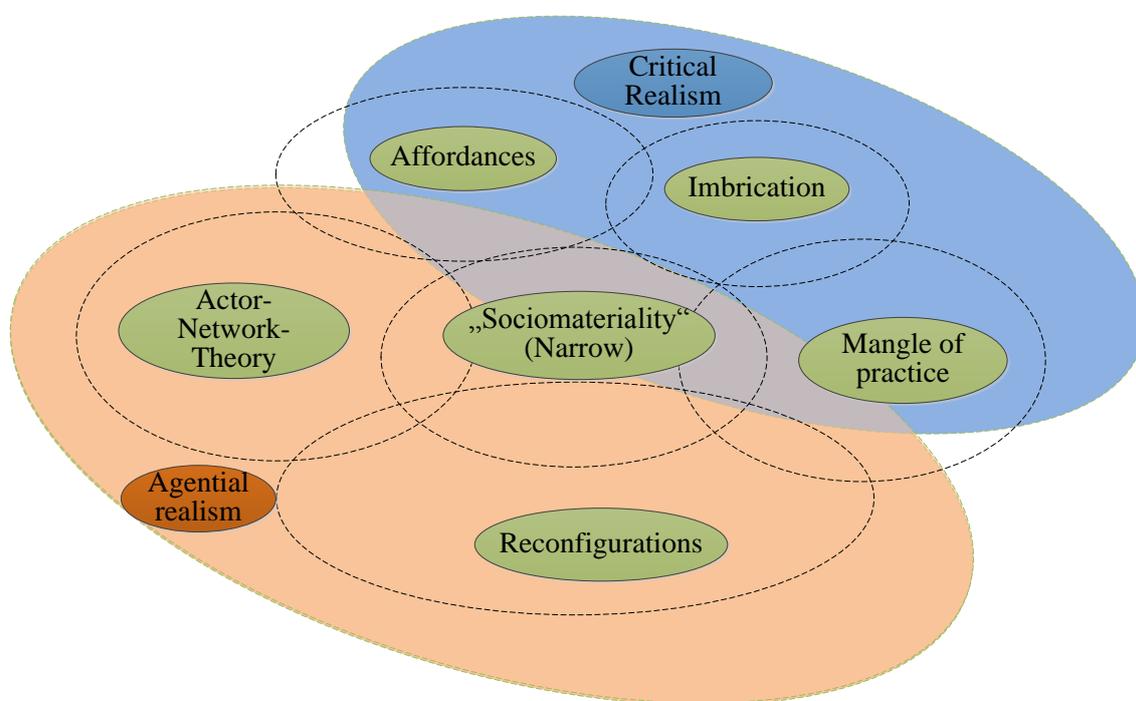


Figure 9: Map of the sociomaterial territory.

2.4.2 Mapping of the sociomaterial territory

From the above discussion it becomes clear, that the analyzed papers, as well as the lenses they are based on, can be positioned in relation to each other, that is, showing their proximity and relationships between them. Furthermore, the identified lenses should not be understood as fixed and mutually exclusive categories. Given that the articles associated to a lens may differ considerably with respect to their affinity to neigh-

boring lenses and the fact that several studies successfully developed a multifaceted perspective, the lenses are better imagined as overlapping territories (Figure 9).

Getting back to the distinctions discussed in section two, and thus closing the loop, the identified lenses can further be associated with one of the two paradigms or philosophical foundations identified by Jones (2014) and Leonardi (2013) respectively. In the following only the association of each lens with either Agential or Critical Realism will be discussed. Yet, the conclusion would be the same for the concepts of strong and weak sociomateriality as both categorizations are closely related.

The above discussion of the reconfiguration and ANT lens show, that these lenses are closely related to an Agential Realist position. In contrast the imbrication lens is epistemologically and ontologically very similar to Critical Realism. Similarly, most studies employing the MoP lens build on a Critical Realist foundation (e.g., Stein et al. 2014). Finally, the sociomateriality and affordance lens form a middle ground between both categories, as there are studies, which are closer to Agential Realist thinking (e.g., Hultin and Mähring 2014; Gherardi and Perrotta 2014), while others can be associated with Critical Realism (e.g., Pollock and D'Adderio 2012; Cacciatori 2012).

2.5 Summary

Confronted with the apparent diversity of theoretical positions embodying the socio-material paradigm, the empirical literature based on sociomateriality was reviewed with the objective to render the currently evolving theme of sociomateriality more accessible for interested scholars. Six distinct lenses were identified (green ellipses in Figure 9), each providing a consistent theoretical basis for inquiries of socio-material phenomena. But, the analysis also showed the fluidity of the boundaries between them. While both the identified lenses as well as the analyzed articles can be positioned in relation to each other, the lenses should not be understood as fixed and mutually exclusive categories, but are better imagined as overlapping territories. The territorial mapping outlined above allows to positioning current studies related to the phenomenon of ES post-implementation and provides fertile grounds for the reconceptualization of ES Transformation (sections 3.4 and 3.5).

3 Conceptual foundations

Focusing on the effortful accomplishment of repairing routines after a major disruption caused by the implementation of packaged software, this thesis builds on a stream of research that developed around the concepts of practices and enactment of phenomena in situated action. This practice-based research posits that social life is produced and reproduced in everyday, situated actions or practices (Feldman and Orlikowski 2011). With the focus on practices this kind of research aims to overcome traditional dichotomies like objective and subjective, social structure and human agency, or the seemingly contradictory characteristics of routines. Instead of these binary oppositions, practice-based research highlights the mutual constitution of phenomena which always exist in relation to each other (Feldman and Orlikowski 2011). Giddens' (1984) structuration theory, for example, describes the recursive nature of human agency and social structure. Agency from this view produces and reproduces structure, while simultaneously being constrained and enabled by this structure. Similarly, Feldman and Pentland (2003) explain the contradictory findings of research on organizational routines by highlighting the mutually constitutive nature of their ostensive and performative aspects.

3.1 Organizational routines and situated action

Literature typically defines organizational routines as “repetitive, recognizable pattern[s] of interdependent actions, involving multiple actors” (Feldman and Pentland 2003, p. 96). The seemingly contradictory, characteristics of routines identified by prior research include the following:

First, routines are formed by repeated execution of a sequence of actions and can stabilize very quickly. Second, they are still found to improve over time especially in the early phase of formation and in general often change even though external conditions largely remain stable. Third, they are often also found to stay stable even though external conditions change, a fact that is often referred to as inertia. (Feldman and Pentland 2003; Pentland et al. 2011)

In order to explain these contradictions, Feldman and Pentland (2003) distinguish two aspects of routines: the ostensive and performative aspect (Figure 10).

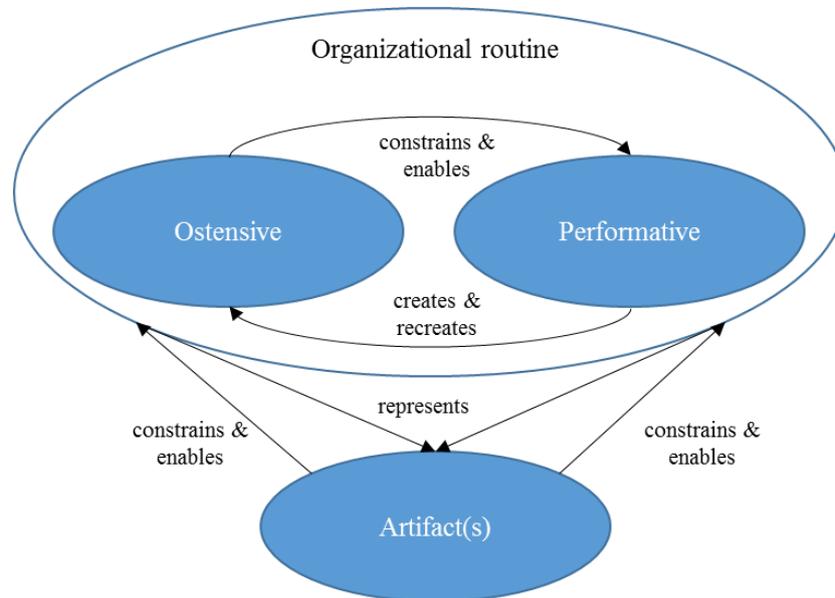


Figure 10: Organizational routines and artifacts (based on Beverungen 2014, p. 195)

The *ostensive aspects* describe what the routine in general encompasses and thus includes the understanding of those participating in it. While this understanding may be codified in standard operating procedures or similar documents, these *artifacts* only (partially) represent, but do not fully capture the ostensive aspects. This is due to the fact that the different participant's subjective understanding may considerably vary because of their different roles and points of view, making the ostensive aspects a multifaceted and socially distributed stock of knowledge (p.101). As such it fundamentally differs from a single, unified description. Furthermore these aspects involves both the cognitive as well as embodied understandings of the participants (Pentland and Feldman 2008). Thus, the ostensive aspects of a routine encompasses much more than is typically documented in a standard operating procedure. Still, it only provides an incomplete characterization of a "live routine" (Pentland and Feldman 2008, p. 240) because actual performances are missing. As thinkers like Wittgenstein (1973) and Garfinkel (1967) showed, it is impossible to specify any rule, plan or routine in sufficient detail that it could actually be carried out without any discretion on part of the actor. This is due to

the fact, that language – and with it our conceptual access to reality – stands in a generally indexical relationship to the circumstances that it presumes, produces, and describes (Garfinkel 1967). In other words, the significance of a linguistic expression in a specific situation “lies in its relationship to circumstances that are presupposed or indicated by, but not actually captured in, the expression itself” (Suchman 2007, p. 77). This has two important implications for rule following or working according to a standard operating procedure. First, it implies that rules and standard operating procedures, while not being equal to the ostensive aspects of a routine, still have considerable influence on them. As an important element of the circumstances that are presupposed by these aspects (indexicality), they substantially enable and constrain it. Second, for working according to a standard operating procedure in a particular situation this implies that in the end there is some point where “one must simply know how to go on” (Feldman and Pentland 2003, p. 101) without any further instructions. Similarly, the ostensive aspect of a routine – because it is an abstraction as well, no matter how specific it is for a particular individual – becomes significant only if it is actually performed (Feldman and Pentland 2003).

The *performative* aspect describes the effortful accomplishments (Pentland and Rueter 1994) and improvisation through which participants construct routines from the field of possibilities available in a given situation. As Suchman (1987) argued in her study on the difference between plans and situated action, people are people and do not, like automata or computers, simply follow prescribed rules or programs. For better or worse, participants will engage in reflective self-monitoring in order to see and make sense of what they are doing (Feldman and Pentland 2003; Orlikowski 2000) even in the most constrained situations. In the case of routine performances this implies both, “attending to actions taken by relevant others and the details of the situation” (Feldman and Pentland 2003, p. 102). The latter again includes artifacts, which thus also enable and constraint routine performances.

As argued before, only together the ostensive and performative aspect make an organizational routine. But, in addition it is important to consider the recursive interrelation between both aspects. The ostensive aspect allows to control one’s own performance of a routine and those of others through “the ability both to signify that some performances are part of a recognizable routine, and to legitimate some performances as appropriate to that routine” (Feldman and Pentland 2003, p. 106). This implies that the ostensive as-

pect of a routine can serve as a “template for behavior” (Feldman and Pentland 2003, p. 106) and as such can guide behavior in a particular situation, while – as discussed before – it will never be able to fully specify or determine the performance. Thus, it may best be characterized as a resource for reflexive self-monitoring (Feldman and Pentland 2003). Furthermore the ostensive aspect also supports retrospective sensemaking (Weick et al. 2005) as it provides a basis for explaining and accounting for ones actions. Relating behavior to a routine, for example, legitimates it if it is an accepted part of it and thus can serve as “ready-made justification” (Feldman and Pentland 2003, p. 106) when someone challenges our actions. The ostensive aspect further offers a framework for deciding which actions one should report and helps articulating what one decided to reveal. In the same way it of course also allows us or others to express concerns about a particular behavior or to ask for an account of it. Finally, the ostensive aspect also helps navigating in the “sea of activities” (Feldman and Pentland 2003, p. 107) of everyday practice by providing labels which help focusing attention to a “comprehensible and manageable portion” (p.107) of it. This way it also allows us to engage in activities that we do not fully understand or cannot fully anticipate as we can simply evoke the routine without paying specific attention to all the particulars involved in the performance. In much the same way a routine can initially be created by referring to or signifying what is similar about a set of performances and thus assigning an “ostensive category that makes the pattern coherent and recognizable” (p. 107). Thus, performance are as essential for the creation of a routine as is formation of the ostensive aspect.

But, as routines are not only recognizable but also repetitive, actual and repeated performance is required not only in initial creation but also for the continued existence of a routine. If an element of the routine only exists in the ostensive realm, it is nothing more than an ideal or ‘lip service’, which only matters and becomes meaningful if it is accompanied by corresponding performances. Furthermore, the performative aspect also is crucially involved in maintenance and modification of the ostensive aspect. Maintenance crucially involves exercising the capabilities to enact the routine, which at least in part requires trying out different ways of performing the routine or observing corresponding performances of others. While the ostensive aspect or an artifact representing it (e.g. a standard operating procedure) may exist without anyone any longer choosing to perform the corresponding actions, both will become meaningless over time as the capabilities to enact the routine vanish. On the other hand, people enacting a routine can

as easily deviate from the ostensive aspect as they can recreate and maintain it. Deviation may for example occur in response to changes in circumstance or in response to reflexive self-monitoring and may then be incorporate into the ostensive aspect of the routine. This incorporation or retention is selective only, that is not all deviations will be retained, basically because retention requires the person to become aware of the change and interpret it as part of the “story” of how to execute the routine instead of discarding it as exceptional deviation. This being said, it still needs to be considered that the enactment of routine typically is an unintended effect of action. The motivation for performing the corresponding sequence of actions will likely not be the creation, maintenance, or modification of the routine, but to achieve the (work) goal associated with the routine (Feldman and Pentland 2003), for example entering data related to a customer into the database of a Customer Relationship Management (CRM) system.

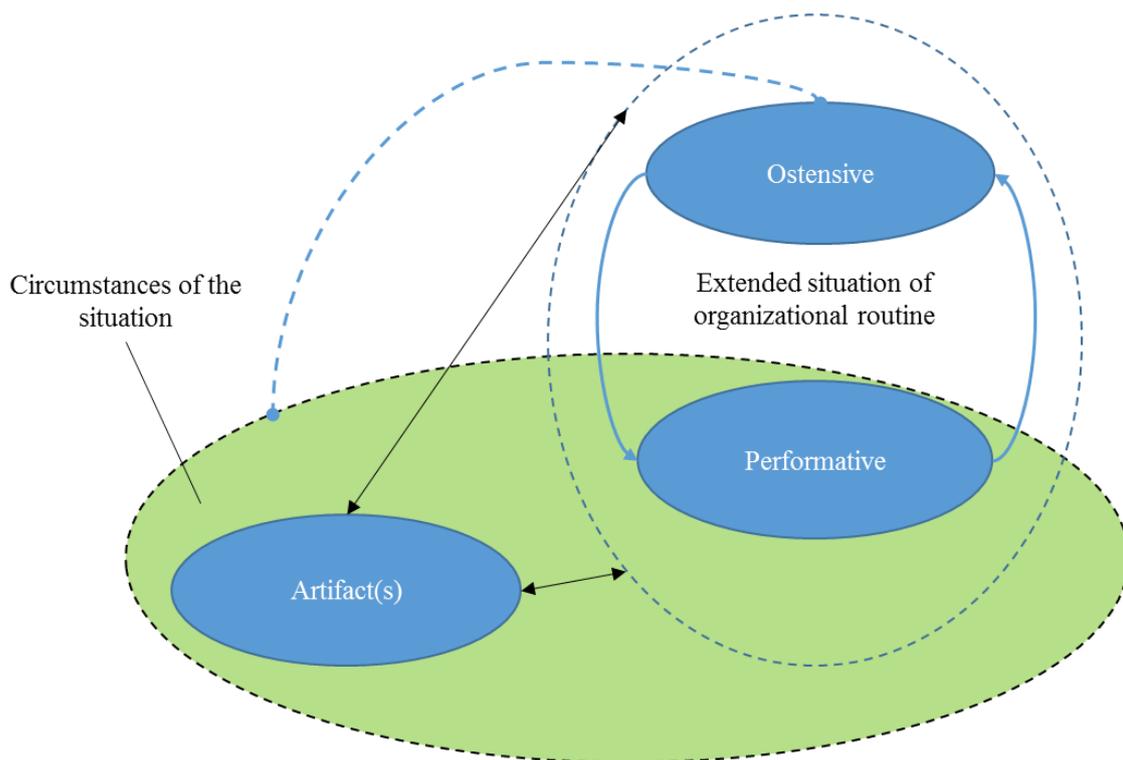


Figure 11: Organizational routines and situated action

In summary, organizational routines are constituted by “repetitive, recognizable pattern[s] of interdependent actions, involving multiple actors” (Feldman and Pentland 2003, p. 96) and can be conceptualized as having two interrelated aspect: the performa-

tive and ostensive. The mutual interaction between these two elements is described as a generative mechanism producing stability as well as change of routines, as situated routine performances are guided (not determined) by the ostensive aspects while at the same time creating, replicating, or challenging these abstract ideas. Consequently, a specific routine performance is always influenced both by the situational particulars as well as the ostensive aspects. As outlined above, the latter further depends on the particular circumstances of the situation due to its indexicality. That is, the ostensive aspects even though they are abstractions, are not independent of the situation, but include many references to taken for granted aspects of it. For example, a routine may include searching the name of a customer using a customer number. For a particular company this may be done by querying an electronic database. Thus, searching a customer name implies that the database is available and working correctly. But, because this is taken for granted, it is only included in the ostensive aspects of the routine as a reference to the assumed situation. Figure 11 depicts the relationship between these concepts. The indexical relation of the ostensive aspects and the situation is visualized by a dotted line connecting the two ellipses. By including the situation, the figure further highlights that the artifacts related to organizational routines are but one aspect of the situation within which an organizational routine is rooted. But, this does not mean that artifacts only have a minor influence on organizational routines and the daily work performed in organizations. Quite the contrary, the availability of new artifacts, like ES technology, has considerable effects on work in organizations as the next sections shows.

3.2 Situated learning after ES technology implementation

ES technology is a particular class of packaged software applications, which target large-scale integration of data and business processes across a company's functional areas (Devadoss and Pan 2007). As a ready-made mass product ES technology is designed to fit the requirements of generic customer groups rather than the specific needs of a particular organization (Van Fenema et al. 2007; Strong and Volkoff 2010). This can be highly beneficial for organizations acquiring these packages, as it "makes knowledge available that has been elicited from interactions with numerous customers" (Van Fenema et al. 2007, p. 584). But, the implementation of technology developed

based on what is identified as “best practices” by the vendor typically also generates considerable problems for the organization. As discussed before, ES technology implementation requires that both the organization and especially its employees cope with misalignments between “best practices” associated with the new technology and the routines established before (Sia and Soh 2007; Strong and Volkoff 2010). Thus, successful implementation of ES technology requires individuals to eventually adjust existing routines and develop new ones by learning two things (Yamauchi and Swanson 2010): First, they have to interact with the technology in new ways. Second, this might also have ripple effects in that they will have to develop new ways of interacting with each other. For example, new ways of interacting with a technology may challenge existing interaction patterns between departments or simply impact the ways employees enact their roles (Mueller and Raeth 2012). The associated process of learning is said to be primarily driven by local situated practice and is bound to local communities of practice (Lave and Wenger 1991), that is, individuals learn from each other in the course of actually executing tasks themselves. This is in part due to the fact that, given the characteristics of routines described above, not one single, stable routine has to be adapted, but essentially the ability to appropriately react to situational triggers has to be adjusted (Feldman and Pentland 2003). Thus users of newly deployed ES technology typically engage this technology by experimenting with it (Swanson 2004). This process of learning is considerably guided by peoples' own frames of understanding, which in turn are adjusted through learning (Beaudry and Pinsonneault 2005; Orlikowski and Gash 1994) and is facilitated where users are co-located and able to support each other (Lim et al. 1997; Rieman 1996). Furthermore experimentation and improvisation in part are important because individuals find what they perceive as mismatches between the technology and the work they must accomplish only after starting to actually work with the new system (Koopman and Hoffman 2003; Sachs 1995). Yet, it is important to note that what is established during this essentially local and improvised process of learning includes both, knowing how to use the system as well as coping with limited knowledge. In the process of learning to use the new system, users create “familiarity pockets” (Yamauchi and Swanson 2010) within which they routinely work with the system and outside of which they competently ignore it. And even within familiarity pockets, routine use masks much that is not known by users. This implies that, while appropriation of technology enables routines to be performed without actors giving focal attention to

it and attention can be focused on the task at hand (Swanson 2004), much about the technology may remain unknown.

This essentially local and improvised learning process, along with individuals' difficulties in integrating the new ES technology into their daily work, has several effects worth noting. In response to perceived mismatches users or groups of users will often create workarounds and avoid using the technology where it does not fit their preferred work practices (Koopman and Hoffman 2003; Sachs 1995) or does not allow them to accomplish their work (Wagner et al. 2010). A common example is the prevalence of practices related to the legacy technology, where users establish workarounds to be able to keep 'old,' well-known practices despite the requirements of the new technology and intentions of its advocates (Boudreau and Robey 2005). Similarly, users may work around their lack of knowledge about the ES technology or the way others work with it (Yamauchi and Swanson 2010), for example by double checking whether a data record was successfully stored by the ES technology by opening it again. Users also often "re-invent" (Boudreau & Robey, 2005) the technology by establishing new ways of working with it not anticipated by its designers and implementers (DeSanctis and Poole 1994; Orlikowski 2000). Yet, users may also rather quickly establish their own routines for working with parts of the new ES technology and competently ignore the rest (Yamauchi and Swanson 2010). In doing so, they may preclude opportunities for learning about a new technology's features (Robey et al. 2000; Tyre and Orlikowski 1994) as well as aspects of their work the new technology may be beneficial for, but that they did not include in their familiarity pockets.

These findings suggest that ES technology implementation will likely be challenging for the organization as well as its employees, making it appear close to impossible to successfully complete such an implementation project. While the situated and improvised mode of learning at the individual level calls for local deviation from "best practices", the integrated nature of this type of technology requires a relatively high level of standardization. Indeed, research suggests that upon initial implementation, firm performance often drops, rather than improves, as units grapple with the transition (Markus and Tanis 2000). Yet, far from being abandoned, many ES technology implementations have apparently been successful and ES technology is now widely deployed among firms. This raises the question, how organizations (and employees) manage to (re)establish a working Enterprise System after new ES technology was implemented.

3.3 Reestablishing a working Enterprise System

A working ES is established, if the various individuals involved in performing organizational work and routines are willing and able to use ES technology required in these performances in a satisfactory manner, even though the technology and/or the resulting performances may not be considered ideal from any one perspective (Wagner et al. 2010). In other words, a working ES is effective in that it allows individuals to achieve their work-related goals (that is the purpose of the organizational routines they perform), but may not be efficient in terms of offering an optimal solution. Thus, a working ES is characterized by a “good enough solution for all involved” (Wagner et al. 2010, p. 281) that allows everyone to get on with the work at hand. From a management perspective, establishing “just” a working ES most likely will not be considered satisfactory or even a success. Yet, regaining the ability to work effectively is a crucial prerequisite for creating value from technology implementations (Burton-Jones and Grange 2013; Lauterbach et al. 2014). Few studies have so far focused on the post-go-live phase and the process of (re)establishing a working ES after ES technology was introduced (e.g. Boudreau and Robey 2005; Wagner et al. 2010; Yamauchi and Swanson 2010).

Boudreau and Robey (2005) describe the post-go-live period as one where users move from inertia, through improvised learning, to reinvention. In their study of the implementation of an ERP system in a US American State agency, they found that despite pre-go live excitement, users avoided the new ES technology as much as possible and kept working the way they did before, e.g. using paper forms and delegating the work of entering data into the ERP system to experienced users (power users). Inertia was eventually overcome through improvised learning which was triggered by the social network of employees at the state agency. Different groups within the organization provided both incentives and support for learning in different ways. For example project leaders changed their persuasion strategy from a laissez-fair approach during trainings to more directly insisting that everyone has to use the new system. Similarly, power users stopped supporting their colleagues’ resistance by no longer accepting to enter data into the ERP system on behalf of them and thus also forced them to use the system themselves. But, in parallel power users also offered help to users who lack sufficient knowledge about the new technology. Furthermore users assisted each other by creating and distributing own manuals and propagating tips and tricks they found while using the system either informally, in user groups that met monthly. Creating and using binders

with a collection of relevant documents was in general a common way of learning how to use the new system, that is, many users created these collections for personal purposes as well without the intention to develop a resource for sharing knowledge with others. The process of improvised learning finally culminated in both a working ES as well as considerable reinvention of the technology through workarounds. Such workarounds were enacted to circumvent what users perceived as deficiencies of the new ERP system. These deficiencies result both from missing as well as existing –but ignored – features.

Similarly, Wagner and colleagues (2010) studied the implementation of an ERP system at a US American University (cf. section 2.3.4, p. 39). In summary, they found that practices are negotiated through processes of use rather than being permanently and systematically selected at a particular moment in time. This negotiation requires resolving conflicts occurring at the boundaries of different communities of practice and establishing a solution that can support the practices of various communities. But, the solution to be achieved is not established by adapting the users' way of working only. It may also imply changes to the new technology as well as changes in organizational structure, like the creation of a new organizational unit in charge of handling some of the additional tasks imposed by the new technology. Yet, "project survival does not depend on benevolently accommodating everyone" (p. 290). The concept of selective accommodation established in this study rather emphasizes the need to "distinguish the essential debates from issues of preference alone" (p.290). Thus, establishing a working ES requires individuals to collectively work towards an effective solution composed of "critical established practices and the aspects of the proposed best practices" (p.290).

At the level of individual users Yamauchi & Swanson (2010) found users to create "familiarity pockets" through the following process. At first pockets are established when users gain initial familiarity through trial-and-error learning and experimentation which leads quickly to a "minimal pocket of moves and move sequences that can serve as components of routines" (p. 201). Further familiarity is gained by coping with the troubles that arise when new situations challenge the current understanding and incorporating the resulting experience into the pocket. This is achieved either alone or with the support of others. Similar to the concept of organizational routines discussed before, the pocket is reinforced through repeated performances and thus becomes routinized. But, this does not imply that it is not further refined and extended, as new situations or varia-

tions of familiar ones still lead to adapting pockets in breadth (i.e., adding new moves) and depth (i.e., improving the understanding of existing moves).

In summary the process of reestablishing a routinized way of working may involve the need to overcome initial resistance or inertia, as users do not want to change their established work practices (Boudreau and Robey 2005), but may also entail negotiation of what constitutes a legacy practices worth keeping (Wagner et al. 2010). In any case the period after go-live of new ES technology is characterized by improvisation and the need to collaboratively regain routinization by learning (Boudreau and Robey 2005; Yamauchi and Swanson 2010) or adapting technology and organizational structures (Wagner et al. 2010). Due to this process of improvisation and adaptation, the resulting routine use of ES technology, while allowing a diverse set of stakeholders to do their work with the system, will most likely deviate from what was anticipated by designers and implementers before go-live (DeSanctis and Poole 1994; Orlikowski 2000). This stream of research already revealed a lot about the fragile processes constituting the phase of ES technology post-implementation and authors agree on the situated and improvised nature of activities in this phase as well as the partial unpredictability of final results. Yet, it remain unclear when the different practices (or situated activities) for establishing a working ES (that is learning, adapting technology or adapting organizational structures), identified in different studies, occur and how they relate to each other. The following (re-)conceptualizations of a working ES and ES Transformation are a first step towards answering these questions. This will support the analysis and discussion of the empirical material by providing a perspective or lens different from those previously employed when studying the phenomenon of implementing ES technology in organizations. This change in perspective will help extending the current understanding of this phenomenon.

3.4 An agential realist conceptualization of the working ES

An essential element of the practice-based research discussed so far is the concept of situation. Yet, far from being unequivocal, it generated considerable debate among researchers, and thus deserves further explanation. Scholars following this line of research

agree that work – and action more generally – is embedded in a situation that emerges from a specific time and place. Still, the degree to which the situation is conceptualized as being limited in time and space varies considerably. Studies on situated use of IT, for example, typically focus on situations in terms of specific, local circumstances (cf. sections 3.2 and 3.3). This narrow focus on local work and circumstances was criticized by several authors (e.g., Pollock et al. 2009), and recently the concept of extended situation was developed (e.g., Almklov et al. 2014) to answer this critique. It is based on Suchman's (2007) definition of situated action as "actions taken in the context of particular, concrete circumstances" (p. 26), which stresses the particularity of situations - instead of temporal or local characteristics. The concept of extended situation further emphasizes the relevance of the history of interactions preceding the current situation as well as the non-locality of situations, that is, co-location is not necessary condition for situatedness. Situations from this perspective are thus extended in time and space. Pentland and Feldman (2007) make a similar point by arguing that the coherence of situated action is not rooted in co-presence and co-location only, but may also derive from unity of purpose. The ostensive aspects provide coherence between temporally and spatially distributed parts of a routine performance by offering a common purpose that links the particular situated actions and allows individuals to "recognize and organize diverse parts of a performance [...] as a coherent whole" (Pentland and Feldman 2007, p. 787). To illustrate this point as well as the subsequent concepts, the imaginary example of a sales agent's interaction with a customer and a CRM system will be used in the following. Far from being limited to the immediate dialogue with the customer, the interaction stretches both in time and space by being part of a routine. For a new customer, the sales agent is required to gather all relevant data during the interaction with the customer. Back in her office, she enters the data into the CRM system. In case of an initial contact by telephone the routine may be slightly different, as she can directly enter the data during the call. In both cases, the performance of the routine is thus extended in space and for the face-to-face meeting it is even significantly extended in time. Still, the routine can be recognized as a coherent whole, due to the common purpose linking the different performances. Furthermore, the history of interactions with this and other customers as well as the CRM system are relevant as well. The difference in performances of face-to-face meetings and telephone calls may have been established because of previous discussions with customers concerned about data security, when data was entered

directly into the CRM system in front of them. Or, the recurrent problem of missing important information during a meeting may have led the sales agent to create a checklist for the data required in the CRM system and take more detailed notes during customer visits.

Weick and colleagues (2005) describe this process of recognizing and organizing situated encounters with the world into a coherent whole in more detail. In particular, they distinguish it from rationalistic accounts of decision-making as the process aims at making sense of a situation at hand (hence they use the term sensemaking) instead of choosing a preferred, readily available alternative. Thus, sensemaking is about "the interplay of action and interpretation rather than the influence of evaluation on choice" (p. 409). The concept of sensemaking assumes that problems (here for example the need to appropriate new technology) are not being given and ready to be perceived by individuals, but must be bracketed from an amorphous stream of experiences and need to be labeled as relevant before ongoing action can be focused on them. In summary, this perspective holds that people organize to make sense of equivocal inputs and enact this sense back into the world to make that world more orderly. The crucial difference between sensemaking and basic cognitive psychology is that it is based on plausibility rather than accuracy, that is, "people may get better stories, but they will never get *the* story" (p. 415; emphasis in the original). Extending the above example this can be illustrated as follows. For existing customers, the routine does not only include gathering information during the conversation and updating data in the CRM system. It starts earlier, because the sales talk is prepared by retrieving required data from the system. This includes two figures representing the volume of past sales for the customer as well as the average volume for the corresponding customer segment. Both figures are automatically calculated by the CRM system. Based on these figures, the prospective sales volume is estimated by the sales agent. Still, during the conversation this expectation may not be met and the sales agent has to make sense of the new situation. Not only can the customer's situation simply differ from the customer segment average, but there may also be an error in the data stored in the CRM system or the information the customer is giving during the talk may be wrong. Thus, the sales agent has to bracket and label the problem during – and probably again after – the conversation to make sense of the situation. If remembered, this bracketing and labelling may then also help to make sense of similar situations in the future.

But, this example also shows that the environment offering experiences typically is not just a stable site awaiting action of a particular human. It is constituted of many other human (e.g., colleagues) and non-human actors (e.g., software performing calculations). Thus, the environment equally contributes to the process of situational knowing and understanding (Pentland et al. 2012; Weick et al. 2005), which makes depicting the relationship between technology and people as interaction between stable, predefined entities appear to be problematic.

Instead this relationship may better be described as one of mutual constitution, like proposed in contemporary discussions on sociomateriality (cf. chapter 2). Especially the reconfiguration and ANT lens conceptually extend the mutual constitution and relationality of humanist practice-based approaches to include the material aspects of the world. That is, according to this view, local emergence does not include social structures and processes only, but the material realm, like for example artifacts (Feldman and Orlikowski 2011), as well. Furthermore, the concept of relationships of mutual constitution stresses that no phenomenon can be taken to be independent of other phenomena and thus they exist only in relation with each other (Feldman and Orlikowski 2011). This implies that relationships between humans and artifacts are not inherently defined or naturally given. Thus, separation of a phenomenon from its context (or the delineation of concepts by abstraction) is always in part artificial. For the above example the (personal) computer used to interact with the CRM system illustrates this well. Indeed, it is easily possible to point to the metal or plastic case, which hides an assortment of hardware components, and call this collection a computer or just grab the case and transport it elsewhere. Yet, for the computer to be a meaningful part of everyday practice, much more is required than the hardware in the case. The most tangible examples are electrical power supply, local and global networking infrastructure, and all the peripheral devices (like keyboard, monitor, etc.). But, the list of additional requirements also includes software (i.e., programs and data) as well as the work practices and knowledge of the individual using the computer.

Yet again, the delineation of these constituting parts is only an analytical one. Enumerating the 'structural features' of technology, like abstract data structures (e.g. database schemata or data types) or functionality (i.e., programs or algorithms) is not sufficient to fully describe the behavior of a computer in a specific situation and its effects. Particular instances of such data (i.e., actual data), which are processed by some algorithm at a

specific moment as well as the use behavior and interpretation activities of the user are also important for an effect to occur. A number appearing on a screen may be produced by a program invisible for the user or may be the product of an extended, iterative interaction between programmed calculations and input entered by one or many different users. For example, past and average sales volumes calculated by the CRM system are based on data entered by many different sales agents over an extended period of time and at different locations. Actually, entering, accessing, and changing data is a functionality as well, enable by (some part of) a program. For example, the conformity of entered customer data (e.g., contact information) with predefined data structures is ensured by algorithms. Furthermore, users seldom see any 'raw data' in terms of what is 'really' stored in the database of the CRM system, not to mention the cryptic (binary) format data (as well as programs) are stored in at the physical level.

Thus, there are numerous ways of delineating 'things' and consequently relations between these conceptual entities exist at many different levels. On the other hand, the concept of relationality does not imply that everything is (directly) related to everything else, but rather reminds us of the fact that there are always relations that are foreclosed by delineating the boundaries of a 'thing' (Barad 2007).

So far the considerations emphasized the dynamic, interrelated, and situated nature of the phenomena relevant here (like routines, technology) without considering significant changes in these phenomena. Related to the above example the question arises, what happens to these complex phenomena if the CRM system is replaced by a new system? Reflecting on current studies of sociomateriality, Ramiller (2013) argues "that socio-material 'entanglement,' while integral to human existence, is in any particular area of practice – including the use of information technologies in work – not ontologically given but a nascent possibility that must be realized in part as a cognitive accomplishment" (p.5). In essence, this perspective advances the discussion by asking what ontology, or better the ontology of what, we are talking about. In this, it is important to highlight the material nature of knowing and situated action. This essentially shifts the sociomaterial unity from the level of individuals and objects (which is perfectly adequate for studies of change at the organizational level) to the level of processes of knowing and enactment. Building on the insights of ethnographers of sporting disciplines, Ramiller (2013) argues that the sociomaterial state of affairs is not a given but comes about through socialization, hard work, and disciplined experience in the practices that em-

ploy these objects and things, making the dualities, rather than unity, the starting point. This perspective resonates well with accounts of sensemaking as offered by Weick and colleagues (2005) as well the insights of authors like Suchman (2007). Yet, knowledge there is posited as inherently provisional and heavily relying on reference to (indexicality) and performance in a particular situation. That is, it is better characterized as situated knowing. Individuals have to (cognitively) separate, based on their existing understanding and the environment around them, subject and object(s) to be able to learn something about the world, and still need to fuse both back together in order to act on (or even merely remember) what was learned. The same applies for intentional changes, which similarly require subject and object distinctions for orientation and still can just be accomplished when both come together again. This implies, that changes in subject / object roles and the corresponding effects will depend on the situation at hand and are not as fixed as is commonly assumed. Returning to the example of routinely working with a CRM system these considerations can be explained as follows. Indeed proficient use of a new system will not be immediately given, but has to be achieved by hard work. But, sales agents do not have to learn how to use the new CRM system in general, that is, with all its functionality and the possibilities for action arising from its use. Rather, they are required to learn how to use the system as part of their work, skillfully combining recognized features and patterns of use in organizational routines. This implies both identifying relevant functionality as well as and accepting it as given without necessarily being able to fully understand, or merely know, the technical details of its realization. For example, the new system may calculate the figure representing the prospective sales volume automatically. For this figure to be valuable it is important to understand what it can be used for in daily work, yet it may well be irrelevant how it was actually calculated by the system. Routinely using the system may thus simply mean to use the figure in routine performances without any further considerations and the ostensive aspects of this routine may just refer to (indexicality) the situation for the availability of the figure. The relevant question thus is not which functionality the system offers in principle and how it is provided, but what the system actually means for a particular person in a specific situation: does it for example force me to change my current behavior or do I work around its deficiencies?

But, these kinds of qualifications have to be handled with care as "what is at issue is not some ill-defined process by which human-based linguistic practices (materially support-

ed in some unspecified way) manage to produce substantive bodies” (Barad 2003, p. 823). Instead it is important to consider the “conjoined material-discursive nature of constraints, conditions, and practices” (Barad 2003, p. 823). As discussed in section 2.3.2, what is meant by material-discursive practices here, are specific iterative enactments through which “matter is differentially engaged and articulated (in the emergence of boundaries and meanings), reconfiguring the material-discursive field of possibilities” (Barad 2003, pp. 822–823). That is, the field of possibilities people engage with in every moment is crucially formed and restricted by both material and discursive factors, while in turn every performance (i.e., the reciprocal exchange between actor and environment) may change these factors. In other words, it is not only humans who engage in the agential delineation and reconfiguration of the world, but it is the combination of an active ‘material’ environment with these humans, which results in the enactment of agential cuts and a different configuration of reality. For the above example this means, that effects are jointly produced by sales agents, customers, and technology. Furthermore, these effects emerge from the particularities of a specific situation (specific in terms of the understanding and interpretation of those involved, the data currently stored in the CRM system, the current execution of programs, etc.) and because these effects occur, the situation itself is necessarily changed as well. This in turn has two important implications. First, understanding continually has to be achieved in processes of situated sensemaking and offers a provisional ordering of the world only. Second, this situated understanding together with changes in databases, on paper (e.g. checklist), in routines, etc. results in a reconfiguration of the field of possibilities that forms the basis of any future performances. Thus, current performances necessarily influences future possibilities.

More general, from this perspective every encounter with ES technology is sociomaterial, requires agential cuts and will in some way reconfigure the field of possibilities. Thus, the extended situation of ES technology-in-practice (Orlikowski 2000) is agentially delineated, produced and reproduced within this phenomenon and should not be thought of as a collection of stable, well-defined entities. That is, it is rooted in but also configures the material-discursive field of possibilities of the phenomenon (Figure 12).

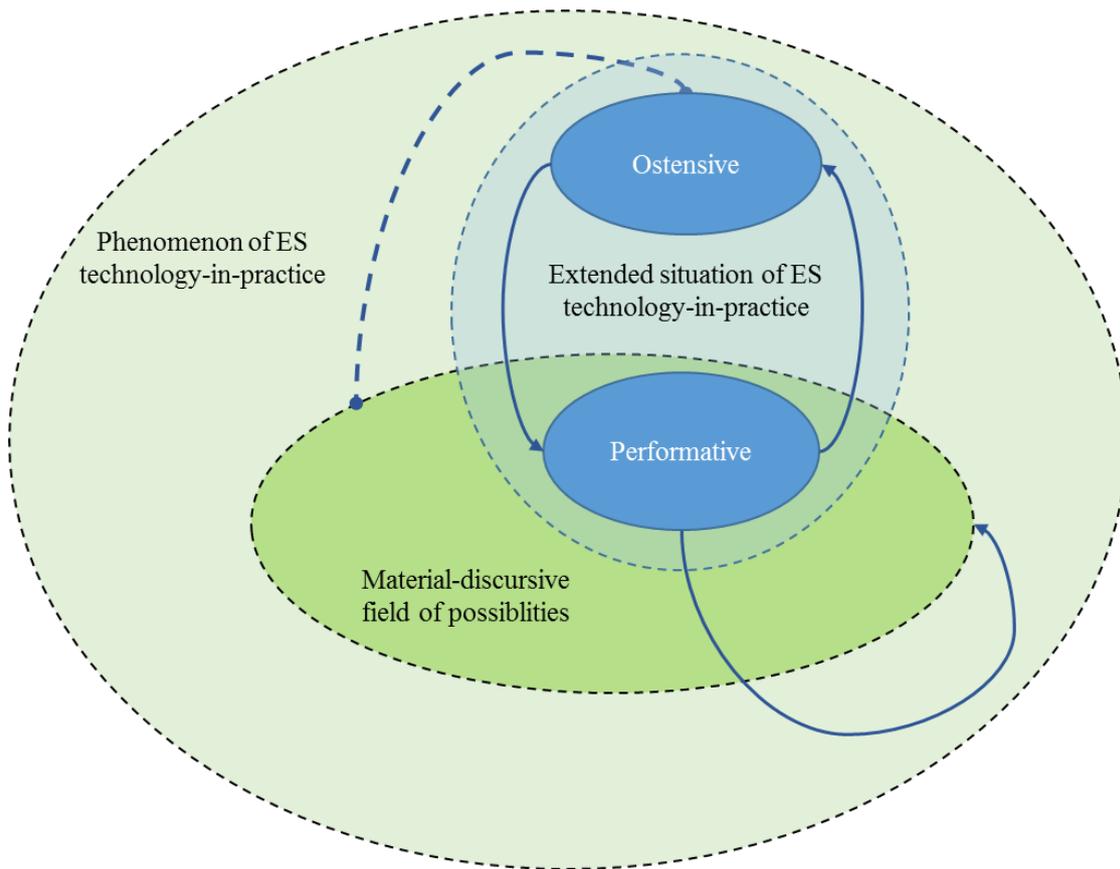


Figure 12: Phenomenon of ES technology-in-practice

Borrowing the terms established for organizational routines, ES technology-in-practice can thus be conceptualized as being constituted by ostensive (the ES technology in general) and performative aspects (the ES technology in situated action). Performances are part of the emergent field of possibilities and participate in its delineation (indicated by the arrow). And, the ostensive aspects are related to the field as well because of their indexicality (indicated by the dotted lines connecting the two ellipses) and their impact on performances.

Following this argument, routines occurring in an extended situation should be similarly understood as being produced and reproduced within the phenomenon under investigation by means of agential cuts. Thus, ostensive and performative aspects of a routine are rooted in, and participate in configuring, the material-discursive field of possibilities as well. The same is true for other organizational structures, like for example roles, (Volkoff et al. 2007) legitimacy, or power relations (Jones and Karsten 2008).

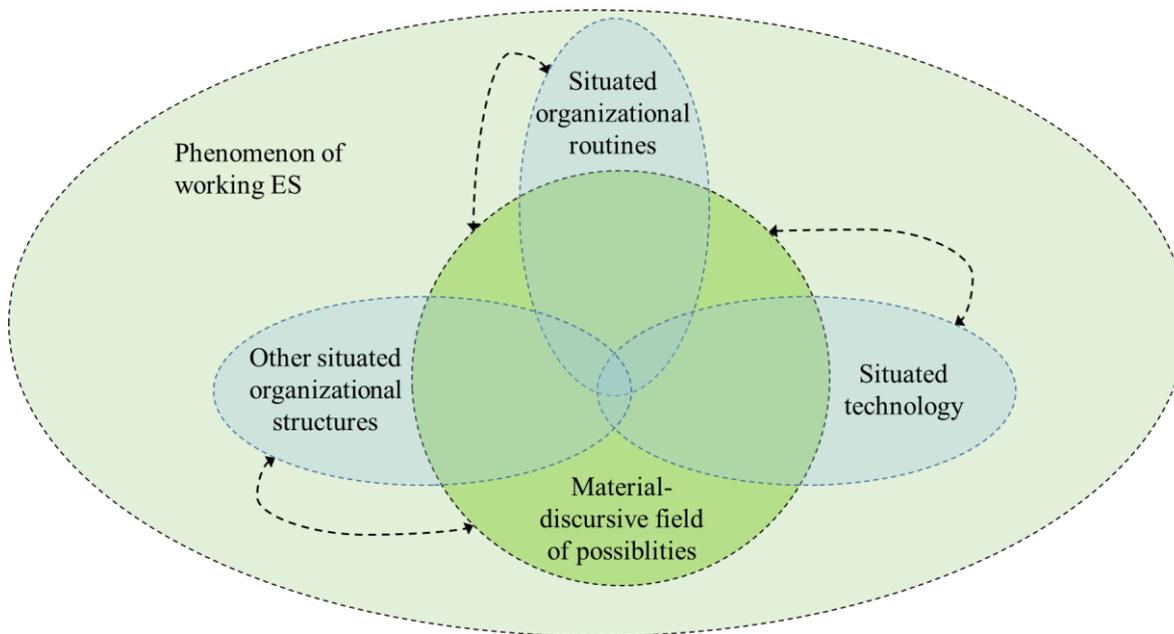


Figure 13: Phenomenon of working ES

Given these dynamics and the shift towards situated, material knowing and enactments, a working ES should not be conceptualized as a well-defined, stable state. Instead it is better characterized as an interactively stabilized phenomenon constituted by the conjoint performance of organizational routines, (ES) technology-in-practice, and other organizational structures (Figure 13). These constituents are not only formed by the extended situations they are a part of (depicted by the blue ellipses), but are crucially inter-related through their being part of the same field of possibilities. Because, as discussed above, the extended situations do not only emerge from this field of possibilities, but also continually reconfigure it (indicated by the arrows), the working ES has to be established and reestablished in practice all the time.

3.5 (Re-)Conceptualizing ES Transformation

In summary, research so far revealed that situated action and improvisation are key in the phase of ES technology post-implementation. Several different practices for establishing a working ES have been identified ranging from individual level learning and

establishing routines to adapting technology and/or organizational structures. Yet, it remains unclear when these practices occur and how they relate to each other.

A first step towards answering this question is the shift towards an agential realist understanding of a working ES outlined above. In addition to the insight that sociomaterial entanglements are best characterized as accomplishments in practice, this shift has a further profound implication for the conceptual understanding of the process of reestablishing a working ES. For situations where an existing technology is replaced, the point of departure is as much characterized by an achieved sociomaterial unity of humans with the old system as it is by the duality of humans and new technology. Taking the idea of sociomaterial entanglements, accomplished by intense learning, seriously raises the question of what happens with existing entanglements in the course of (post-) implementation. If the perspective offered above is valid, the process of agentially cutting subjects and objects out of the material-discursive field of possibilities will also hold true for the process of delineating and making sense of the relationship between existing entanglements and new technology.

With respect to ES technology implementation, this implies that, while achieving sociomaterial unity of an individual and a new technology has to be seen as an accomplishment, the sociomaterial constitution of the initial situation (i.e., the point of departure) also has to be considered as it crucially shapes the finally accomplished unity. Furthermore what is described above as the process of accomplishing unity also heavily depends on material and discursive factors. That is, change implies the breaking of old associations (yet without predefined breaking point) as much as the iterative and reflexive building of new ones and is itself sociomaterial. Thus, the change occurring in these kinds of situations may be better described as transforming the dynamic sociomaterial network lying at the heart of the (existing) ES by changing (part of) its technological basis rather than "just" adopting or implementing new ES technology. In the following, the term ES Transformation is used to refer to this process. More specifically the term denotes the sociomaterial process of reestablishing a working ES in response to a significant change in the material-discursive field of possibilities, like the substitution of central legacy technology by new ES technology.

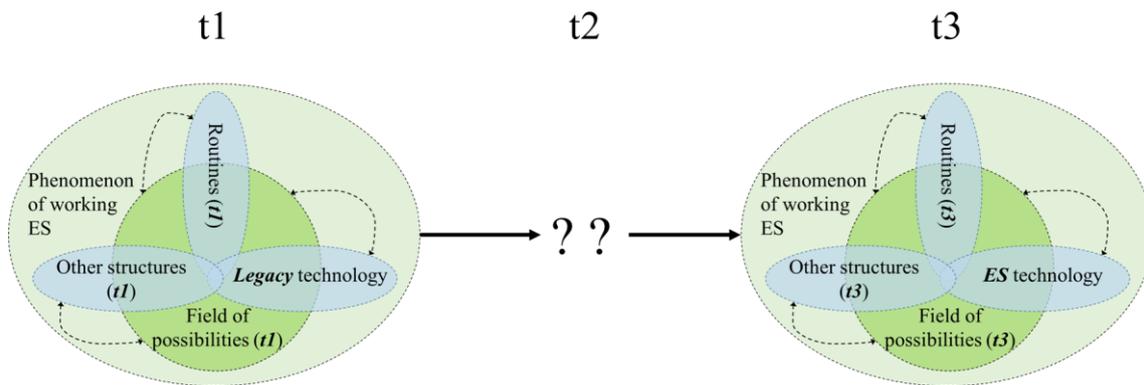


Figure 14: Phenomenon of ES Transformation

According to this reconceptualization establishing a working ES requires individuals to effortfully achieve a routinized way of working with ES technology (Figure 14, t3), while the material-discursive field of possibilities was crucially formed during work with the old technology (t1). In other words, individuals have to find ways to repair the organizational routines, which have been disrupted by the substitution of technology (t2). As this implies a reconfiguration of the field of possibilities, other organizational structures will likely be affected by and will have an impact on this process as well. The empirical material below provides an answer to the question of how exactly this repairing of routines is achieved.

4 Research Design

Recognizing the nascent stage of theorizing on this question and the crucial role of agential cuts in enacting the phenomenon of interest, a predominately inductive and interpretive research approach appears to be most valuable. In particular, the interpretive case study methodology in its hermeneutic version (e.g., Sarker and Lee 2006) was found to be most applicable to guide the collection and analysis of data. That is, texts reflecting the subjects' experiences with and the observations of the transformation of the ES at their organization were used to develop a second-order theoretical understanding of the phenomenon (Sarker et al. 2006). In line with the recommendations of Klein and Myers (1999) the concept of the hermeneutic circle (cf. section 2.2) was applied to examine and make sense of the data. The framework established in chapter 3 served as theoretical scaffold (Mueller and Raeth 2012) to distinguish between what is relevant and what is not in order to avoid data asphyxiation (Langley 1999).

4.1 Case Description²

The case material was collected at the retail banking division of BANK, a global universal bank with roots in central Europe. At the time of the investigation the bank conducted a multi-year ES technology implementation program which had the objective to replace the custom-built core banking system as well as related systems in front- and middle offices with a standard software solution. The program followed a phased approach, that is, the system was not rolled out at once, but in several releases. This also implied that parts of the old core-banking system were not immediately replaced, but had to be used in parallel with the new ES technology.

Within the retail banking division the study focused on the credit service unit Credit Factory (CF), which offers back-office services to the bank's customers and advisors, like post-processing of credit business in particular mortgage loans. CF is composed of

² To ensure anonymity of the informants, part of the information was anonymized or removed.

several departments that deal with different aspects of credit processing, like collateral management, credit applications, or associated after-sales activities such as redemptions. As part of BANK's program for replacing the old core-banking system, a new standard software for managing loans LMS (loan management system) was implemented at CF. While LMS is a system specific to the banking industry, it has the typical characteristics of ES technology as they are defined in the literature (e.g., Markus and Tanis 2000; Devadoss and Pan 2007). First, it is a customizable software package provided by a large vendor of ERP software. Second, it integrates data and business processes across the various departments within CF as well as other divisions of BANK. LMS replaced the old loan management system (OLMS), which had been in place for over thirty years before.

The two systems differed substantially in their internal processing logic. While OLMS used an accounting logic based on actually booked values (actual value-based logic), LMS internally generated a plan for all future transactions related to a loan and automatically booked transactions conforming to the plan (plan-based logic). Thus, in LMS every transaction deviating from the plan had to be manually corrected before it could be booked into the loan account, while in OLMS booking occurred immediately and the assignment of the transaction to a particular category could be done manually later. For the work at CF this implied that deviations had to be handled much faster in order to avoid subsequent errors. For example, in case of an unscheduled repayment, OLMS would just register the unexpected transaction, but would continue to performed transactions (like direct debiting of instalments) as before. In contrast LMS, due to its plan-based logic, would take the additional money available for the next instalment instead of debiting the customer account.

At the IT department of BANK initial project activities related to the implementation of LMS started about one year before the introduction with requirements analysis and definition followed by configuration and implementation activities and testing. Several members of CF were involved in these activities. They especially participated in requirements gathering, the redefinition of process description to be included in the process management system and testing of customized LMS functionality.

Starting about two months before LMS go-live, change management activities, like trainings, were conducted at CF. These trainings were similar for all employees in the three departments and consisted of a one-day basis training and self-trainings based on

pre-defined training cases using a test-system. In addition, two new roles were established for the time of the change: change agent and multiplier.

Change agents were LMS experts, typically from other divisions of BANK, who were charged with helping CF employees to solve unexpected problems with using LMS. Because there were only few change agents available, several of the employees who participated in LMS-related project activities, were assigned the role of a multiplier. For every team at CF one to two multipliers were appointed, who served as an information hub during the post-implementation phase. They collected questions and problems related to LMS, discussed them with change agents or others at CF responsible for the particular issue, and channeled the flow of information to employees.

During the case study service employees of three departments, Sales Service Group (SSG), Production Service New (PSN) and Production Service Stock (PSS) were affected by the implementation of LMS. Employees at SSG are the main point of contact for anyone outside CF. But, in contrast to a common call center, their job does not only include communication but they are in addition responsible for handling all requests that do not fit the standardized processes at CF. Examples of such requests include making unusual corrections to loan contracts or confirming specific facts for notaries. Thus, daily work basically involved two very different tasks with almost oppositional characteristics: handling of calls and processing of non-standard request. While the first task is fully controlled by a call center telephone system, the second one requires independent thinking and self-organization. Furthermore every employee at CF is responsible for a particular region and thus will typically handle requests of a relatively stable (but, still very large) group of bank advisors and external contacts. Consequently, SSG employees perceive themselves not as mere call center agents but as specialist with comprehensive expertise and intermediaries between sales agents and CF.

In contrast, the other two departments are in charge of efficiently processing large numbers of standard requests. On average, approx. 300,000 requests related to about 380 banking products are processed per month. Efficient processing of requests is enabled by a procedural way of working and strict division of labor. The steps required to handle requests are defined in approx. 140 processes (consisting of about 4000 process steps in total). These processes are described in process descriptions, which are available to every CF employee in an online tool. Furthermore, handling of these requests is supported by a workflow system. Division of labor is particularly evident in the fact that there are

two departments in charge of processing standard requests: one responsible for new contracts, the other for existing ones. PSN is responsible for requests related to new loan contracts. This includes approving data entered by sales people using a special software tool for managing loan contracts as well as transferring data from printed contracts into OLMS (and LMS respectively). In addition, they are responsible for sending contract documents to customer and disbursing loans. For all requests they process, PSN employees are further required to check if the submission criteria are met, that is, that they are complete and correct.

Requests related to existing loan contracts are processed by PSS. Basically, this means that they have to enter all kinds of changes into OLMS (and LMS respectively). This includes changes in customer data, but also contractual changes like redemptions and prolongations. Like their colleagues at PSN, before processing requests PSS employees have to make sure that requests meet the submission criteria.

The above description shows that the loan management system is the most central technology at CF, but in addition several other systems support the work at CF. The most important ones are a workflow system, an advanced telephone system, a system for managing processes, and system for managing loan contracts. While the loan management system is equally relevant for all three departments, the other system are more task specific (Table 7).

Department	OLMS / LMS	Workflow system	Telephone system	Process Management system	Contract management system
SSG	X	X	X		
PSN	X	X		X	X
PSS	X	X		X	

Table 7: Technical systems supporting the work at CF

The workflow system serves as a task list and task specific data repository for employees as it includes all requests to be handled together with related documents like contracts or letters. Furthermore, helps coordinating the interaction between employees performing subsequent or interrelated tasks and the system supports request-specific com-

munication between employees. All CF employees use the workflow system regularly, even the non-standard requests processed in SSG are (at least in most cases) recorded in the system.

In contrast the advanced call center functionality of the telephone system is only relevant for SSG employees. The call center system can be programmed to assign calls to SSG employees based on different criteria. Two modes of operation became relevant during the case study. The system can either assign an incoming call to one of the employees responsible for the corresponding region or simply choose the next free employee without any more specific differentiation. Furthermore, the system gives employees a certain amount of discretion over their availability on the phone, as it permits logging in and out of the call center system. This allows individuals to choose if they want to be available for external calls without limiting the internal availability.

The process management system, while generally available to all CF employees, is most relevant for the work at PSN and PSS. It offers a fully description of all processes at CF and is often consulted by employees if they are not sure how they are supposed to process a particular request. This is not limited to a checklist like enumeration of relevant steps to be performed, but often also includes detailed descriptions of these steps together with screenshots.

Finally, the contract management system is used at PSN only. The system is designed to facilitate the interaction between sales people and CF employees by eliminating the need to enter contract data multiple times. Data is entered by sales people and electronically transferred to CF, where the employees in charge of processing the related requests only have to checked data for completeness. If approved, the contract data then is automatically added to the loan management system.

4.2 Data collection

In line with the majority of studies employing a reconfiguration or ANT lens, multiple methods for data collection were used to capture the complexity of the phenomenon. Initially, the analysis of *documents* – including, for example, project documentation, organization charts, role and process descriptions, and intranet pages – provided the ba-

sis for identifying relevant topics and participants for interviews and observations. These documents also provided access the company internal concepts and terminology early in the study and thus facilitated the discussion with participants especially in the initial phase. *Participant observation* (Gold 1958; Myers 2008) of clerks at CF aim at the development of an understanding of the work environment and the context within which participants interacted with (O)LMS and each other. That is, it helped capturing the situated material and social nature of the phenomenon and thus relates to the performative aspect. But, it also involved asking questions as well as brief, informal discussions with participants, which enabled gaining access to their perceptions and understanding of these situations. In addition, the more formal *interviews* provided insight into the understanding of the phenomena of interest in general (i.e., the ostensive aspects). Still, interviews were not limited to abstract ideas, but also allowed to learn more about the personal experiences and thoughts of the different individuals studied (Schultze and Avital 2011). This was facilitated by the semi-structured design of interviews (Myers and Newman 2007) that was chosen 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 develop a comprehensive understanding of the phenomenon and to avoid “elite bias” (Myers and Newman 2007), individuals from all levels of the organizational hierarchy were interviewed.

Two researchers were on-site at BANK about one year before go-live of LMS exploring the overall ES implementation program. The exploration primarily involved analyzing project-related documents and selectively talking to members of the program team. The primary data collection was done in three waves starting two month before LMS go-live. Every wave involved at least one week-long visits to CF. Figure 15 shows the timing of the waves relative to the go-live of LMS.

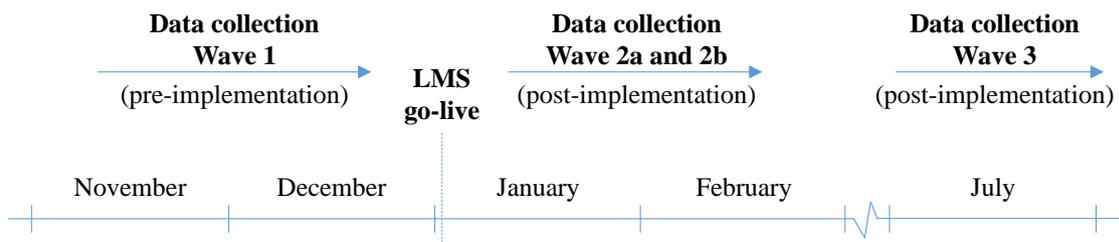


Figure 15: Timeline of research activities

Wave one was conducted to capture the original routines at CF before LMS was introduced, that is, the status quo before go-live. In November one researcher participated in a one-day basis training to gain some knowledge about the technology to be introduced at CF and experience the preparation CF employees had before go-live. In December two researchers performed 21 interviews as well as participant observations to capture the way people worked at CF before LMS was implemented. All participants at the clerk level as well as a team lead and one member of top management were also observed during their work after each interview for at least one hour resulting in 17 participant observations.

Wave two captured the immediate time after go-live, as well as the subsequent two months. One week after go-live in January (Wave 2a) the same two researchers conducted observations of respondents of wave one and the situation at CF in general including participation in telephone conferences and status meetings. Interviews with clerks were not scheduled during this time because CF employees were very busy with the effects of the ES technology introduction. Still, two interviews with a team lead and a top manager were conducted during the visit. The second complete round of 19 interviews was conducted in February (Wave 2b), about two months after LMS was introduced.

Finally, wave three was conducted in July to capture the situation six month after the system was introduced and employees have had sufficient time to accommodate the new technology. Overall, 15 interviews were performed in this wave and most employees whose work was already attended in waves one and two could be observed while working.

Participant observations typically took about one hour, during which a single individual was observed while working. Still, because most participants were working in open-

plan offices, observation was not limited to the individual currently accompanied, but interactions between other CF employees frequently could be observed as well. In total 38 observation sessions were conducted. In addition, several participant observations (especially in wave 2a) took several hours. For example, a group of CF employees were accompanied for one whole day in January, who were selected to support PSN and thus were required to learn how to use LMS functionality relevant for their new tasks.

Observations were captured directly during and after participant observation as well as at the end of each day on-site similar to Volkoff and colleagues (2005) and were frequently compared and discussed by the two researchers present at CF. Additionally, debriefings with a colleague, who was not on-site, were conducted to discuss and document experiences and observations.

The interviews were conducted in German and took between 30 and 120 minutes. All interviews were tape recorded and transcribed. For the interviews two types of interview guidelines were developed, one for managers and one for clerks that were supposed to work with LMS directly. During wave one, interview questions focused on participant's work processes and routines, their interactions with colleagues, the role of technology in their work, and expectations towards LMS and its impacts. In wave two interviews centered on changes in their work practices and routines, in the technology supporting their work, and the problems that occurred after LMS go-live as well as the actual impact the implementation had for them. Similarly, wave three was intended to capture the effects of the implementation with regard to participant's way of working, social interaction, and technological support, but further focused on the emergence of the solutions established by then. Each interview in the three waves closed with an open question asking participants to freely talk about any themes they deemed important for understanding the situation at CF as well as their experiences during the change in general. Table 8 shows the distribution of interviews over the three waves and the departments at CF.

Overall, the case material comprises 1185 pages of interview transcripts, 653 pages of hand-written observation memos and field notes as well as numerous documents gathered during the field visits. All material as well as intermediary results of the analysis were stored in a research database (AtlasTi, Microsoft Sharepoint, Excel, and Visio) from which the results presented in the subsequent chapter were derived.

Department/position	# Persons	#Interviews			
		Wave 1	Wave 2a+b	Wave 3	Total
Top management	4	3	5	2	10
SSG team lead	2	1	1	1	3
SSG clerks	8	8	7	4	19
PSN team lead	1	1	1	1	3
PSN clerks	4	4	3	3	10
PSS team lead	1	1	1	1	3
PSS clerks	3	3	3	3	9
Totals	23	21	21	15	57

Table 8: Interviews at CF

4.3 Data analysis

Building on the concept of the hermeneutic circle, the research presented in this thesis aims at advancing the understanding of the process of transformation at the individual and inter-individual level triggered by implementation of new ES technology. The application of the hermeneutic circle is similar to the one described in section 2.2. But the ‘texts’ (or better text analogues) to be analyzed and understood in this case were the statements from interviews and the observed behavior of individuals that constitute the empirical data (Sarker and Lee 2006). Similar to Constantinides and Barrett (2012) the concept of narrative networks was used to capture the sociomaterial and emerging nature of routines, and ES Transformation more generally. The concept and its application in data analysis are described in detail subsequently.

Narrative networks are a “way of representing and visualizing patterns of action that preserves the multiplicity of possibilities inherent in any organizational form” (Pentland and Feldman 2007, p. 790). A narrative network is defined as a collection of narrative fragments related by their sequential occurrence in a narrative, that is a story or set of stories. A narrative fragment (subsequently called fragments or routine fragments) is similar to the concept of “functional event” in narrative analysis, that is, an event that advance the plot (Hendricks, 1972, 1973). It basically answers the question: What hap-

pens next? A fragment consists of at least two actants connected by some action. Like in ANT, the term actants, instead of actors, is used to emphasize that fragments can include humans or non-humans, such as a telephone or computer (Pentland and Feldman 2007). As fragments are arranged sequentially to form a narrative (Hendricks 1972, Czarniawska 1997), sequence is the most basic relation between fragments in a narrative network. This relation does not only imply chronology but also coherence established through unity of purpose (Pentland and Feldman 2007). Yet, the narrative network makes no assumption about shared understanding or shared goals. While a particular sequence of fragments is connected by unity of purpose, this purpose is localized to the individual adding the next fragment to that particular story. There are two basic ways that participants can introduce variety into a narrative network. First, within each fragment, there may be alternative ways to do it. Second, the sequence of fragments may be adjustable by the participants. To accommodate this possibility for variation at the individual level, narrative networks explicitly allow for alternative pathways (Pentland and Feldman 2007).

Narrative networks were used to capture the routines at the different departments of CF before and after the implementation of LMS, while preserving the multiplicity of pathways available in the network along with the identities of the actants involved. Figure 16 shows an example of a narrative network created based on data from the case. It shows a simplified version of the routine for handling calls at SSG. The narrative network is similar to those created during the analysis, yet has been adapted to be valuable as an example by limiting the number of fragments and adjusting the descriptions.

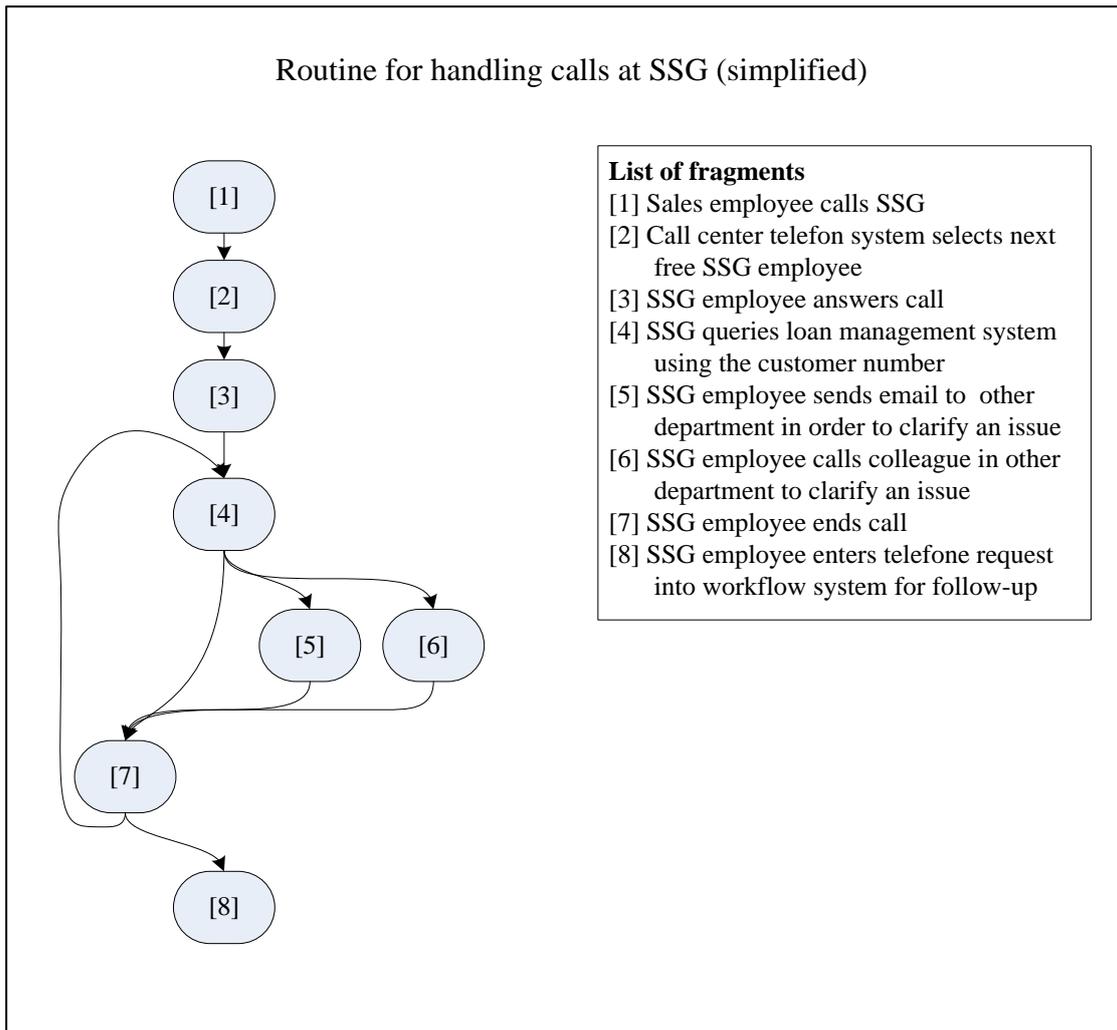


Figure 16: Example of a narrative network³

The overall process of analysis can be divided in two steps: (1) establishing a understanding and accessible account of the situation at CF for the different waves and (2) integrating this understanding with the theoretical accounts available in literature (the preunderstanding in the terminology of hermeneutics). The first step builds on an analytical approach similar to the one used in Grounded Theory (Glaser and Strauss 1967). It involved open-coding of empirical data (interview transcripts, field notes, documents, etc.) and intended to render the data transparent and accessible. In particular, routines,

³ The example presented in this figure was derived from the narrative network of routine SSG1 described in section 5.1.1.

routine fragments, the relations between fragments (i.e., their sequence), as well as themes relating to the literature-based preunderstanding were identified. Building on these codes, narrative networks were constructed. This step resembles the process of axial coding, and the associated merging of codes into more abstract concepts (Glaser and Strauss 1967), yet with a specific focus on routine fragments and their sequences. AtlasTi was used both for coding as well as for the initial construction of narrative networks. As the analysis further progressed and narrative networks became more complex, the networks were transferred to Microsoft Visio because it provides better functionality for this kind of modelling than the ones offered by AtlasTi. The link between the original data sources and the emerging networks was maintained using spreadsheet tables. These tables provide a mapping between the codes stored in AtlasTi and the routine fragments captured in Microsoft Visio and thus allow to trace fragments back to their original source in the empirical data. Building on the detailed account and visual representation of routines at CF the changes occurring over time were identified.

While the first step was methodologically closer to the ideas established in Grounded Theory, the second step explicitly emphasized the hermeneutic circle as mode of analysis. The logic of constant comparative analysis together with an explicit articulation of the current (or pre-) understanding described above was used to identify initial concepts, to link this evolving set of concepts to higher level categories, and then to identify potential linkages between the categories as appropriate (Sarker et al. 2012). Implicitly, the constant comparative process also involves data triangulation across respondents and data sources (Patton 1990). Furthermore the process also involves the emergence of the theoretical basis of the case study (Walsham and Sahay 1999). That is, the theoretical basis was continually assessed and adjusted to fit the evolving understanding established based on empirical data. In other words, the conceptual foundations presented in chapter 3, while presented together were not developed at the same time. Initially, the study was based on the ideas presented in sections 3.1 to 3.3 and a general understanding of the concepts of sociomateriality. In contrast, the reconceptualizations in sections 3.4 and 3.5 in large part emerged together with the understanding of empirical data during the case study.

In summary, this iterative analytical process involved focusing on those changes related to re-establishing a working ES and tracing these variations in routines back to problems employees faced while trying to recover their routines. This allowed analyzing

how individuals and the organization in general dealt with problems occurring in their routine performances due to the substitution of the original ES technology with LMS. That is, based on the list of problems identified, the data was analyzed and reanalyzed to identify the practices members of the organization (at different levels and with different roles) performed to re-establish a working ES. This in turn allowed answering the question, how routines are repaired during ES Transformations.

5 Results

The following sections introduce the routines identified at CF (section 5.1) and the situation at the three departments after go-live of LMS (section 5.2). The latter focuses in particular on the issues that emerged after LMS was implemented. While, as will be discussed later, change required intense collaboration across departments, routines and issues are presented separately for each department because this appears to be the easiest way to get familiar with the situation at CF. The subsequent sections build on these accounts, but describe the phenomenon from the perspective of ES Transformation at CF in general. They describe how individuals at CF (in different positions/at different organizational levels) dealt with the issues they faced and thus repaired routine performances (sections 5.3 to 5.5).

5.1 Status quo: routines at Credit Factory before LMS go-live⁴

In line with the conceptualization of routines discussed in chapter 3, the routines identified at CF are not to be confused with the formal processes defined in the process management system (cf. section 4.1). While formal processes descriptions are an important resource in some routine performances, they only capture some aspects of the routine or may not even exist for others. In other words, part of the variation in routine performances results from the need to work in compliance with different processes depending on the request at hand. Thus, the number of routines identified (Table 9) is considerably smaller than the number of formal processes. Furthermore, the number of activities performed routinely is much higher than those captured and formalized in process descriptions. That is, some (parts of) routines, while necessary to maintain a working ES are not formally defined as processes.

⁴ Appendix C offers more detailed representations of the routines identified together with their fragments in the form of Narrative Networks.

Department	Routine code	Routine description
SSG	SSG1	Answering calls by sales people
	SSG2	Processing non-standard requests
PSN	PSN1	Processing digital requests related to new contracts
	PSN2	Processing mail requests related to new contracts
	PSN3	Disbursing loans
	PSN4	Approving data entered into the system
	PSN5	Repairing incomplete and incorrect requests
PSS	PSS1	Processing change requests related to existing contracts
	PSS2	Approving changes made in the system
	PSS3	Handling error note list received by email
	PSS4	Checking the general account of BANK for payments

Table 9: Routines at CF before go-live of LMS

5.1.1 Routines at Sales Service Group

As described in section 4.1, employees at SSG are the main point of contact for those external to CF, but also have to process all non-standard requests. Before LMS go-live, the analysis revealed two main routines with very different, almost oppositional, characteristics: (SSG1) handling of calls and (SSG2) processing of non-standard request. While the first routine was fully controlled by a call center telephone system, the second one required independent thinking and self-organization. The performances of both routines were highly interwoven, as SSG employees were often interrupted multiple times by incoming phone calls while processing a request, and answering calls was always first priority. From 8am they had to be available on the telephone. Thus, if they started early, they could focus on checking their emails, their stacks of documents with open issues of the previous day, and have a look at the workflow system from which they retrieved non-standard request. After 8am they had to organize their work on these issues around incoming calls.

SSG employees developed numerous idiosyncratic strategies for handling telephone requests, which became part of their performances of routine SSG1. Several employees took notes on a sheet of paper to capture details of the telephone call, like the content of the request or the customer and branch numbers required to retrieve additional information from

the workflow system and OLMS during and after calls. One employee even developed a card box based knowledge base, where s/he stores important information for fast retrieval if required during a call.

Typically questions could be answered relatively fast as the answer to a particular question was either well known or could be easily found using the systems at hand. Similarly, requests or complaints were often easy to handle. For example, instead of forwarding the issue to the production team responsible, SSG employees often took care of correcting smaller, well-known issues addressed by salespeople during calls themselves by changing the contract data in OLMS accordingly. On the other hand subsequent steps related to a request were also often interrupted by yet another call, which made the paper notes taken during calls a valuable resource for finishing the processing of these requests later.

Only if they did not currently have to answer a call SSG employees engaged in the routine SSG2. The requests handled in this routine typically either involve writing official letters to external contacts (like notaries) or entering and changing data in OLMS if the related request is categorized as non-standard. The requests were available in the workflow system and could be accessed by every employee of SSG. The SSG employee thus had to filter the list for requests from the region s/he was responsible for and processed the requests starting with the oldest one or, in rare cases, selected a very urgent case to be handled with priority.

Because of the multiple interruptions by calls, some SSG employees included a further idiosyncratic variation into their routine performances. They printed the texts related to non-standard requests and took notes on the printouts to organize the work related to these tasks around frequent interruptions. This makes it easier for them to fully focus on the request addressed to them by phone while still preserving the task context of the non-standard task.

5.1.2 Routines at Production Service New

PSN is responsible for entering data of new loan contracts into OLMS and disbursing loans (cf. section 4.1). At PSN, five main routines were identified before LMS go-live: (PSN1) processing digital requests, (PSN2) processing mail requests, (PSN3) disbursing loans, (PSN4) approving changes in OLMS, and (PSN5) ‘repairing’ requests.

Basically there were three types of primary requests (i.e., requests from customers) each being handled in a different routine. All these routines involved an initial step of con-

sulting the process descriptions, available in the process management system, before starting to process the request, at least if the process of handling the current request was still relatively new to the PSN employee. The most simple routine (PSN1) was related to requests issued by salespeople using the contract management system. The PSN employee basically was responsible for checking if the request is complete and correct. If no errors were found the request was approved and required data was automatically added to OLMS overnight. In case of major deviations or need for clarification the request was forwarded to a colleague performing the repair routine (PSN5) described below. Mail requests are in principle similar to digital requests, yet instead of approving data only, PSN employees had to enter the data manually, which required the performance of a different routine (PSN2). As these requests typically involve the extension of an existing contract, the PSN employee first had to retrieve basic information on the old contract from OLMS and subsequently entered this information together with data available on the request form into OLMS. As the PSN employee entered data into OLMS him/herself the results of the routine performance had to be checked and approved by a colleague, who performed the approval routine (PSN4) described below. For this purpose, the PSN employee printed a summary sheet of the changes made in OLMS, which was subsequently put to the approval basket located at a central place in the office. As in routine PSN1 problems with the request or need for clarification were handled by a colleague performing the repair routine (PSN5). Finally, disbursement requests are requests related to new contracts, which often just were entered into the system through routine PSN1 or PSN2. Before go-live, the routine performed to handle these requests (PSN3) was basically similar to routine PSN2. Just the content of the requests was different and the system did not offer a change summary, but typically the related printouts (like letters to be sent to the customer) were sufficient as context for the approving colleague.

In addition to these primary routines, selected PSN employees were responsible for performing two more routines. The approval routine (PSN4) deals with approving data entered into OLMS by colleagues. For this purpose a PSN employee authorized to perform this routine compares the request data and the data stored in OLMS or documented in the change summary. If everything was correct, s/he approves the changes in OLMS, and in case of errors, the PSN employee asks the colleague who entered the data to correct the error. Similarly, the repair routine deals with requests initially handled by a col-

league, but instead of approving finished work, problematic requests were repaired by calling the salesperson responsible, sending email request, or requesting documents from the archive. Only if the request requires more detailed negotiations with salespeople or very specific changes to the system, the request is forwarded to SSG and becomes a non-standard request handled in routine SSG1.

All routines at PSN were supported by the workflow system (cf. section 4.1). The system serves as a task list for PSN employees, but also supports coordination and communication at CF. The status field of requests helps coordinating the interaction between employees performing interrelated routines like forwarding requests to a colleague performing the approval routine (PSN4). Furthermore the workflow system supported communication between employees as it allowed adding notes to a request. PSN employees used this functionality in two ways. First, they documented the processing activities performed while handling the request basically using abbreviations common in OLMS. Second, approvers also used notes for describing errors found during approval before returning the request to the colleague that initially handled it.

5.1.3 Routines at Production Service Stock

PSS is responsible for all requests related to existing loan contracts (cf. section 4.1). Before LMS go-live, the analysis revealed four routines: (PSS1) processing change requests, (PSS2) approving changes in OLMS, (PSS3) error note list handling, and general account payments handling (PSS4).

Handling of change requests again is similar to routines PSN2 and PSN3. It likewise starts with consulting the process descriptions, if the process related to the current request is new to the employee. Afterwards data in OLMS is changed as requested and the results of the routine performance have to be checked and approved by a colleague. Yet, for this routine the system does not offer a change summary, but typically the related printouts are sufficient as context for the approving colleague. As in PSN a brief note documenting the changes made is added to the request in the workflow system. Yet, as opposed to routines PSN1 and PSN2 requests are immediately forwarded to SSG in case of problems or need for clarification, as there is no repair routine at PSS.

Furthermore selected employees are responsible for performing two more routines. The approval routine (PSS2) is similar to the approval routine at PSN (PSN4). Yet as opposed to the routine at PSN, PSS employees in case of errors typically discuss mistakes found during approval directly with the colleagues instead of adding a note to the workflow system. In addition to the continuous routines of handling change requests and approvals, some PSS employees daily had to perform two more routines, error note list handling (PSS3) and general account payments handling (PSS4). Error note lists were notifications of unplanned changes in a customer's account, for example in case of unscheduled repayment of a loan. PSS employees receive these lists, which include the account number as well as a textual error note, by email once a day. The error note lists were printed and a request had to be manually added to the workflow system for every item on the error list. Similarly, some PSS employees daily had to check the banks general account for payments received from other institutions, e.g. notaries or other banks. For every payment, a request was added to the workflow system.

5.2 Issues after LMS go-live

5.2.1 The situation at Sales Service Group

After LMS go-live, the situation at SSG was very different. The introduction of LMS had three major effects on the work at SSG. First, the number of phone requests increased tremendously. Because of this increase, the telephone system was reprogrammed and did no longer assign calls to the person responsible for the corresponding region, but directly routed the call to the next free SSG employee (I01⁵). Thus, the an-

⁵ The numbers in brackets link the detailed descriptions of issues to the summary table provided below. The descriptions and summary describe the situation from different perspectives. This is essential to capture the overall picture of the case study and is thus meant to support the reader in making sense of the data.

swering employee was much less likely to be familiar with the local circumstances of the caller or the requests history. More critical, the increase in calls also inhibited the performance of routine SSG2 (I02) as SSG employees were basically bound to the phone and thus routine SSG2, which involved several fragments for organizing the performance of the routine around frequent phone call interruptions, could no longer be performed in the way it was before. Similarly, the sequence of fragments typically performed in routine SSG1 was no longer effective, as pre-go-live strategies for being available on the phone while still being able to finish work on earlier requests – like for example note taking during calls and working on pending requests during quite times – did not work any longer (I03).

Second, several of the fragments originally constituting routine SSG1 could no longer be performed, as they were based on OLMS and related knowledge. Questions occurring during calls could no longer be answered as fast as before go-live (I04). This partially was because it proved to be difficult for SSG employees to derive the answer for a question using the systems at hand – in particular LMS (I05). In addition, new questions emerged with LMS go-live and OLMS-related knowledge was in part no longer valuable (I06). For example many questions concerned the (partial) view on data stored in LMS that sales people got displayed on the intranet. Because SSG was the only department at BANK that was able to answer questions related to LMS, they were expected to help their colleagues at the branches with making sense of the new view. This not only increased the number of calls as mentioned above, but also required SSG employees to answer types of question not asked before LMS. Furthermore, SSG employees in general had difficulty explaining the logic and behavior of the new system (I07). Even if they understood the behavior themselves they had trouble communicating this understanding without using LMS related technical terms well known at CF due to trainings.

Similarly, requests or complaints could no longer be handle by simply correcting the contract data in the loan management system accordingly. Because the corresponding fragments based on OLMS could no longer be performed, individuals had to find new ways of coping with this situation (I08).

5.2.2 The situation at Production Service New

In contrast, PSN employees soon were able to return to the routines they were accustomed to after go-live. Still these routines partially had to be adjusted to fit the new circumstances. First and foremost, the fragments related to OLMS could no longer be performed, which confronted PSN employees with the issue of how to keep their routine performances alive while a major component (OLMS) was missing and it was initially often not clear how to best integrate LMS into the performances. A major problem with LMS related to PSN3 was that it was no longer possible to automatically calculate the redemption value for a contract (I09), which was a relevant figure for payments related the conversion of a debt. Less critical issues, which nevertheless made work more cumbersome and complex included the lack of integration between LMS and parts of the old banking system (I10) yet to be replaced in further phases of the implementation program. For example, PSN employees performing PSN3 with LMS had to manually check if an internal account exists before triggering a payment, while with OLMS this check was performed by the system automatically. Furthermore, for specific customers it was now required to switch to another client⁶, that is, a different instance of the system (I11). The latter was especially annoying for employees as they were “completely kicked out of the system”⁷ if they tried to enter a customer number not available for the corresponding client. This issue equally affected routine PSN2. One of the more serious problems in PSN2 was the initial need to learn how to navigate LMS (I05). This was especially difficult as the very need to navigate a complex system did not exist in the part of OLMS used in PSN2, which basically consisted of three masks successively displayed on the screen. In addition, the fragment of consulting process descriptions in case of question related to the correct execution of a process was no longer effective (I12). This was due to the fact that, in several cases, LMS behaved differently in the version finally implemented than was expected by those who had been in charge of adapting the process descriptions. Thus, it was often unclear if process descriptions were correct, which considerably limited their value for PSN employees.

⁶ A concept not included in OLMS.

⁷ That is they had to login again.

But, the problems PSN employees encountered did not only related to single fragments. For example, routine PSN1 could no longer be performed like before as LMS required some data to be entered manually into the system in addition to checking data already available in the contract management system (I13). This in turn required the inclusion of an approval by a colleague, that is both routine PSN1 and PSN2 were linked to the approval routine (PSN4) now. Furthermore the approval routine changed in several ways. LMS does not provide the functionality to print summary sheets for the changes made in the system (I14). As the sheets were no longer available in LMS, and thus the related fragment could no longer be performed, PSN employees had to find new ways of performing approvals related to routine PSN2. Similarly, the advantage of LMS that payment letters were automatically created by the system and printed as well as send by the central mail processing department required a change in the way approvals related to PSN3 requests were triggered (I16). As printouts were no longer available, employees had to find new ways how to coordinate the performance of these approvals. Yet, only most, but not all, documents were automatically created, which made it necessary to differentiate between these cases (I15) during the performance of the approval routine (PSN4). Similarly, the possibility to schedule bank transfers available in LMS⁸, while in general being an advantage, also created the need to somehow communicate information about the timing of payments to ensure optimal prioritization of request (I17). And, due to the difference in the internal logic between LMS and OLMS it was required to find an efficient way for transforming the data (I18) available on the contract (i.e., interest rate and installment) into the data required by LMS (i.e., interest rate and repayment rate).

In addition, the approval routine could no longer be performed as before for specific cases related to the disbursing routine (PSN3). LMS allows the routine PSN3 to be performed directly after the related account was created (i.e., after routines PSN1 or PSN2 were performed)⁹. While offering the possibility to process account creation and disbursement right after one another, the new flexibility also added complexity and the need for

⁸ In OLMS each transaction was immediately executed after approval.

⁹ In OLMS disbursing a loan was possible only the day after the account creation was approved.

coordinating related approvals (I19). LMS allowed disbursements to be entered into the system even before the corresponding account creation was actually approved, yet approval of changes related to disbursing loans was only possible after the account creation was approved. Thus, PSN employees had to find ways to coordinate request approvals.

5.2.3 The situation at Production Service Stock

Like their colleagues at SSG, PSS employees had to face considerable challenges after go-live, but still were partially able to return to the routines they were accustomed to. Similar to the situation at PSN, employees at PSS were confronted with the problem that fragments related to OLMS could no longer be performed and it was often not clear how to integrate LMS into performances. A major problem with LMS already discussed for PSN was that it was no longer possible to automatically calculate the redemption value for a contract (I09). And, there were other similar, but less dramatic, issues like the need to switch to another client for specific customers (I11) and the need to transform the data available on the change request into the data required by LMS (I18). In addition to these issues, PSS employees were required to – but had substantial difficulty with – understanding the cash flow simulation available in LMS¹⁰ (I20) as they were instructed to check the simulation before saving changes. Changing payment mandates turned out to be much more complex with LMS compared to OLMS (I21), because the system allowed for more flexibility, like for example paying interest rate and repayment rate from different accounts, which required changes not only in customer data, but also directly in the contract.

Furthermore, routine PSS1 could no longer be performed like before. As LMS did not directly build on the processes at CF, approvals were often required for single changes and the system prohibited further changes before approval, as opposed to OLMS where approvals were always done after the complete request was processed. The required intermediary approvals were difficult to coordinate using the approval routines. Thus, a

¹⁰ Due to its plan-based logic (cf. section 4.1) LMS offers the functionality to simulate the expected cash flow for the entire term of an account.

new way of getting intermediary approvals had to be found (I22). Still, final approval was partially coordinated as before. While the workflow system still was used to the access documents related to the request, coordination like in PSN was could no longer be performed based on printed letters and screenshots as these were not available or not easily produced in LMS (I16). The lack of printed documents also made it more difficult for PSS employees to ensure correctness of entries in the system as they often first had to find out which way of entering data into the system triggered correct creation of documents by LMS (I05). Furthermore, the fragment of forwarding requests to SSG in case of problems did no longer have the intended effect, as SSG was basically unable to perform routine SSG1 (I23) and thus requests piled up at SSG. And, like at PSN, the fragment of consulting process descriptions in case of process-related questions was also no longer effective (I12), because it was unclear if these descriptions were really correct.

Similar to the situation at SSG, routine changes at PSS also affected whole routines. As LMS enabled sending reports about unplanned changes in accounts – the former error notes – directly to the work flow system, the error list handling routine (PSS3) disappeared. Yet, handling these reports was much more complex than processing requests related to error notes. For example, it was often difficult to identify the actual problem from the information presented in reports and in many cases multiple reports are created by LMS, for issues that were entered as a single request before, especially if issues are not immediately resolved. Thus, the routine PSS1 was no longer appropriate and a new way for handling these requests had to be found (I24).

5.2.4 Summary

In summary, changes at CF due to go-live of LMS, affected the whole set of routines in place before LMS was introduced. Issues appeared both at the routine and the fragment level. In many cases the original fragment could no longer be performed due to missing components. For example, the issue related to the missing functionality for creating change summaries in LMS (I14), which prohibited the performance of the corresponding fragment of printing these summaries and handing them to a colleague for approval. Table 10 provides an overview of the issues related to this type of problems. The identi-

fiers (issue numbers) in the first column provide the link to the detailed descriptions in the preceding sections.

Issue No.	Routine(s)	Problem description
I04	SSG1	Questions could no longer be answered relatively fast
I05	ALL	Need to learn how to navigate and use LMS because OLMS no longer available
I08	SSG1	Requests were no longer easy to handle by simply correcting the contract data in LMS accordingly
I09	PSN3, PSS1	No longer possible to automatically calculate the redemption value for a contract
I10	PSN3,PSN2	Lack of integration between LMS and legacy system
I11	PSN3, PSN2, PSS1	Need to switch to another client for specific customers
I14	PSN4, PSN2	No functionality to print summary sheets for use during approvals
I16	PSN4, PSN3, PSS1, PSS2	Payment letters could no longer be used to coordinate approvals
I18	PSN2, PSS1	Need to transform the data available on the contract to fit requirements of LMS
I21	PSS1	Unclear how to change payment mandates

Table 10: Issues due to the inability to perform the original routine fragment

Furthermore, in several cases the original fragment did no longer have the intended effect, like the fragment of returning requests to SSG in case of problems originally included in routine PSS1. The same applies to the routine level. Several routine performances did no longer have the intended effect, like the problem related to processing reports with routine PSS1. Table 11 provides an overview of the issues related to this problem.

Issue No.	Scope	Routine(s)	Problem description
I03	Routine	SSG1	Strategies for parallel execution of multiple performances of routine SSG1 were no longer effective
I06	Fragment	SSG1	New questions emerged related to LMS and the view sales people had
I07	Fragment	SSG1	SSG employees had difficulty explaining the logic and behavior of the new system
I12	Fragment	PSN1, PSN2, PSN3, PSN4, PSS1, PSS2	Consulting process descriptions in case of process-related questions no longer effective
I15	Routine	PSN3, PSN4	Need to differentiate between cases where documents were automatically created and locally printed respectively
I17	Routine	PSN4, PSN3	Need to find ways to communicate information about the timing of payments
I23	Fragment	PSS1	Forwarding requests to SSG in case of problems no longer an option

Table 11: Issues because the original routine/fragment is no longer effective

And finally several routines could no longer be performed the way they were before LMS go-live, like the routine for processing digital requests (PSN1). Table 12 provides an overview of the issues related to this problem.

Issue No.	Routine(s)	Problem description
I01	SSG1	Telephone system did not assign calls to the person responsible for the corresponding region any longer
I02	SSG2	The increase in calls inhibited the performance of routine SSG2
I13	PSN1	LMS required some data to be entered manually into the system in addition to checking data in PSN1 and thus also an approval
I19	PSN4	Need to find ways to coordinate request approvals for PSN2 and PSN3 requests
I20	PSS1	Need to understanding the cash flow simulation available in LMS
I22	PSS1	Required to coordinate intermediary approvals
I24	PSS1, PSS3	Handling LMS reports is much more complex than processing requests related to OLMS error notes

Table 12: Issues due to the inability to perform the original routine like before

If a problem occurred during routine performance, that is, an individual was not able to continue with or find an appropriate next step in the routine performance, s/he tried to keep the performance alive by pragmatically dealing with the current situation – thus repairing the routine performance - which in turn led to changes in the routine over time. Employees at CF repaired routine performances at the fragment level by (1) adjusting and recombining existing fragment, or (2) introducing new fragments into the routine. But, they also developed support practices, from which they (3) incorporated fragments into their routine performances. In addition, management and employees at CF repaired routines by (4) changing their technological basis or (5) adapting organizational structures. The different strategies for repairing routines are subsequently presented in detail.

5.3 Repairing routines at the fragment level

5.3.1 Adjusting and recombining existing fragments

CF employees often adjusted or recombined existing fragments if the original fragment could no longer be performed. SSG employees for example could no longer handle requests or complaints received during calls by correcting the contract data in OLMS accordingly themselves (I08) as the original fragment used for this purpose, which included OLMS, was no longer available and they lacked in depth knowledge about LMS. Thus they stop correcting issues themselves and instead send all requests – not only major issues as done before LMS – back to the production team (at PSN or PSS) responsible, asking them to fix the problem.

“[...] one actually looks up [in the workflow system] who did process it [...] and then one shoots it back [to them] and says ,please correct it‘. [...] we do not [correct] it ourselves, because the new system is much too complex [...].” (Q1, clerk 2, SSG)

Similarly PSN employees faced the problem that they could not perform the fragment of printing LMS summary sheets for the changes made in the system through routine PSN2 (I14). This fragment was performed before as their colleagues used the summary sheets during approval for efficiently comparing contract data and changes made in the system. Thus, PSN employees slightly adjusted the related fragments in that they printed and compare screenshots of all relevant LMS views instead of an actual change summary.

“In the old environment [...] if we entered a loan, a summary [...] of the data entered was printed. The approver could check everything based on this. [...] This function is not available in the new [LMS] system. Thus, we took screenshots of all entries at the beginning.” (Q2, clerk 3, PSN)

Similarly, both PSN and PSS employees could no longer coordinate approvals for routines PSN3 or PSS1 respectively using printouts of documents related to the request, as most documents were automatically created by LMS now and were centrally printed at the headquarters (I16). Yet, thanks to the availability of the workflow system, which

was nevertheless used for accessing related electronic documents (like the original contract or request forms), resolution of this issue was relatively easy as the list of requests in the workflow system could simply be used as starting point for approvals thus substituting for the piles of paper used for coordination before.

But, CF employees also used the repair practice of adjusting or recombining existing fragments if routine performances did no longer have the intended effect. At SSG for example employees frequently faced the problem that they needed to clarify an issue at hand while the next call was already pending. Pre-go-live coping strategies, like note taking during calls and working on pending requests during quiet time, did not work any longer (I03) and much more time was required to solve problems due to lack of in depth knowledge about LMS (I05). To avoid pending request piling up, they needed to find a different solution based on their current understanding of the situation at hand. Thus, SSG employees started to incorporate the fragment of logging out of the telephone system to finish handling the current request into their performances. Basically this option was available before and some SSG employees already used it in exceptional cases before LMS was introduced, but now it became a common strategy at SSG.

“I always log out of the telephone and then I write my email before I log in the telephone again and answer calls.” (Q3, clerk 4, SSG)

Another strategy that evolved after a certain level of familiarity with LMS was achieved, was to keep sales persons on the phone until the request was completely handled. This allowed them to avoid interference of the next call in task competition while still being compliant to the rule of being permanently logged into the telephone system.

Finally, this repair practice was also employed if routines could no longer be performed like before. At PSN the performance of routine PSN1 (digital request handling) had to be adjusted as LMS required some data to be entered manually into the system in addition to checking data already available in the contract management system (I13). Thus, PSN employees incorporated fragments for entering and approving data already performed as part of routine PSN2 (mail request handling) into their performances.

5.3.2 Introducing new fragments

However problems encountered while performing a routine, could not always be solved by reusing exiting fragments. Often, CF employees had to introduce new fragments into their routine performances. One reason for introducing new fragments was that the original fragment could no longer be performed.

At SSG for example, the original fragment of querying the system to retrieve required information had to be replaced by two new fragments, because the original OLMS based fragment was no longer available and they lacked in depth knowledge about LMS (I05). Thus, many questions asked by salespersons on the phone could not be answered (I04, I06, I07) and in addition to querying and trying to interpret information available in LMS, they frequently asked colleagues sitting nearby for support or ideas during calls.

“[It’s] learning by doing and asking the others. If I have a call and I cannot explain the issue or do not find [the required information], I ask my colleagues“
(Q4: clerk 4, SSG)

Lacking in-depth knowledge about LMS SSG employees also typically did not make any changes in the system – as indicated above (related to I08) –, and if they could not avoid making changes to the system themselves, for example in case of urgent non-standard requests or major issues discovered during a phone call, they typically had to ask one of the change agents for support, thus adding an additional fragment to the routine, which further slowed down routine performance.

Similarly, employees both at PSN and PSS often required the help of change agents or asked a colleague for help because they did not know how to navigate or use LMS (I05). Yet, before asking someone else, both PSN and PSS employees often tried to solve the issue themselves. As LMS allows for simulating the cash flow of an account, clerks are able to immediately check if the changes they made in LMS had the intended effects. Thus, they added the fragment of consulting the cash flow simulation to their performances. This in turn resulted in an often incorporated new fragment of returning to data entry if the simulation of the cash flow did not show the intended results and looking for possibilities to change the contract data in a way that fixes the issue.

As LMS was not capable of automatically calculating the redemption value of a contract (I09), PSS employees had to incorporate a new fragment of manually looking up rele-

vant data in the system and calculating the value “manually” using an electronic calculator.

A further issue related to the need to differentiate between different instances (called clients) of the system, where employees had to remember to check the customer type before starting to enter the customer number in order to avoid being “kicked out” (I11). Simultaneously, they had to learn why this being “kicked out” happened and how to handle the situation after it occurred, that is, that they had to change the client before trying to enter the customer number again. A similar issue related to the integration between LMS and the parts of OLMS still in use (I10). As opposed to OLMS PSN employees performing PSN3 had to actively check if an internal account actually exists before triggering the payment. Yet, as opposed to the LMS client issue the feedback cycle was much longer, as the payment first had to be processed, than “returned” to the account thus triggering a report processed by PSS, which then finally could give feedback.

As discussed before, most documents were automatically created by LMS automatically, resulting in the need not only to use the workflow system as primary coordination mechanism for approvals, but in addition also requiring employees performing PSN3 to add additional data into a field of the workflow system not used before. Because only most, not all, documents were automatically created, the need to differentiate between these cases arose, requiring the employees to mark those request still related to a printed document (I15). Similarly, information on the timing of a payment (I17) was captured by entering the due date into an unused field in the workflow system.

The approval routine related to PSN2 actually saw several subsequent changes related to the issue that change summaries were no longer available (I14). After initially trying to perform the approval routine similar to the performance before LMS go-live – as described above – the routine was finally changed as follows. Instead of comparing the contract data and screenshots taken in LMS, PSN employees incorporated the new fragment of retrieving data directly from LMS.

“[...] before we had a protocol, it was one page of paper [...] and now we have to click through all the forms in LMS”. (Q5: clerk 1, PSN)

Yet, to make it easier for approvers to identify the changes made in LMS, PSN employees add more detailed notes to the workflow system now.

“One only sees the loan in its current form with all the data that was ever entered and one does not know what was changed. Thus, the changes are added to the notes [...]“ (Q6: clerk 3, PSN)

Furthermore, PSN employees initially did not handle errors found during approval by simply adding a note to the request in the workflow system and returning the request, as they were not able to perform this fragment due to missing language for talking about LMS. Instead, they often incorporated the new fragment of printing screenshots and discussing issues directly with the colleagues.

But, after some time, they returned to the use of notes in the workflow system for all but exceptional cases. The use of notes however was possible only after the teams at PSN found an unambiguous, yet concise, way of talking about issues, fields, and concepts in LMS.

“At the beginning one wrote abbreviations etc. and called [things in specific ways], but the [colleague] does not know what this is supposed to mean. But then we came to an agreement.“ (Q7: clerk 3, PSN)

In addition, to solving problems related to the inability to perform original fragments, new fragments were also incorporated into routines if the original fragment did not have the intended effect. PSS employees for example stopped forwarding requests to SSG in case of problems with handling the requests (I23), as they realized that SSG employees were not able to perform routine SSG1. Instead they performed the new fragment of asking a change agent for support and trying to handle the request themselves this way.

Finally, this repair practice was also used if a routine could not be performed as before. At PSN the approval routine (PSN 4) for disbursal requests had to be adjusted as LMS allows disbursals to be entered into the system even before the corresponding account creation was approved, yet approval of changes related to disbursing loans are possible only after approval of the initial change (I19). Thus, PSN employees had to incorporate an additional fragment of asking the colleagues responsible for the initial approval to process the corresponding request with priority.

Similarly, at PSS the routine for processing change requests (PSS1) could not be performed as before because in LMS approvals are often require for single changes and the system prohibits further changes before approval (I22). This change added a level of complexity in coordination between PSS employees hard to handle using the original

approval routine. Thus, intermediary approvals were not based on the approval routine (PSS2), but were incorporated as new fragment into the performance of routine PSS1 by directly asking an authorized colleague to approve the change.

5.4 Repairing routines with support practices

5.4.1 Support practices and organizational routines

In addition to changes of fragments directly related to routines, CF employees developed several support practices which can be imagined as being orthogonal to routines, yet sharing common fragments with the supported routine or enabling the performance of a routine fragment. Figure 17 shows a schematic representation of this relationship.

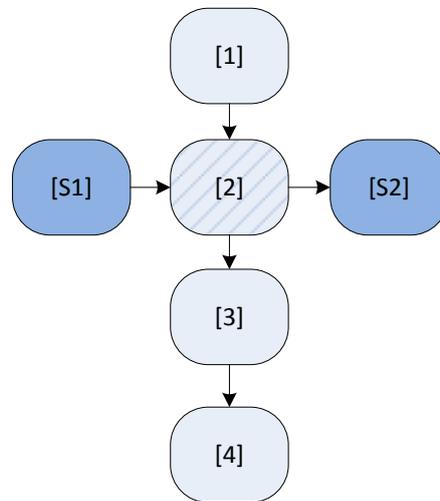


Figure 17: Support practices and organizational routines

The routine fragment [3] is not only part of the routine (vertical sequence, fragments [1]-[4]), but is also included in a support practice (horizontal sequence, fragments [S1], [3], [S2]). A simple routine for writing letters, may for example involve booting the personal computer [1], checking one's notes related to how to use the word processing software [2], writing the letter using the word processor [3] and printing it [4]. But,

fragment [3] can only be performed as part of the routine, if it is included in a support practice, which includes keeping all the notes related to software related issues in a folder at hand [S1] and further extending the notes, if something new has been found out [S2]. Thus, the other fragments of the support practice are crucially involved in establishing the situation required for fragment [3] to be performed.

5.4.2 Incorporating fragments of support practices

If the original fragment could not be performed this practice was used to repair routines in addition to the practices presented before. At SSG this was the case for several of the fragments of routine SSG1, which were related to OLMS or knowledge about it. Many routine performances involved collecting questions, which could not be answered during a phone call (I04), along with a call back note, and asking one of the change agents, which already had deeper knowledge of LMS, as soon as one was available. But, often they could not answer the questions either and had to consult others in the organization or from the project team.

“If one always has to say [during a phone call] ‘well I do not currently know it, I have to call back’, it makes work much more complicated because one collects these call back notes and one also has to find someone with whom one can discuss [the issue]” (Q8: clerk 2, SSG)

These delays in combination with the amount of pending requests made it very difficult for SSG employees to keep track of these issues. Thus, several of them stopped trying to track the progress in solving these problems, as they were simultaneously recorded in specific lists in the work flow system and thus were assumed to be taken care of after a solution to the problem was found. Yet, others developed additional fragments to handle these problems like one employee who created a list in a word processor for every pending issue, where s/he noted the related account number together with further details of the issue and the date the change agent was asked.

For handling of intermediary approvals (I22) related to report processing at PSS another support practice evolved in addition to the incorporation of the fragment of asking a colleague for approval. As the processing of reports typically required a great number of intermediary approvals, an excel sheet was developed which included a checklist of all

necessary intermediary approvals and was circulated during processing of a request to allow for parallel work on several such requests without losing track of the actual status of a request.

Often CF employees also used print outs of emails, teaching cases or screenshots in their routine performances as the original fragment related to OLMS could no longer be performed and they still were not well able to incorporate the new LMS fragment into their performance (I05). These fragments also were not simply part of the routine only, but belonged to individual support practices involving for example the actual printing of information, which obviously was a prerequisite of using print outs in routine performances, but also less obvious activities like annotating print outs if new information became available or keeping folders with print outs up to date by removing old print outs and adding new ones. Furthermore some employees joined forces with a colleague to share the work of printing and organizing emails and used print outs together. Other CF employees only sorted emails on changes into dedicated folders, instead of printing them, either consulting the folders if required or taking notes on other print outs to make the information easily accessible.

But the practice was also used if the original fragment did not have the intended effect. At PSN and PSS, for example, employees included a fragment of consulting their annotated teaching cases, which is part of a support routine as discussed before, if the fragment of consulting process descriptions was not effective (I12).

5.5 Repairing routines by adapting other aspects of the ES

5.5.1 Changing the technological basis

Beside repair practices targeting routines directly, several routines required further support to recover, which implied changes to technology. For example the “report issue” (I24) at PSS could in part only be solved because several changes to technology were initiated. After it became clear that processing reports was too complex, the transfer of reports from LMS to the workflow system was changed to include an algorithm for

classifying reports and correspondingly inserting them into different lists in the workflow system. This considerably facilitate processing of reports as the initial routine fragments, performed to determine a report's meaning, could be skipped. In addition, several reports were eliminated by automating the steps required to be performed for resolving the corresponding issue. An example is the automatic booking of repayments in certain cases without manual intervention.

Other changes to LMS and related systems included the automatic transfer of customer and payment data for digital credit requests (I13) processed in routine PSN1, thus making the repair practices initially required to recover routine PSN1 obsolete. Similarly, part of the problems at SSG were solved by changing technology related to LMS. Due to changes to the way LMS data is displayed to sales people, SSG had to handle less calls related to information available in LMS (I06).

But, changes involving technology also came in form of small, additional tools to cope with differences between OLMS and LMS (I18), like an excel tool for calculating the repayment rate from data available on credit contracts. This value was required, because in LMS the basic figure for contracts are interest and repayment rate and not the repayment value, which was required in OLMS and was thus included in contract forms.

Furthermore, changes to LMS were not limited to major reconfigurations, which could be accomplished by the LMS project team only. Several changes were also made by users themselves. As discussed before, the simulation of cash flows available in LMS was difficult to understand for most CF employees (I20). This problem could, in part, be solved by changing the configuration of the corresponding component of the LMS front-end. As this component allowed users to define, at least to a certain degree, which data was displayed, CF employees could adapt LMS to show only data that was relevant for their tasks. While everyone could, in principle, make these changes, many CF employees required help of their colleagues to be able to perform these changes.

Other individual changes related to the need to learn how to navigate and use LMS (I05) include for example saving links to specific parts of LMS to a list of favorites, which reduced the number of mouse clicks to get to the parts of LMS typically used in routine performances, or configuring the initial mask of LMS front end to automatically switch to the next input fields if a sufficiently long number was entered in the current field. This allowed CF employees to enter the different parts of the customer number in a row

without the need to manually switch to the next input field, which made LMS behave more like OLMS.

5.5.2 Changing organizational structures

While much of the adaptation required to repair routines could be performed by employees, several changes that helped regaining routinization were initiated by other stakeholders, as is for example evident in the repair practices performed by the LMS project team. In addition, to changes of technology, team leads and top management also initiated several other repair practices.

The issue, that with LMS redemption values had to be calculated manually (I09), did not only result in changes of routines as was evident at SSG and PSS, but at PSN was handled by changing employees' responsibilities. PSN employees performing PSN3 simply were no longer responsible for calculating the redemption value of account before issuing a payment, they simply executed the request PSN3 – at least initially as will be discussed below. As a result LMS created a report in cases where the payment did not fit the redemption value, which then had to be processed by PSS and thus contributed to the problems at PSS (I24).

The issue with the new complexity of changing payment mandates at PSS (I21) similarly was solved organizationally by assigning the task to PSN, how - at the time this decision was taken - already had achieved a satisfactory level of routinization for their tasks, which fortunately already involved most fragments required processing these kinds request. Thus they could establish the required new routine relatively fast.

The need to coordinate intermediary approvals at PSS (I22) was discussed already above. In addition to the already mentioned incorporation of a new fragment in PSS1 and the development of a support practice, repairing this routine also involved the managerial decision to relocate team members as follows. The team was subdivided in groups of 6 employees sitting together at a desk group and at least one of those 6 needed to be allowed to perform approvals. Only through this change was it actually possible for employees to adapt their routines as presented before.

Probably one of the most problematic issues in the whole change process was the handling of reports (I24). This problem required a whole array of organizational changes to

be resolved. After realizing that the issue cannot be handled by simply processing reports similar to the way requests resulting from error notes were handled, management decided to create an extra team for processing these reports only. This team soon was further subdivided in a group that only handled old reports (i.e., those that accumulated due to the problems at go life) and the other group fully focusing on new report to ensure that at least these newer requests were processed in time. In addition the first group also was supported by employees from other departments as far as possible.

As these changes only partially helped getting hold of the problem, two more changes were initiated, which aimed at reducing the amount of incoming reports. First, PSN employees performing routine PSN3 were instructed to calculate redemption values again before issuing a payment. Second, other banks and notaries were no longer requested to transfer money directly to the customer's account, but to use BANK's general account, a practice which was in place before LMS, but was changed due to the capabilities of LMS. While this in turn required to reactivate the routine of daily checking the general account for payments, it helped substantially to solve the "report issue".

Similarly, a new group of LMS specialist helped to deal with two major problems at SSG. While the difficulty of answering questions on the phone (I04, I06, I07) could partially be solved by employing the repair strategies discussed above, several questions simply were too specific, requiring too much knowledge about the details of LMS for SSG employees to answer them. After some time management decided to form a team of specialists, recruited from those CF employees that were involved in the implementation project as (internal) trainers and multiplier. Initially, this group solved the difficult problems their colleagues could not answer and forwarded the solution to them, who then contacted sales employees to provide the answer. This division of labor was later adapted in that the LMS group directly contacted the requesting sales colleague.

Furthermore the new group also helped processing LMS related no-standard tasks, which the other SSG employees could not work on even half a year after go-live, partially due to lack of time (there was still a much higher amount of incoming calls compared to pre-go-live; I02), but also because they lack related knowledge and skills (I05). Some exceptional tasks that would have been performed by SSG before LMS also were performed by PSN employees now (like changing contracts according to a recent court decision), who both had sufficient time to take care of additional tasks and also were

better able to make certain changes in LMS due to the higher flexibility of the new system.

5.6 Summary

In summary, individuals in different positions and at different organizational levels contributed to the recreation of routines at CF in several ways. They adapted routine performances by either (1) adjusting and recombining existing routine fragments or (2) introducing new fragments into the routine. But, they also developed (3) support practices, which were performed in addition to routines and continually reproduce the circumstances required for certain routine fragments to be performed. In addition, both (4) the technological basis of routines as well as (5) other organizational structures were also adapted in an attempt to repair routines.

Repair practice	Issues solved
(1) adjusting and recombining existing fragments	Inability to perform the original fragment (I05, I08, I14, I16), original routine/fragment is no longer effective (I03, I13)
(2) introducing new fragments into the routine	Inability to perform the original fragment (I04, I05, I09, I10, I11, I14), original routine/fragment is no longer effective (I06, I13, I17, I23), inability to perform the original routine (I19, I22), I15
(3) incorporating fragments of a support practice	Inability to perform the original fragment (I04, I05), inability to perform the original routine (I22), I12
(4) adapting the technological basis	Inability to perform the original fragment (I05, I18), original routine/fragment is no longer effective (I06, I13), inability to perform the original routine (I20, I24)
(5) adapting organizational structures	Inability to perform the original fragment (I04, I05, I09, I21), original routine/fragment is no longer effective (I06, I13), inability to perform the original routine (I22, I24)

Table 13: Repair practices and the issues solved by these practices

These activities, or repair practices, were not performed in response to specific types of issues encountered (Table 13), but were different approaches of handling the challenges posed by the implementation of LMS. In particular, the performance of specific repair practices depended on the situation in terms of the possibilities offered by the circumstances and perceived by individuals. For example at PSN, the development of the

fragment resembling the use of change summary printouts appears to be a pragmatic response to a problem at hand. This assumption is supported by the fact that this practice was soon abandoned in favor of the combined use of functionality offered by the workflow system and LMS. Thus, the performance of a repair practice is not only rooted in a particular situation, but its results may emerge further and should not be considered stable. Furthermore, the empirical data shows considerable interrelation between the different repair practices identified. This is well illustrated with the example of how CF got hold of the significant problems related to processing reports. Similarly, other examples like the need for changes required to handle intermediary approvals at both the team as well as the organizational level also illustrate this interrelation. Furthermore, changes in one routine also can have severe effects on other routines. An example is the practice of SSG to forward all problems and required changes identified during calls to PSS, which further increased the amount of requests to be handled there. Thus, repairing routines (and consequently also reestablish a working ES) requires the conjoint, situated activities of many different individuals. These repair practices are further discussed in the following chapter.

6 Discussion

6.1 Repair practices in ES Transformation

The results show that repair practices – like routines – are patterns of actions which emerge from and produce an extended situation. While they are similar to routines in being constituted by ostensive (the general pattern of actions aiming at repairing a routine performance) and performative (the situated enactment of the repair practice) aspects, they also differ from the latter. The characteristics of the five repair practices described in chapter 5 will be discussed subsequently.

The first two practices repaired routines by directly adapting it. These practices were typically not repeated, as they aimed at providing routine fragments – either (1) exiting or (2) new ones – that could be included in routine performances. The effects of both practices are presented in Figure 18 A and B respectively. The figures show the narrative networks of a simple routine after it has been repaired. The blue fragments depict those that were not affected by the repair practice, while the green fragments were changed or added. Figure 18 A shows how the right routine (fragments [1-3, 5]) was repaired by adding a fragment of the left routine (fragments [A-E]). Thus, after the routine was repaired, fragment [D] is equally part of both routines. Similarly, the routine in Figure 18 B was repaired by adding a fragment, but in this case the added fragment [4] needed to be developed before it could be added, that is, it was a new fragment.

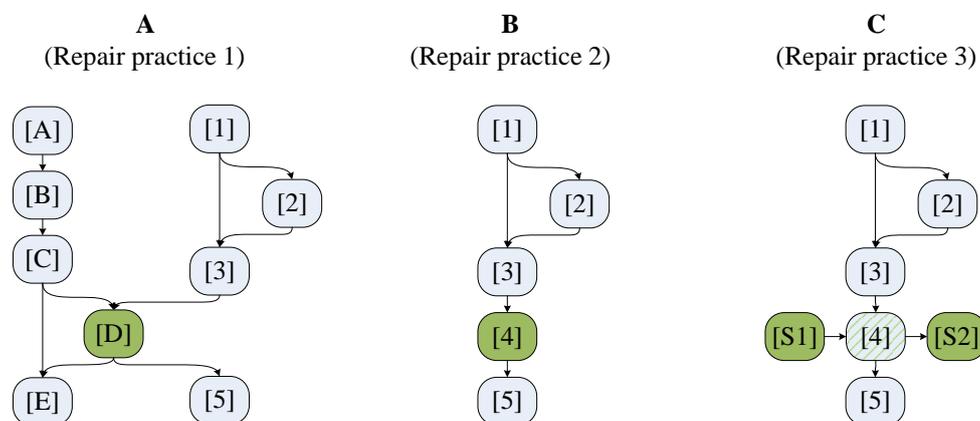


Figure 18: Schematic representation of the effects of repair practices 1-3

In both cases, repairing routines implied to adjust routine performances in response to changes (the implementation of new ES technology) in the material-discursive field of possibilities based on which they were enacted. Thus, routines were essentially repaired by their constitutive mechanism: the interaction of ostensive and performative aspects (Feldman and Pentland 2003). In other words, the routine “absorbed” the changes in the technological basis (the implementation of new ES technology) like any other variations in routine performances (Pentland et al. 2012).

In contrast, (3) support practices were performed in a routinized way in addition to the supported routine (cf. section 5.4.1). They did not establish a new fragment in a one-off fashion, but continually maintained some aspects of the material-discursive field of possibilities in a particular state (e.g., keeping a folder with relevant information up to date). This in turn enabled the performance of a fragment as part of a routine. Thus, support practices are effective because they are performed in a routinized way and considerably overlap with the supported routines. Figure 18 C depicts the effect of this repair practice.

Repair practices four and five similarly targeted the material-discursive field of possibilities. But, their effect on routines was less direct because it involved further extended situations. These practices adapted the extended situations of (4) technologies-in-practice or (5) organizational structures. This in turn changed the basis on which the actants that are forming the routine fragments (cf. section 4.3) – as well as the relationships between them – are delineated. Figure 19 presents the effects of repair practice 4. Like before the color green is used to highlight changes effected by the repair practices. The figure show how the change in the extended situation of the (ES) technology-in-practice affects a particular routine fragment [4]. Because the latter is in part constituted by technical actants changes in technologies-in-practice also result in a modified fragment. But the effect is not limited to the actant itself, but may also concern its relationship with human or other technical actants. Similarly, practice five repairs routines by changing the extended situation of organizational structures other than routines (Figure 20).

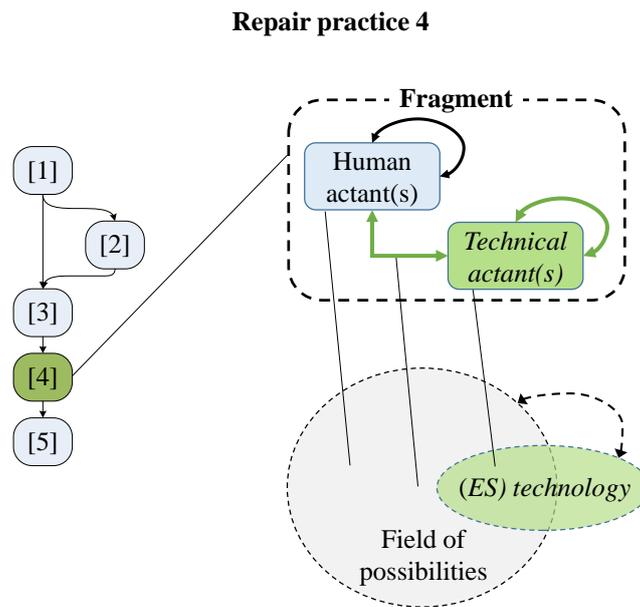


Figure 19: Schematic representation of the effects of repair practice 4

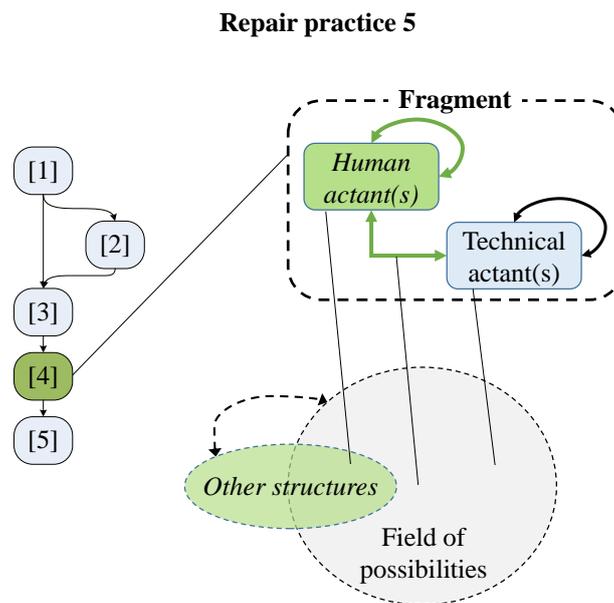


Figure 20: Schematic representation of the effects of repair practice 5

As the examples show, these practices – in contrast to support practices – did not have to become routinized in order to be effective. They had an effect on the basis (the material-discursive field of possibilities) on which the fragment's actants are delineated. The material-discursive field of possibilities in turn was maintained by being implicated in

the extended situations related to the phenomena affected, that is, the extended situations of ES technology-in-practice or organizational structures.

In summary, repair practices emerge from and produce an extended situation and affect all constituting parts of a working ES (cf. section 3.4) either directly or indirectly. Thus, similar to routines they are patterns of action with ostensive and performative aspects. Yet they also fundamentally differ from the latter because they may or may not be repeated and become routinized. That is, the situation which they constitute may be substantially less extended in time. Still, even those repair practices that are not repeated produce lasting effects, because they reconfigure routines and the material-discursive field of possibilities. In other words, after ES technology has been implemented repair practices form a crucial part of the working ES (Figure 21).

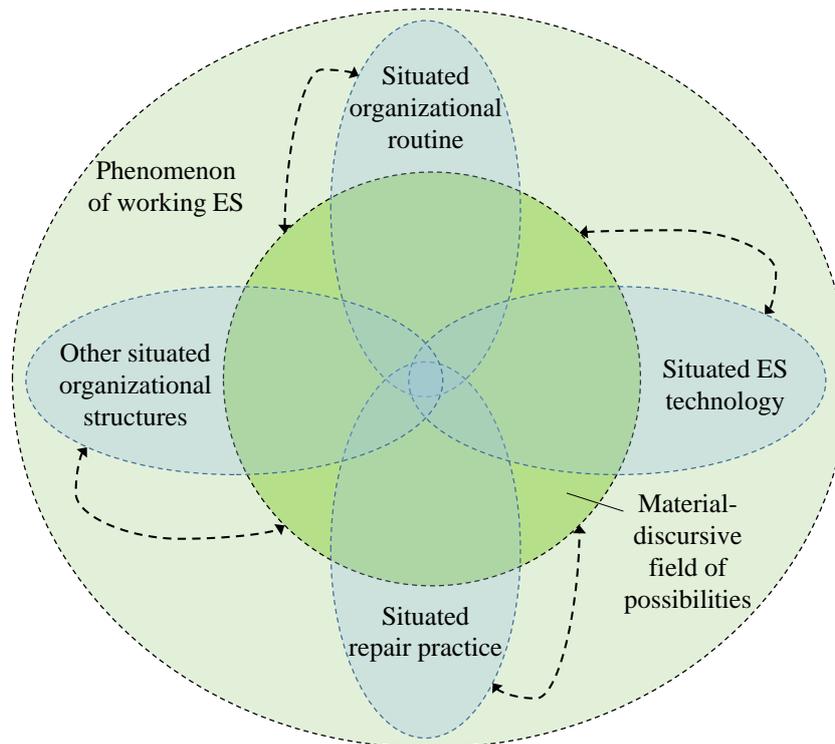


Figure 21: Working ES after ES technology implementation

The concept of (sociomaterial) repair practices extends the current understanding of how a working ES is (re)established in several ways. First, it links the results of previous studies by emphasizing the iterative and multi-level nature of the process. Second, the sociomaterial conceptualization of repair practices not only allows the appropriate

incorporation of technology in the analysis, but further uncovers the role of other material in establishing a working ES. Third, conceptualizing repair practices as being embedded in extended situations also highlights the role of time in this phenomenon. The following sections elaborate on these considerations.

6.2 Jointly recovering the Enterprise System

In line with other studies of post-implementation behavior (Barki et al. 2007; Beaudry and Pinsonneault 2005) the results section shows that repairing routines does not happen at any particular level of the organization, but is a joined achievement of many, if not all, people directly and indirectly affected by technological change and the associated organizational change. To a great deal repairing routines involves exchange and coordination with, as well as support by others (Yamauchi and Swanson 2010), but is also considerably influenced by organizational and technological adaptations (Barki et al. 2007). Yet, by and large these repair practices do not operate independently, but are considerably interrelated.

Thus, like Wagner and colleagues (2010), project survival – or repairing routines – was found to require molding together “critical established practices and the aspects of the proposed best practices” (p.290) associated to packaged software. Yet, the empirical data shows that negotiation is required not only at the boundaries of different communities of practice, but is required – and happens – at all levels of an organization from dyad and team level up to the whole organization and the implementation project team. Furthermore the possibility to negotiate practices (Wagner et al. 2010) as well as the need for situated learning (Boudreau and Robey 2005) does not exist in universities and public organizations only but is equally relevant in privately held enterprises like BANK.

Overall, this shows that locality and situatedness of practices does not imply that remote decisions and actions are not influential, but – quite contrarily – many situated improvisations observed in the case study were only possible because others elsewhere paved the grounds for these performances. Thus, it is always the combination of actions taken on several levels / at several locations and the cooperation of those involved that is re-

quired to repair routines. Neither a laissez-faire approach nor the assumption of social or technological determinism are an accurate answer to the challenge of repairing routines. The best approach appears to be to try to plan an implementation as accurate as possible in advance based on the knowledge and assumptions available, but being aware that both may, in part, turn out to be wrong. This is also in line with the observation that it was possible to sustainably repair the routines of PSS only after their problems received sufficient attention from top management.

6.3 The materiality of repair practices

While there is broad recognition in literature that it is important to consider the materiality of phenomena, there also is considerable discussion on what the term is supposed to mean (Jones 2014). Materiality, as the term is used here, refers to the physical (e.g., use of paper) as well as digital¹¹ (e.g., functionality of LMS) characteristics (Jones 2014) of both problems as well as repair practice.

The most obvious material in this context is the digital materiality of OLMS and LMS, as the switch from the first to the latter was the event triggering the whole change process discussed here. But, as is evident from the descriptions in the previous sections LMS was not only relevant because it triggered social change, but was also subject to change (i.e. adaptation) itself and in important ways part of the solutions established through repair practices. Adaptation of technology occurred both at the individual as well as at the project level and LMS was incorporated in repaired routines not only as substitute for OLMS, but also as a way for dealing with new challenges accompanying the introduction of the new system, like the use of the cash flow simulation feature for learning. In addition to LMS several other digital tools and systems helped repairing the routines at CF. A particularly prominent example is the workflow management system, which was an inherent part of many repair practices and made it sometimes much easier

¹¹ Digital materiality refers to the non-physical yet relatively persistent characteristics of information technology, like for example software.

helped solving problems related to LMS. Establishing a new way of coordinating final approvals for the routines PSS1 and PSN3, was almost no problem and just some minor issues, like the communication of payment dates, had to be considered. But, this was only possible because the workflow system offered a ready-made alternative, which was already well integrated in existing routines and, in a way, just had to be used to its full potential. Other examples of digital tools relevant for repairing routines include the excel “tool” for calculating repayment rates. Additionally, adaptations of digital materiality of other technology were observed as well such as, for example reprogramming the telephone system to assign calls directly to the next free employee independent of the region. Furthermore adapting digital materiality also was present in more subtle ways. Several of the observed problems did not result from the “structural features” of technology, like abstract data structures (e.g. database schemata or data types) or functionality (i.e. algorithms), but were a result of particular instances of such data (i.e., actual data), which was processed by some algorithm. Data is the part of an IS that is – and is supposed to be by definition – particularly easy to change, at least within a preset scope defined for example in form of data types, yet due to the storing capacity of technology (Pentland and Feldman 2007) becomes more durable and may create substantial effects. That being said, entering or changing data is in a way the method for adapting a “living” (Pentland and Feldman 2008) information system best accessible for end-users. Keeping the above example of report processing in mind, data entry in routine PSN3 nicely illustrates this effect. As discussed before, part of the report issue at PSS was, rooted in the fact that PSN employees were instructed not to check the redemption value of a contract before issuing an internal payment. Thus, they entered the payment data without checking for potential consequences for PSS, who then in turn received a report. Like the problem, the solution also included entering data in a particular way, that is, PSN employees were asked to calculate the redemption value and enter the correct amount into the payment form. Another example was a problem related to data entered into OLMS by SSG, which was part of a work around to handle problems with OLMS. Even though the migration rate was about 99% (i.e., almost all data was successfully transferred from OLMS to LMS), some problems with old contracts surfaced after some time. Yet, the problems did not relate to errors during data migration, but were caused by the fact that SSG employees sometimes had to make direct bookings, i.e. change data in OLMS in non-standard ways, for example in order to handle problems caused by colleagues inter-

nally. Due to the different internal accounting logic of LMS (plan-based) and OLMS (actual value-based), these unexpected changes to the account did not matter in OLMS, but constituted a deviation from the plan in LMS, which had to be resolved. As is obvious from both examples effects of non-standard data entry may be especially severe if much of the subsequent tasks are automated and thus problematic data is just “routed through” without any cross checking by humans aware of the situational particulars, and may then accumulate at some point to form a major problem.

But not only digital materiality in its different forms affected the change process, physical materiality also was relevant in many repair practices. This includes both physical objects, like blank sheets of paper or printed excel checklists incorporated in repair practices at the individual level, as well as aspects of spatial position like seat arrangements or the availability of change agents. In contrast to the findings of Barrett and colleagues (Barrett et al. 2012), these aspects of physical materiality were much easier to adapt for people at CF than digital materiality.

6.4 Time: an essential aspects of repairing routines

The other aspect of repair practices to be considered is time. Time and especially the emergence of phenomena over time is a theme, which is generally emphasized in sociomaterial studies (cf. sections 2.3.1 and 2.3.2). For example, Wagner and colleagues (2010) highlight the emergent process of reestablishing a working ES and the corresponding need to “[p]lan iteratively and into the post-roll-out period” (p.289). But in addition, related to repairing routines time was found to be a factor affected by and affecting the material-discursive field of possibilities. This is in line with the conceptualization of the latter by Barad (2007).

The temporal aspect of repairing routines refers to three interrelated ways in which time is important here: timing of routine executions, unfolding of repair practices over time, and persistence of repair practices over time.

First of all, timing is an important aspect of routine execution in addition to the routines internal constitution. An example is the management decision to establish two timeslots (starting 11 am and 2 pm), during which all employees allowed to execute the ap-

approval routine have to solely focus on approval requests until the corresponding work flow list is empty. This helped preventing problems stemming from the higher number and complexity of approvals required in LMS as well as avoiding frequent need for coordination between those approving PSN2 requests and those performing approvals related to PSN3. Another example relates to the availability of change agents at SSG. Key to understanding the problems SSG employees had while trying to answer requests on the phone is to consider the timing of events. If change agents would have been immediately available during a call, there would not have been a need for establishing the support practice of collecting call back notes and asking the change agent once s/he was available, and work would have been much easier for SSG employees. Similarly, the major problem with intermediary approvals at PSS was not the increased number of approvals required. The problem was the timing of these additional approvals, which were no longer only required when a request was fully processed, but potentially needed to be included at any time during routine performance. This in turn made it necessary to change routine PSS1 as described before.

Second, in much the same way, time was also an essential component of repair practices and the process of repairing routines in general. For example, the empirical data shows that repair practices were initiated at different times during the change process depending on the level they were triggered at. Most of the organization level adaptations started either before go-live or one to two months after the new technology was available. Similarly, technology adaptation occurred rather late in the change process, both at the individual as well as the project level. In contrast, individual and team repair practices were typically established in the early phase after go-live. This may be attributable to the fact that both employees as well as management first had to find out how well the preparation, in terms of learning and organizational adaptation, helped to handle the problems related to the incorporation of the new technology into routines at CF and in important ways first had to find out what the (unexpected) problems not covered by preparation were. Thus, all actors of this change process initially perceived the situation as “given” and tried to adjust their own behavior and immediate environment (i.e. everything situated in their sphere of influence) to accommodate change. Yet, after some time it became clear that this will not suffice to fully repair routines in all cases. For these especially persistent problems, organizational and technical solutions were sought, which in turn required individual and team level adaptation as discussed before. In

many cases successful repair practices at earlier stages of the change process were also pre-requisite for later changes, like for example the fast recovery of PSN routines which allowed management to solve the problem PSS had with changing payment mandates by assigning the task to PSN.

Finally, third, time is also relevant with respect to the persistence of repair practices. In the course of the six month of change studied, many repair practices were established, as discussed before, but not all of them persisted. This can be attributed to two reasons. First, several repair practices simply vanished as they were no longer required. Examples include the support practices related to organize information send to employees by email or fragments related to asking change agents during routine performance. A second reason for the extinction of repair practices was that they were replaced by ways of working perceived to be more effective (i.e., better ways of working were discovered by trial and error). The change in performances of approval for PSN2 request from printing screenshots to making more detailed comments in the work flow system falls into this category. Another example is the excel sheet used to coordinate intermediary approvals for report requests, which replaced the practice of asking a colleague to immediately approve intermediary changes.

Reflecting on this difference, two categories of repair practices could be identified, with different qualities in terms of persistence: those related to handling the situation of change and those required for adapting routines and accommodating the new system. Yet, interestingly not all repair practices that would typically be thought of belonging to the first category did actually disappear again, at least not until end of the case study. For example, the task forces formed during change to handle particularly difficult problems related to LMS, even were institutionalized in form of the LMS expert group. Thus, practices from the first category, while being more likely to disappear again, may still persist and similarly those from the second category will most likely persist, yet may be replaced by other practices.

6.5 Summary

In summary, repair practices are conceptually similar to routines in being embedded in extended situations and thus constituted by ostensive and performative aspects. Still, these practices are distinct from routines, because they are not necessarily repeated and thus may not become routinized. But this does not mean that they do not produce any lasting effects. Those repair practices that are not performed in a routinized way affect routines by reconfiguring them or the material-discursive field of possibilities. This implies that recreating routines involves intense negotiations both with the social and material environment. Furthermore, repair practices are not stable patterns of action, but evolve over time, yet may be surprisingly persistent as well. Thus, repair practices do not only form a crucial part of the working ES immediately after ES technology has been implemented, but likely will continue to be present well beyond the initial time of intense change (Figure 22).

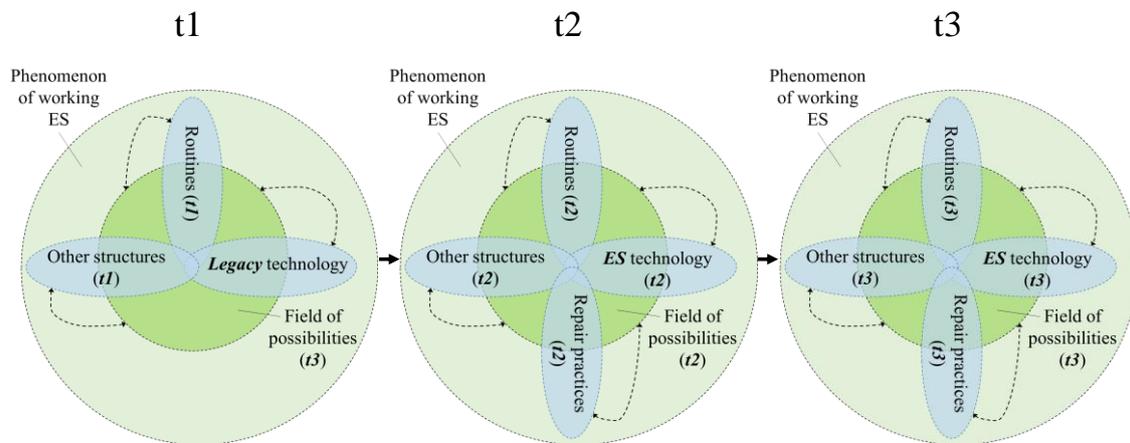


Figure 22: Repairing routines in ES Transformations

7 Conclusion

7.1 Summary

Being interested in how individuals are able to re-establish a working ES after new ES technology has been implemented and how the different foci and findings of previous studies can be integrated, sociomateriality was chosen as a meta-theoretical basis. Confronted with the apparent diversity of theoretical positions embodying the sociomaterial paradigm, the empirical literature based on sociomateriality was reviewed with the objective to render the currently evolving theme of sociomateriality more accessible. Six distinct lenses were identified, each providing a consistent theoretical basis for inquiries of sociomaterial phenomena, but also recognized the fluidity of the boundaries between them. While both the lenses identified as well as the articles analyzed can be positioned in relation to each other, the lenses should not be understood as fixed and mutually exclusive categories, but are better imagined as overlapping territories. Building on this understanding a conceptualization of ES Transformation as a sociomaterial process of breaking associations with an old technology together with the iterative and reflexive integration of new technology was developed. An interpretive case study was conducted to answer the question how sociomaterial routines are repaired in such a situation. Based on a comparison of relevant routines at different points in time during (post-) implementation, five categories of repair practices individuals (in different positions/at different organizational levels) employed to repair routine performances were identified. Two of the practices aimed directly at adapting routines. Individuals repaired routine performances by (1) adjusting and recombining existing fragment or (2) introduced new fragments into the routine. But, individuals also developed additional (3) support practices. These practices are performed in addition to, but share common fragments with, the supported routine and enable the performance of the share fragment as part of the routine. Two more repair practices targeted the sociomaterial background, that is the material-discursive field of possibilities, based on which routines are established by (4) changing the technological basis or (5) adapting organizational structures. In other

words, they changed the basis on which those actants are delineated, which are subsequently forming routine fragments.

7.2 Contribution

7.2.1 Theoretical Contributions

Theoretically the doctoral thesis provides contributions to the emerging field of sociomaterial studies as well as research focusing on ES post-implementation and use.

The literature review and discussion of theoretical lenses currently used in empirical research based on a sociomaterial worldview provides a starting point for orientation in the vast amount of concepts currently discussed and may be useful for scholars in identifying suitable (and conceptually consistent) basis for their research. Furthermore, the mapping of the different lenses may help others positioning their work and highlighting blind spots of current research (i.e., research gaps) and potential future areas of investigations for a particular phenomenon of interest. It may also help identifying fertile grounds for the integration of other concepts with sociomaterial ideas (like was already successfully done with institutional logics and boundary objects).

In line with other studies of ES post-implementation behavior (Barki et al. 2007; Beaudry and Pinsonneault 2005; Wagner et al. 2010), it was found that repairing routines is a collaborative achievement of many, if not all, people directly and indirectly affected by the technological change. Yet, the repair practices employed at different levels do not operate independently, but are highly interrelated. In addition, it is important to consider the material and temporal aspects of ES Transformation. In line with researchers studying other phenomena using a sociomaterial lens (e.g., Barrett et al. 2012; Jones 2014), both physical (e.g., use of paper) as well as digital (e.g., functionality of LMS) materiality was found to be important constituents of problems and repair practice. Yet, in contrast to the findings of Barrett and colleagues (2012), aspects of physical materiality were much easier to adapt for people at CF than digital materiality. Time was similarly important for the ES Transformation at CF as both the timing of

routine executions as well as the unfolding of repair practices over time had major effects on the final success of recreating routines at CF. In addition, repair practices were found to be different with respect to their persistence. While those practices employed to handle the situation of change were more likely to disappear again (yet did not necessarily do so), those required for adapting routines and accommodating the new system will most likely persist.

Thus, repairing routines after ES technology implementation does not only involve replacing one routine fragment (related to the old technology) with a new fragment (based on new technology) and appropriately reincorporating this new fragment into an otherwise stable routine. To the contrary, repairing routines implicates far more profound changes to routines, which have to be negotiated both with the social and material environment, and further requires adjusting the sociomaterial background based on which routines are established. In addition, repair practices evolve over time and differ with respect to their persistence. Thus, repairing a routine has a social, material, and temporal dimension, which jointly have to be considered.

7.2.2 Practical Contributions

From a managerial perspective these findings have several implications. First, it is important to be aware of the influence exiting routines and work practices have on the process of transformation after ES implementations. The categorization of repair practices presented above offers a framework for anticipating the efforts required at different levels during ES technology implementation and post-implementation. While the case is very specific, both in terms of the ES technology implemented as well as the industry, the examples of these types of repair practices offered by the case study may still help practitioners to develop a better understanding of ES technology implementations and in particular the post-implementation phase. This in turn will likely improve the ability to appropriately plan programs and projects related to these kinds of changes.

Second, the present study highlights that as repair practices employed at different levels are highly interrelated and emerge over time. Thus, the best approach for making use of the knowledge about the repair practices identified appears to be a combination of planning an implementation as accurately as possible in advance based on the knowledge and assumptions available and being attentive to deviations from the initial plan after

go-live. This of course also requires keeping sufficient resources to be able to react if plans turn out to be less effective than expected.

Yet, third, the repair practices identified may also help making sense of unforeseen circumstances and thus facilitates reacting appropriately in these situations. Thus, the findings can support those in charge of as well as those affected by an ES technology implementation to carefully plan, but also successfully perform implementation and post-implementation.

Fourth, and similar to the types of repair practices identified, the elaboration of the different and changing material as well as temporal characteristics of these repair practices provide a resource for planning as well as dealing with ES Transformation.

Finally, the findings highlight that – given the different practices individuals employed to repair their routine performances and the creativity of many participants– it appears valuable to observe the behavior of employees during change to identify successful practices for specific problems at hand. These can then be communicate them to the rest of the organization.

7.3 Limitations and Future Work

In the light of these contributions, the limitations of the research presented here also have to be acknowledged. First, the research design implies that the generalizability of the findings beyond the specific case investigated is possible analytically only (Lee and Baskerville 2003). But, this analytical generalizability is in turn supported by the design of the study, because it included an intensive study of the context of the ES implementation program in which the particular case of CF was located. In addition, an initial exploration phase was conducted to identify a part of BANK's implementation program most suitable for studying the phenomenon of interest. And, the theoretical and meta-theoretical grounding of the study further strengthen the analytical account.

Similarly, the particular ES technology that was implemented at CF, because it is specific to the banking sector, limits generalizability. Yet, while being an instance of ES technology especially tailored for this industry, it also shares many common features

with other ES technology (like e.g., ERP) in providing large-scale integration based on packaged software. Thus, the repair practices identified in the study will likely occur after the implementation of other types ES technology as well.

Second, while the study presented here offers a detailed account of how individuals repair their routines after ES technology was implemented, several changes in routines were not included in the analysis, because they did not occur in response to problems. Future research could build on the account of ES Transformation presented here and include the affordances (e.g., Leonardi 2011; Zammuto et al. 2007) of new ES technology in addition to the problems and constraints people face during its implementation.

Third, due to the focus on organizational routines at CF, other organizational structures as well as the practices performed by individuals working in other units of the organization did only surface in the analysis if they had an effect on routines. Thus, the extension of the research scope to include, for example, the practices of members of the implementation project team or of bank advisors, will further strengthen the understanding of the phenomena of ES Transformation and repairing routines. Similarly, additional structural analyses will likely result in a better understanding of the role of organizational structures other than routines in the process of ES Transformation.

Fourth, because the present study focused on the practices involved in reestablishing a working ES, the outcomes of ES Transformations, for example in terms of firm performance or gains in efficiency were not considered. Thus, it remains unclear, how the repair practices affect these outcomes and whether certain practices should be preferred to others from an individual or organizational perspective. Future research may build on the account of ES Transformation and repairing routines to identify, which repair practices are better suited for which kinds of situations. Furthermore, repairing routines may not necessarily be valuable in every case or run counter to the objectives of management, which may be more interested in establishing new routines instead of preserving existing ones. Thus, researchers may want to investigate the general value of repair practices. This relates to the theme of resistance, which is heavily discussed in IS research (Rivard and Lapointe 2012). Investigating the relationship between the emergence of repair practices and employee resistance against organizational change initiatives or implemented technology offers a promising avenue for future research.

Finally, additional research is warranted with respect to the processes of learning to routinely use ES technology at the individual level, that is, further unpacking the practices required to actually establish (as opposed to ‘only’ integrate) routine fragments related to ES technology. Both these perspectives, together with findings presented here, may in addition be usefully combined with an analysis of the related outcomes; for example in terms of firm performance or effective use (Burton-Jones and Grange 2013).

Appendix A: Publications

Publications related to this thesis

Kahrau, F., and Maedche, A. 2013. "Knowledge Workers' Time Management As Sociomaterial Practice," *ECIS 2014 Proceedings* (available at http://aisel.aisnet.org/ecis2013_cr/195).

Kahrau, F., Müller, B., and Maedche, A. 2015. "Theoretical Lenses for Studying Sociomaterial Phenomena," Working Paper to be submitted in April 2015.

Kahrau, F., Müller, B., Lauterbach, J., and Maedche, A. 2015. "Repairing Routines in Enterprise System Transformations – A Sociomaterial Perspective," Working Paper to be submitted in April 2015.

Lauterbach, J., Kahrau, F., Mueller, B., and Maedche, A. 2014. "What makes 'the System' tick? - Explaining Individuals' Adaptation Behavior towards Effective Use in Enterprise System Implementations," *ICIS 2014 Proceedings* (available at <http://aisel.aisnet.org/icis2014/proceedings/HumanBehavior/29>).

Lauterbach, J., Kahrau, F., Maedche, A., and Müller, B. 2013. "Reconceptualizing Enterprise Systems," Presented at the IFIP 8.2/Organizations and Society in Information Systems (OASIS) Pre-ICIS Workshop (available at <https://ub-madoc.bib.uni-mannheim.de/35231>).

Further Publications

Scheiber, F., Wruk, D., Oberg, A., Britsch, J., Woywode, M., Maedche, A., Kahrau, F., Meth, H., Wallach, D., and Plach, M. 2012. "Software Usability in Small and Medium Sized Enterprises in Germany: An Empirical Study," in *Software for People*, Alexander Mädche (eds.), Berlin Heidelberg: Springer, pp. 39-52.

Appendix B: Articles excluded from the literature review

The following table include the articles excluded from the literature review presented in chapter 2 together with their classification according to the dimensions presented subsequently (1 means that the fact referred to in the column applies and 0 that it does not).

The first classification column (relevant field of research) indicates if the article describes research related to organizational research and/or Information Systems. The next column shows if the full text was available. The column passing mention indicates if the article only includes passing mention of the term or actually applies sociomaterial concepts. Finally, the last column (empirical study) shows if the article empirically studies sociomateriality or conceptually engage with it.

The list of references provided by Jones (2014) in the appendix of his work does not include entries for some articles. These articles are included in the table with the citation only. The identifiers provided in the first column relate to those used by Jones (2014) as follows. The articles extracted from his the review have an identifier stating with J and followed by the number used in his article. All additional articles collected with the database search have an identifier starting with N followed by serial number (the serial numbers missing in the table below belong to the articles discussed in chapter 2).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J001	Orlikowski, W. J. 2007. "Sociomaterial Practices: Exploring Technology at Work," <i>Organization Studies</i> (28:9), pp. 1435-1448.	1	1	0	0
J002	Orlikowski, W. J., and Scott, S. V. 2008. "Sociomateriality: Challenging the Separation of Technology, Work and Organization," <i>The Academy of Management Annals</i> (2:1), pp. 433-474.	1	1	0	0
J003	Ashcraft, K. L., Kuhn, T. R., and Cooren, F. 2009. "Constitutional Amendments: 'Materializing' Organizational Communication," <i>The Academy of Management Annals</i> (3:1), pp. 1-64.	1	1	0	0
J004	Baptista, J. 2009. "Institutionalization as a Process of Interplay Between Technology and its Organizational Context of Use," <i>Journal of Information Technology</i> (24:4), pp. 305-319.	1	1	1	0
J005	Jones, M., and Karsten, H. 2009. "Divided by a Common Language? A Response to Marshall Scott Poole," <i>MIS Quarterly</i> (33:3), pp. 589-595.	1	1	1	0
J007	Agarwal, R., Sambamurthy, V., and Stair, R. M. 2010. "Research Commentary—The Digital Transformation of Healthcare: Current Status and the Road Ahead," <i>Information Systems Research</i> (21:4), pp. 796-809.	1	1	1	0
J008	Baptista, J., Newell, S., and Currie, W. 2010. "Paradoxical Effects of Institutionalization on the Strategic Awareness of Technology in Organisations," <i>Journal of Strategic Information Systems</i> (19:3), pp. 171-183.	1	1	0	0
J009	Choi, S. Y., Lee, H., and Yoo, Y. 2010. "The Impact of Information Technology and Transactive Memory Systems on Knowledge Sharing, Application, and Team Performance: A Field Study," <i>MIS Quarterly</i> (34:4), pp. 855-870.	1	1	1	0
J010	Chua, C. E. H., and Yeow, A. Y. K. 2010. "Artifacts, Actors, and Interactions in the Cross-Project Coordination Practices of Open-Source Communities," <i>Journal of the Association for Information Systems</i> (11:2), pp. 838-867.	1	1	1	0
J011	El Sawy, O. A., Malhotra, A., Park, Y., and Pavlou, P. A. 2010. "Research Commentary—Seeking the Configurations of Digital Ecodynamics: It Takes Three to Tango," <i>Information Systems Research</i> (21:4), pp. 835-848.	1	1	1	0
J012	Iannacci, F. 2010. "When Is an Information Infrastructure? Investigating the Emergence of Public Sector Information Infrastructures," <i>European Journal of Information Systems</i> (19:1), pp. 35-48.	1	1	0	0

Table 14: Articles excluded from the literature review.

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J013	Iveroth, E. 2010. "Inside Ericsson: A Framework for the Practice of Leading Global IT-Enabled Change," <i>California Management Review</i> (53:1), pp. 136-153.	1	1	1	0
J014	Leonardi, P. M., and Barley, S. R. 2010. "What's Under Construction Here? Social Action, Materiality, and Power in Constructivist Studies of Technology and Organizing," <i>Academy of Management Annals</i> (4), pp. 1-51.	1	1	0	0
J015	Orlikowski, W. J. 2010. "The Sociomateriality of Organisational Life: Considering Technology in Management Research," <i>Cambridge Journal of Economics</i> (34:1), pp. 125-141.	1	1	0	0
J016	Schultze, U., and Orlikowski, W. J. 2010. "Research Commentary—Virtual Worlds: A Performative Perspective on Globally Distributed, Immersive Work," <i>Information Systems Research</i> (21:4), pp. 810-821.	1	1	0	0
J017	Schultze, U. 2010. "Embodiment and Presence in Virtual Worlds: A Review," <i>Journal of Information Technology</i> (25:4), pp. 434-449.	1	1	0	0
J018	Van Osch, W., Bohnsack, R., and Avital, M. 2010. "From Green IT to Sustainable Value: The Path-Dependent Construction of Sustainable Innovation," in <i>Best Paper Proceedings of the Annual Meeting of the Academy of Management</i> , Montreal, Canada.	1	1	0	0
J020	Wiberg, M., and Robles, E. 2010. "Computational Compositions: Aesthetics, Materials, and Interaction Design," <i>International Journal of Design</i> (4:2), pp. 65-76.	1	1	0	0
J021	Yoo, Y., Bryant, A., and Wigand, R. T. 2010. "Designing Digital Communities that Transform Urban Life: Introduction to the Special Section on Digital Cities," <i>Communications of the Association for Information Systems</i> (27:33), pp. 637-640.	1	1	0	0
J022	Yoo, Y. 2010. "Computing in Everyday Life: A Call for Research on Experiential Computing," <i>MIS Quarterly</i> (34:2), pp. 213-231.	1	1	1	0
J023	Ayyagari, R., Grover, V., and Purvis, R. 2011. "Technostress: Technological Antecedents and Implications," <i>MIS Quarterly</i> (35:4), pp. 831-858.	1	1	1	0
J024	Barley, S. R., Meyerson, D. E., and Grodal, S. 2011. "E-Mail as Source and Symbol of Stress," <i>Organization Science</i> (22:4), pp. 887-906.	1	1	0	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J025	Cabantous, L., and Gond, J.-P. 2011. "Rational Decision Making as Performative Praxis: Explaining Rationality's Éternel Retour," <i>Organization Science</i> (22:3), pp. 573-586.	1	1	0	0
J026	Carlo, J. L., Lyytinen, K., and Rose, G. M. 2011. "Internet Computing as a Disruptive Information Technology Innovation: The Role of Strong Order Effects," <i>Information Systems Journal</i> (21:1), pp. 91-122.	1	1	0	0
J027	Carugati, A., Giangreco, A., and Sebastiano, A. 2011. "Moving the Implementation Line: The Path to Success with IT of a Nursing Home," <i>Systèmes d'Informations et Management</i> (16:4), pp. 73-101.	1	1	0	0
J028	Contractor, N., Monge, P., and Leonardi, P. 2011. "Multidimensional Networks and the Dynamics of Sociomateriality: Bringing Technology Inside the Network," <i>International Journal of Communication</i> (5), pp. 682-720.	1	1	0	0
J029	Faraj, S., Jarvenpaa, S. L., and Majchrzak, A. 2011. "Knowledge Collaboration in Online Communities," <i>Organization Science</i> (22:5), pp. 1224-1239.	1	1	1	0
J030	Feldman, M. S., and Orlikowski, W. J. 2011. "Theorizing Practice and Practicing Theory," <i>Organization Science</i> (22:5), pp. 1240-1253.	1	1	0	0
J031	Galliers, R. D. 2011. "In Celebration of Diversity in Information Systems Research," <i>Journal of Information Technology</i> (26:4), pp. 299-301.	1	1	1	0
J032	Germonprez, M. 2011. "Pluralism Is Not About Me, It Is About Us," <i>Journal of Information Technology</i> (26:4), pp. 304-305.	1	1	1	0
J033	Germonprez, M., Hovorka, D., and Gal, U. 2011. "Secondary Design: A Case of Behavioral Design Science Research," <i>Journal of the Association for Information Systems</i> (12:10), pp. 662-683.	1	1	1	0
J034	Goh, J. M., Gao, G. G., and Agarwal, R. 2011. "Evolving Work Routines: Adaptive Routinization of Information Technology in Healthcare," <i>Information Systems Research</i> (22:3), pp. 565-585.	1	1	1	0
J035	Harris, I., Jennings, R. C., Pullinger, D., Rogerson, S., and Duqueno, P. 2011. "Ethical Assessment of New Technologies: A Meta-Methodology," <i>Journal of Information, Communication and Ethics in Society</i> (9:1), pp. 49-64.	1	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J036	Huang, J., and Galliers, R. D. 2011. "The Importance of Rhetoric in Conceptualizing IS Adoption," <i>Journal of Enterprise Information Management</i> (24:3), pp. 219-223.	1	1	1	0
J039	Katrinli, A., Penbek, S., Gunerergin, M., and Zaptcioglu, D. 2011. "Toward an Alienated Workforce: The Impact of Technology on the Development of an Alienated Workforce," <i>Review of Business Research</i> (11:2), pp. 178-182.	1	1	1	0
J041	Lindvall, J., and Iveroth, E. 2011. "Creating a Global Network of Shared Service Centers for Accounting," <i>Journal of Accounting & Organizational Change</i> (7:3), pp. 278-305.	1	0	0	1
J042	Lyytinen and Damsgaard (2011)	1	1	1	0
J043	Muniesa, F., Chabert, D., Ducroq-Grondin, M., and Scott, S. V. 2011. "Back-Office Intricacy: The Description of Financial Objects in an Investment Bank," <i>Industrial and Corporate Change</i> (20:4), pp. 1189-1213.	1	1	1	0
J045	Peltonen, T. 2011. "Multiple Architectures and the Production of Organizational Space in a Finnish University," <i>Journal of Organizational Change Management</i> (24:6), pp. 806-821.	1	1	1	0
J046	Pentland, B. T., Haerem, T., and Hillison, D. 2011. "The (N)Ever-Changing World: Stability and Change in Organizational Routines," <i>Organization Science</i> (22:6), pp. 1369-1383.	1	1	0	0
J047	Sandberg, J., and Tsoukas, H. 2011. "Grasping the Logic of Practice: Theorizing Through Practical Rationality," <i>The Academy of Management Review</i> (36:2), pp. 338-360.	1	1	0	0
J048	Schoeneborn, D. 2011. "Organization as Communication: A Luhmannian Perspective," <i>Management Communication Quarterly</i> (25:4), pp. 663-689.	1	1	0	0
J049	Su, C. 2011. "Can Social Networking Improve Individual Competitiveness? Exploring the Effects of Social Network Centralities on Knowledge Acquisition and Work Efficiency in Organizational Work Teams," <i>Competition Forum</i> (9:2), pp. 247-254.	1	1	0	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J050	Su, C., and Contractor, N. 2011. "A Multidimensional Network Approach to Studying Team Members' Information Seeking from Human and Digital Knowledge Sources in Consulting Firms," <i>Journal of the American Society for Information Science and Technology</i> (62:7), pp. 1257-1275.	1	1	0	0
J051	Whyte, J. 2011. "Managing Digital Coordination of Design: Emerging Hybrid Practices in an Institutionalized Project Setting," <i>Engineering Project Organization Journal</i> (1:3), pp. 159-168.	1	1	0	0
J052	Ajjawi, R., and Bearman, M. 2012. "Sociomateriality Matters to Family Practitioners as Supervisors," <i>Medical Education</i> (46:12), pp. 1145-1147.	1	1	0	0
J053	Almklov, P. G., Østerlie, T., and Haavik, T. K. 2012. "Punctuation and Extrapolation: Representing a Subsurface Oil Reservoir," <i>Journal of Experimental & Theoretical Artificial Intelligence</i> (24:3), pp. 329-350.	1	1	1	0
J054	Bardon, T., Clegg, S., and Josserand, E. 2012. "Exploring Identity Construction from a Critical Management Perspective: A Research Agenda," <i>Management</i> (15:4), pp. 351-366.	1	1	1	0
J055	Barnes, S.-A. 2012. "The Differential Impact of ICT on Employees: Narratives from a Hi-Tech Organization," <i>New Technology, Work and Employment</i> (27:2), pp. 120-132.	1	1	1	0
J057	Baskerville, R. 2012. "Making Better Choices: A Response to Walsham," <i>Journal of Information Technology</i> (27:2), pp. 94-95.	1	1	1	0
J058	Bhatt, I. 2012. "Digital Literacy Practices and Their Layered Multiplicity," <i>Educational Media International</i> (49:4), pp. 289-301.	1	1	1	0
J059	Bødker, M., Gimpel, G., and Hedman, J. 2014. "Time-Out/Time-In: The Dynamics of Everyday Experiential Computing Devices," <i>Information Systems Journal</i> (24:2), pp. 153-166.	1	1	1	0
J060	Boos, D., Guenter, H., Grote, G., and Kinder, K. 2013. "Controllable Accountabilities: The Internet of Things and its Challenges for Organizations," <i>Behaviour & Information Technology</i> (32:5), pp. 449-467.	1	0	0	1

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J063	Contractor, N. S., Whitbred, R. C., Fonti, F., and Steglich, C. 2012. "Understanding the Ties That Bind: A Longitudinal Investigation of the Evolution of a Communication Network," <i>Western Journal of Communication</i> (76:4), pp. 333-357.	1	0	0	1
J064	Dokko, G., Nigam, A., and Rosenkopf, L. 2012. "Keeping Steady as She Goes: A Negotiated Order Perspective on Technological Evolution," <i>Organization Studies</i> (33:5-6), pp. 681-703.	1	1	1	0
J066	Essén, A., and Värlander, S. W. 2012. "The Mutual Constitution of Sensuous and Discursive Understanding in Scientific Practice: An Autoethnographic Lens on Academic Writing," <i>Management Learning</i> (44:4), pp. 424-426.	1	1	0	0
J067	Galliers, R. D., and Huang, J. C. 2011. "The Teaching of Qualitative Research Methods in Information Systems: An Explorative Study Utilizing Learning Theory," <i>European Journal of Information Systems</i> (21:2), pp. 119-134.	1	1	1	0
J068	Gäre, K., and Melin, U. 2013. "Sociomaterial Actors in the Assimilation Gap: A Case Study of Web Service, Management and IT-Assimilation," <i>Information Systems and e-Business Management</i> (11), pp. 481-506.	1	1	1	1
J069	Garud, R., and Gehman, J. 2012. "Metatheoretical Perspectives on Sustainability Journeys: Evolutionary, Relational and Durational," <i>Research Policy</i> (41:6), pp. 980-995.	1	1	1	0
J070	Ghazawneh, A., and Henfridsson, O. 2012. "Balancing Platform Control and External Contribution in Third-Party Development: The Boundary Resources Model," <i>Information Systems Journal</i> (23:2), pp. 173-192.	1	1	1	1
J072	Hitchin, L., Maksymiw, W., and Neyland, D. 2012. "Editorial: Making Space: Co-Producing Critical Accounts of New Technology, Work and Employment," <i>New Technology, Work & Employment</i> (27:1), pp. 1-8.	1	1	1	0
J073	Høstgaard, A. M. B., and Bertelsen, P. 2012. "Video Observation in HIT Development: Lessons Learned on Benefits and Challenges," <i>BMC Medical Informatics and Decision Making</i> (12:91), pp. 1-33.	1	1	0	0
J074	Iveroth, E. 2012. "Leading Global IT-Enabled Change Across Cultures," <i>European Management Journal</i> (30:4), pp. 340-351.	1	1	1	0
J075	Johannesen, M., Erstad, O., and Habib, L. 2012. "Virtual Learning Environments as Sociomaterial Agents in the Network of Teaching Practice," <i>Computers & Education</i> (59:2), pp. 785-792.	1	0	0	1
J077	Kim, G., Shin, B., and Kwon, O. 2012. "Investigating the Value of Sociomaterialism in Conceptualizing IT Capability of a Firm," <i>Journal of Management Information Systems</i> (29:3), pp. 327-362.	1	1	0	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J078	Kim, G., Shin, B., and Kwon, O. 2012. "Investigating the Value of Sociomaterialism in Conceptualizing IT Capability of a Firm," <i>Journal of Management Information Systems</i> (29:3), pp. 327-362.	1	1	1	0
J079	Liang, H., Xue, Y., and Wu, L. 2013. "Ensuring Employees' IT Compliance: Carrot or Stick?," <i>Information Systems Research</i> (24:2), pp. 279-294.	1	1	0	0
J080	Lobo, S., and Elaluf-Calderwood, S. 2012. "The BlackBerry Veil: Mobile Use and Privacy Practices by Young Female Saudis," <i>Journal of Islamic Marketing</i> (3:2), pp. 190-206.	1	1	1	0
J081	Marabelli, M., and Newell, S. 2012. "Knowledge Risks in Organizational Networks: The Practice Perspective," <i>The Journal of Strategic Information Systems</i> (21:1), pp. 18-30.	1	1	0	0
J082	Marler, J. H., and Liang, X. 2012. "Information Technology Change, Work Complexity and Service Jobs: A Contingent Perspective," <i>New Technology, Work and Employment</i> (27:2), pp. 133-146.	1	1	0	0
J083	Meier, O., Missonier, A., and Missonier, S. 2012. "Analyse des systèmes d'interactions à l'oeuvre au sein d'un projet TI: mise en évidence d'une perspective dynamique et relationnelle," <i>Système d'Informations et Management-SIM</i> (17:1), pp. 7-48.	1	1	0	0
J084	Michalski, M. P. 2014. "Symbolic Meanings and e-Learning in the Workplace: The Case of an Intranet-Based Training Tool," <i>Management Learning</i> (45:2), pp. 145-166.	1	1	1	0
J086	Nicolini, D., Mengis, J., and Swan, J. 2012. "Understanding the Role of Objects in Cross-Disciplinary Collaboration," <i>Organization Science</i> (23:3), pp. 612-629.	1	1	0	0
J088	Pellegrino, G. 2012. "Beyond an IT-Driven Knowledge Society: Knowledge Management as Intertwined Sociotechnical Circulation," <i>European Review</i> (20:2), pp. 164-172.	1	1	0	0
J092	Postma, D. 2012. "Education as Sociomaterial Critique," <i>Pedagogy, Culture & Society</i> (20:1), pp. 137-156.	1	1	0	0
J093	Robertson, P. L., Casali, G. L., and Jacobson, D. 2012. "Managing Open Incremental Process Innovation: Absorptive Capacity and Distributed Learning," <i>Research Policy</i> (41:5), pp. 822-832.	1	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J096	Thompson, M. 2012. "People, Practice, and Technology: Restoring Giddens' Broader Philosophy to the Study of Information Systems," <i>Information and Organization</i> (22:3), pp. 188-207.	1	1	0	0
J098	von Krogh, G., Haefliger, S., Spaeth, S., and Wallin, M. W. 2012. "Carrots and Rainbows: Motivation and Social Practice in Open Source Software Development," <i>MIS Quarterly</i> (36:2), pp. 649-676.	1	1	1	0
J099	Vuorinen, J., and Tetri, P. 2012. "The Order Machine—The Ontology of Information Security," <i>Journal of the Association for Information Systems</i> (13:9), pp. 695-713.	1	1	1	0
J100	Walsham, G. 2012. "Are We Making a Better World with ICTs? Reflections on a Future Agenda for the IS Field," <i>Journal of Information Technology</i> (27:2), pp. 87-93.	1	1	1	0
J101	Waring, T., and Skoumpopoulou, D. 2012a. "Emergent Cultural Change: Unintended Consequences of a Strategic Information Technology Services Implementation in a United Kingdom University," <i>Studies in Higher Education</i> (39:4), pp. 1-17.	1	1	1	0
J102	Waring, T., and Skoumpopoulou, D. 2012b. "An Enterprise Resource Planning System Innovation and its Influence on Organizational Culture: A Case Study in Higher Education," <i>Prometheus</i> (30:4), pp. 427-447.	1	0	0	1
J103	Williams, J., and Mavin, S. 2012. "Disability as Constructed Difference: A Literature Review and Research Agenda for Management and Organization Studies," <i>International Journal of Management Reviews</i> (14:2), pp. 159-179.	1	1	1	0
J104	Wood and Reynolds (2012)	1	1	1	0
J105	Yakhlef, A., and Essén, A. 2013. "Practice Innovation as Bodily Skills: The Example of Elderly Home Care Service Delivery," <i>Organization</i> (20:6), pp. 881-903.	1	1	1	0
J106	Yoo, Y., Boland, R. J., Lyytinen, K., and Majchrzak, A. 2012. "Organizing for Innovation in the Digitized World," <i>Organization Science</i> (23:5), pp. 1398-1408.	1	1	1	0
J108	Bélanger, F., Watson-Manheim, M. B., and Swan, B. R. 2013. "A Multi-Level Socio-Technical Systems Telecommuting Framework," <i>Behaviour & Information Technology</i> (forthcoming, DOI: 10.1080/0144929X.2012.705894).	1	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J109	Benn, S., Edwards, M., and Angus-Leppan, T. 2013. "Organizational Learning and the Sustainability Community of Practice: The Role of Boundary Objects," <i>Organization & Environment</i> (26:2), pp. 184-202.	1	1	0	0
J110	Blanc, A., and Huault, I. 2014. "Against the Digital Revolution? Institutional Maintenance and Artefacts Within the French Recorded Music Industry," <i>Technological Forecasting and Social Change</i> (83), pp. 10-23.	1	1	1	0
J111	Clegg et al. (2013)	1	1	0	0
J113	Effah, J. 2012. "Mobilizing Culture for E-Business in Developing Countries: An Actor Network Theory Account," <i>The Electronic Journal of Information Systems in Developing Countries</i> (52) (available at http://www.ejisdc.org/ojs2.../index.php/ejisdc/article/view/951).	1	1	1	0
J114	Ellingsen, G., Monteiro, E., and Røed, K. 2013. "Integration as Interdependent Workaround," <i>International Journal of Medical Informatics</i> (82:5), pp. e161-e169.	1	1	1	0
J115	Fenwick, T., and Edwards, R. 2013. "Performative Ontologies: Sociomaterial Approaches to Researching Adult Education and Lifelong Learning," <i>European Journal for Research on the Education and Learning of Adults</i> (4:1), pp. 49-63.	1	1	0	0
J116	Ferguson, J., Soekijad, M., Huysman, M., and Vaast, E. 2013. "Blogging for ICT4D: Reflecting and Engaging with Peers to Build Development Discourse," <i>Information Systems Journal</i> (23:4), pp. 307-328.	1	1	1	1
J117	Ford, D. P., and Mason, R. M. 2013. "Knowledge Management and Social Media: The Challenges and Benefits," <i>Journal of Organizational Computing and Electronic Commerce</i> (23:1-2), pp. 1-6.	1	1	1	0
J118	Hannon, J. 2012. "Incommensurate Practices: Sociomaterial Entanglements of Learning Technology Implementation," <i>Journal of Computer Assisted Learning</i> (29:2), pp. 166-178.	1	1	0	0
J121	Johri, A., Roth, W.-M., and Olds, B. M. 2013. "The Role of Representations in Engineering Practices: Taking a Turn Towards Inscriptions," <i>Journal of Engineering Education</i> (102:1), pp. 2-19.	1	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J122	Kautz, K., and Jensen, T. B. 2013. "Sociomateriality at the Royal Court of IS: A Jester's Monologue," <i>Information and Organization</i> (23:1), pp. 15-27.	1	1	0	0
J123	Khoo, M., and Hall, C. 2013. "Managing Metadata: Networks of Practice, Technological Frames, and Metadata Work in a Digital Library," <i>Information and Organization</i> (23:2), pp. 81-106.	1	1	1	0
J124	Lancione, M., and Clegg, S. 2013. "The Chronotopes of Change: Actor-Networks in a Changing Business School," <i>Journal of Change Management</i> (13:2), pp. 117-142.	1	1	1	0
J125	Langeard, C., Minguet, G., Guéganton, L., Cam, P., Faquet, C., Lombraill, P., and Rault, G. 2013. "The Reconfiguration of the Relationship to Care for a Rare Disease: Neonatal Expanded Screening in a Socio-Material Perspective," <i>Science Technology & Society</i> (18:1), pp. 115-138.	1	1	1	0
J126	Leonardi, P. M. 2013. "Theoretical Foundations for the Study of Sociomateriality," <i>Information and Organization</i> (23:2), pp. 59-76.	1	1	0	0
J126	Leonardi, P. M. 2013. "Theoretical Foundations for the Study of Sociomateriality," <i>Information and Organization</i> (23:2), pp. 59-76.	1	1	0	0
J127	Marler and Fisher (2013)	1	1	1	0
J129	Mutch, A. 2013. "Sociomateriality—Taking the Wrong Turning?," <i>Information and Organization</i> (23:1), pp. 28-40. Nam, T. 2012. "Suggesting Frameworks of Citizen-Sourcing via Government 2.0," <i>Government Information Quarterly</i> (29:1), pp. 12-20.	1	1	0	0
J130	Nam (2013)	1	1	1	0
J135	Riemer, K., and Seidel, S. 2013. "Design and Design Research as Contextual Practice," <i>Information Systems and e-Business Management</i> (11:3), pp. 331-334.	1	1	0	0
J136	Roscoe, P., and Chillias, S. 2013. "The State of Affairs: Critical Performativity and the Online Dating Industry," <i>Organization</i> (forthcoming, DOI 10.1177/1350508413485497).	1	1	1	0
J137	Schoeneborn, D. 2013. "The Pervasive Power of PowerPoint: How a Genre of Professional Communication Permeates Organizational Communication," <i>Organization Studies</i> (forthcoming, DOI: 10.1177/0170840613485843).	1	1	0	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
J138	Scott, S. V., and Orlikowski, W. J. 2013. "Sociomateriality—Taking the Wrong Turning? A Response to Mutch," <i>Information and Organization</i> (23:2), pp. 77-80.	1	1	0	0
J139	Slade, B. 2013. "Professional Learning in Rural Practice: A Sociomaterial Analysis," <i>Journal of Workplace Learning</i> (25:2), pp. 114-124.	1	1	1	1
J140	Styhre, A. 2013. "Screenness and Organizing: Sociomaterial Practices in Mediated Worlds," <i>VINE</i> (43:1), pp. 4-21.	1	1	0	0
J141	von Krogh, G., and Geilinger, N. 2014. "Knowledge Creation in the Eco-System: Research Imperatives," <i>European Management Journal</i> (32), pp. 155-163.	1	1	1	0
J142	Whitley, E. 2013. "On Technology Neutral Policies for e-Identity: A Critical Reflection Based on UK Identity Policy," <i>Journal of International Commercial Law and Technology</i> (8:2), pp. 134-147.	1	1	1	0
J143	Whyte, J. 2013. "Beyond the Computer: Changing Medium from Digital to Physical," <i>Information and Organization</i> (23:1), pp. 41-57.	1	1	0	0
J144	Wiberg, M. 2014. "Methodology for Materiality: Interaction Design Research Through a Material Lens," <i>Personal and Ubiquitous Computing</i> (18:3), pp. 625-636.	1	1	1	0
J145	Wiberg, M., Ishii, H., Dourish, P., Vallgarda, A., Kerridge, T., Sundstrom, P., Rosner, D., and Rolston, M. 2013. "Materiality Matters—Experience Materials," <i>Interactions</i> (20:2), pp. 54-57.	1	1	1	0
J146	Wright, R. P., Paroutis, S. E., and Blettner, D. P. 2013. "How Useful Are the Strategic Tools We Teach in Business Schools?," <i>Journal of Management Studies</i> (50:1), pp. 92-125.	1	1	1	0
N01	Aaltonen, A. & Tempini, N., 2014. Everything counts in large amounts: a critical realist case study on data-based production. <i>Journal of Information Technology</i> , 29(1), pp.97–110.	1	1	1	1
N02	Akoumianakis, D., 2014. Ambient affiliates in virtual cross-organizational tourism alliances: A case study of collaborative new product development. <i>Computers in Human Behavior</i> , 30, pp.773–786.	1	1	1	1
N03	Akoumianakis, D., 2014. Boundary spanning tactics and "traceable" connections in cross-organizational virtual alliances: A case study. <i>Journal of Enterprise Information Management</i> , 27(2), pp.197–227.	1	1	1	1
N05	Andalib, T.W., 2014. A process of developing an HRM framework based on qualitative study in Technology companies in Bangladesh and Malaysia. <i>International Journal of Research in Business and Social Science</i> , 3(2), pp.148–163.	1	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N06	Balogun, J. et al., 2014. Placing strategy discourse in context: Sociomateriality, sensemaking, and power. <i>Journal of Management Studies</i> , 51(2), pp.175–201.	1	1	0	0
N07	Bayne, S., Gallagher, M.S. & Lamb, J., 2014. Being “at” university: the social topologies of distance students. <i>Higher Education</i> , 67(5), pp.569–583.	1	1	1	1
N09	Bulkeley, H., Luque-Ayala, A. & Silver, J., 2014. Housing and the (re)configuration of energy provision in Cape Town and Sao Paulo: Making space for a progressive urban climate politics? <i>Political Geography</i> , 40, pp.25–34.	0	1	0	1
N10	Bullock, A., 2014. Does technology help doctors to access, use and share knowledge? <i>Medical Education</i> , 48(1), pp.28–33.	1	1	1	0
N11	Burbach, R. & Royle, T., 2014. Institutional determinants of e-HRM diffusion success. <i>Employee Relations</i> , 36(4), pp.354–375.	1	1	1	1
N12	Byron, C., 2014. A Critique of Sean Sayers’ Marxian Theory of Human Nature*. <i>Science & Society</i> , 78(2), pp.241–248.	0	1	1	0
N13	Carlsen, A., Rudningen, G. & Mortensen, T.F., 2014. Playing the Cards: Using Collaborative Artifacts With Thin Categories to Make Research Co-Generative. <i>Journal of Management Inquiry</i> , 23(3).	1	1	0	0
N14	Cecez-Kecmanovic, D., Galliers, R.D., et al., 2014. The Sociomateriality of Information Systems: Current Status, Future Directions. <i>MIS Quarterly</i> , 38(3), pp.809–830.	1	1	0	0
N16	Clark, M., Denham-Vaughan, S. & Chidiac, M.-A., 2014. A relational perspective on public sector leadership and management. <i>The International Journal of Leadership in Public Services</i> , 10(1), pp.4–16.	0	0	/	/
N18	Dery, K., Kolb, D. & Maccormick, J., 2014. Working with connective flow: how smartphone use is evolving in practice. <i>European Journal of Information Systems</i> , 23(5), pp.558–570.	1	1	1	1
N19	Deville, J., 2014. Consumer credit default and collections: the shifting ontologies of market attachment. <i>Consumption, Markets & Culture</i> , 17(5).	0	0	/	/
N20	Dodson, J., 2014. Suburbia under an Energy Transition: A Socio-technical Perspective. <i>Urban Studies</i> , 51(7), pp.1487–1505.	0	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N22	Fagan, M.H., 2014. Exploring a Sociomaterial Perspective on Technology in Virtual Human Resource Development. <i>Advances in Developing Human Resources</i> , 16(3).	1	1	0	0
N23	Farías, I., 2014. Cultura: la performación de mundos sociomateriales. (Spanish). Culture: performing sociomaterial worlds. (English), 21(64), pp.65–91.	0	0	/	/
N24	Fenwick, T. & Edwards, R., 2014. Networks of knowledge, matters of learning, and criticality in higher education. <i>Higher Education</i> , 67(1), pp.35–50.	0	1	0	0
N25	Fenwick, T., 2014a. Knowledge circulations in inter-para/professional practice: a sociomaterial enquiry. <i>Journal of Vocational Education & Training</i> , 66(3), pp.264–280.	0	0	/	/
N26	Fenwick, T., 2014b. Sociomateriality in medical practice and learning: attuning to what matters. <i>Medical Education</i> , 48(1), pp.44–52.	0	1	0	0
N27	Filstad, C., 2014. The politics of sensemaking and sensegiving at work. <i>Journal of Workplace Learning</i> , 26(1), pp.3–21.	1	1	1	1
N28	Foley, R., 2014. The Roman–Irish Bath: Medical/health history as therapeutic assemblage. <i>Social Science & Medicine</i> , 106, pp.10–19.	0	1	0	0
N29	Fuentes, C., 2014. Green Materialities: Marketing and the Socio-material Construction of Green Products. <i>Business Strategy and the Environment</i> , 23(2).	0	1	0	1
N30	Fuentes, C., 2014b. Managing green complexities: Consumers' strategies and techniques for greener shopping. <i>International Journal of Consumer Studies</i> .	0	1	0	1
N31	Gaskin, J. et al., 2014. Toward Generalizable Sociomaterial Inquiry: A Computational Approach for Zooming In and Out of Sociomaterial Routines. <i>MIS Quarterly</i> , 38(3).	1	1	0	0
N32	Geiger, D. & Schröder, A., 2014. Ever-Changing Routines? Toward a Revised Understanding of Organizational Routines Between Rule-Following and Rule-Breaking. <i>Schmalenbach Business Review : ZFBF</i> , 66(2), pp.170–190.	1	1	1	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N34	Gillespie, A. & Martin, J., 2014. Position Exchange Theory: A socio-material basis for discursive and psychological positioning. <i>New Ideas in Psychology</i> , 32, pp.73–79.	0	1	1	0
N35	Glâveanu, V.P., 2014. Theorising context in psychology: The case of creativity. <i>Theory & Psychology</i> , 24(3), pp.382–398.	0	1	1	0
N36	Greenhalgh, T., Stones, R. & Swinglehurst, D., 2014. Choose and Book: A sociological analysis of “resistance” to an expert system. <i>Social Science & Medicine</i> , 104, pp.210–219.	1	1	1	1
N38	Hall-Andersen, L.B. & Broberg, O., 2014. Learning processes across knowledge domains. <i>Journal of Workplace Learning</i> , 26(2), pp.91–108.	1	1	1	1
N39	Hamilton, M., 2014. Global, regional and local influences on adult literacy policy in England. <i>Globalisation, Societies and Education</i> , 12(1), pp.110–126.	0	0	/	0
N40	Henfridsson, O., Mathiassen, L. & Svahn, F., 2014. Managing technological change in the digital age: the role of architectural frames. <i>Journal of Information Technology</i> , 29(1), pp.27–43.	1	1	1	1
N41	Heynen, N., 2014. Urban political ecology I: The urban century. <i>Progress in Human Geography</i> , 38(4), pp.598–604.	0	1	1	0
N42	Hinrichs, C.C., 2014. Transitions to sustainability: a change in thinking about food systems change? <i>Agriculture and Human Values</i> , 31(1), pp.143–155.	0	1	1	0
N44	Jaeger-Erben, M. & Offenberger, U., 2014. A Practice Theory Approach to Sustainable Consumption. <i>Gaia</i> , 23(S1), pp.166–174.	0	1	1	0
N45	Jones, M., 2014. A Matter of Life and Death: Exploring Conceptualizations of Sociomateriality in the Context of Critical Care. <i>MIS Quarterly</i> , 38(3).	1	1	0	1

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N46	Karanasios, S. & Allen, D., 2014. Mobile technology in mobile work: contradictions and congruencies in activity systems. <i>European Journal of Information Systems</i> , 23(5), pp.529–542.	1	1	0	1
N47	Klecun, E. et al., 2014. Evaluation as a Multi-Ontological Endeavour: A Case from the English National Program for IT in Healthcare. <i>Journal of the Association for Information Systems</i> , 15(3), pp.147–176.	1	1	1	1
N48	Knox, H., 2014. Footprints in the City: Models, Materiality, and the Cultural Politics of Climate Change. <i>Pegadas na Cidade: Modelos, Materialidade e a Política Cultural das Alterações Climáticas.</i> , 87(2), pp.405–429.	0	0	/	/
N49	Knox, H., 2014a. Footprints in the City: Models, Materiality, and the Cultural Politics of Climate Change. <i>Anthropological Quarterly</i> , 87(2), pp.405–429.	0	1	0	1
N50	Knox, H., 2014b. Footprints in the City: Models, Materiality, and the Cultural Politics of Climate Change. <i>Anthropological Quarterly</i> , 87(2), pp.405–429.	0	0	/	0
N51	Kozica, A., Kaiser, S. & Friesl, M., 2014. Organizational Routines: Conventions as a Source of Change and Stability. <i>Schmalenbach Business Review : ZFBF</i> , 66(3), pp.334–356.	1	1	1	0
N52	Krzywoszynska, A., 2014. Christopher Rosin, Paul Stock and Hugh Campbell (eds): <i>Food systems failure: the global food crisis and the future of agriculture</i> : Earthscan, New York, 2012, 236 pp, ISBN: 978-1-84971-229-3. <i>Agriculture and Human Values</i> [...]	0	0	/	0
N54	Lawhon, M., Ernstson, H. & Silver, J., 2014. Provincializing Urban Political Ecology: Towards a Situated UPE Through African Urbanism. <i>Antipode</i> , 46(2), pp.497–516.	0	1	1	1
N55	Leclercq-vandelannoitte, A., 2014. Interrelationships of identity and technology in IT assimilation. <i>European Journal of Information Systems</i> , 23(1), pp.51–68.	1	1	1	1
N56	Lee, C.S. & Watson-Manheim, M.B., 2014. Perceived Risks and Ict Use. <i>The Journal of Computer Information Systems</i> , 54(2), pp.16–24.	1	1	1	1
N57	Liu, X. et al., 2014. Harnessing global expertise: A comparative study of expertise profiling methods for online communities. <i>Information Systems Frontiers</i> , 16(4), pp.715–727.	1	1	1	1

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N59	McBride, N.K., 2014. ACTIVE ethics: an information systems ethics for the internet age. <i>Journal of Information, Communication & Ethics in Society</i> , 12(1), pp.21–44.	1	1	1	0
N60	Michel, A., 2014. The Mutual Constitution of Persons and Organizations: An Ontological Perspective on Organizational Change. <i>Organization Science</i> , 25(4), pp.1082–1110.	1	1	1	1
N61	Mifsud, L., 2014. Mobile learning and the socio-materiality of classroom practices. <i>Learning, Media & Technology</i> , 39(1), pp.142–149.	0	0	/	/
N62	Mingers, J. & Willcocks, L., 2014. An integrative semiotic framework for information systems: The social, personal and material worlds. <i>Information & Organization</i> , 24(1), pp.48–70.	1	1	0	0
N63	Monteiro, E., Pollock, N. & Williams, R., 2014. Innovation in Information Infrastructures: Introduction to the Special Issue. <i>Journal of the Association for Information Systems</i> , 15(4), p. I-X.	1	1	1	0
N64	Montenegro, L.M. & Bulgacov, S., 2014. Reflections on Actor-Network Theory, Governance Networks, and Strategic Outcomes. <i>Brazilian Administration Review</i> , 11(1), pp.107–124.	1	1	0	0
N67	Pina e Cunha, M., Clegg, S. & Rego, A., 2014. The ethical speaking of objects: ethics and the “object-ive” world of Khmer Rouge young comrades. <i>Journal of Political Power</i> , 7(1), pp.35–61.	0	0	/	0
N68	Polanska, D.V., 2014. Urban policy and the rise of gated housing in post-socialist Poland. <i>GeoJournal</i> , 79(4), pp.407–419.	0	1	1	1
N69	Reimers, K., Johnston, R.B. & Klein, S., 2014. An empirical evaluation of existing IS change theories for the case of IOIS evolution. <i>European Journal of Information Systems</i> , 23(4), pp.373–399.	1	1	1	1
N70	Revoll, G., 2014. El tren fantasma: arcs of sound and the acoustic spaces of landscape. <i>Transactions of the Institute of British Geographers</i> , 39(3), pp.333–344.	0	1	0	0
N71	Rice, J.L., 2014. An Urban Political Ecology of Climate Change Governance. <i>Geography Compass</i> , 8(6), pp.381–394.	0	0	/	/
N72	Riemer, K. & Johnston, R.B., 2014. Rethinking the place of the artefact in IS using Heidegger’s analysis of equipment. <i>European Journal of Information Systems</i> , 23(3), pp.273–288.	1	1	0	0

Table 14: Articles excluded from the literature review (cont.).

Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N73	Rosenkranz, C., Vranesic, H. & Holten, R., 2014. Boundary Interactions and Motors of Change in Requirements Elicitation: A Dynamic Perspective on Knowledge Sharing. <i>Journal of the Association for Information Systems</i> , 15(6), pp.306–345.	1	1	1	1
N74	Ross, S.L., 2014. What is ambiguous about ambiguous goods? <i>Journal of Consumer Behaviour</i> , 13(2). Available at: http://search.proquest.com/docview/1511608596/6B621C6ACBDF454CPQ/42?accountid=14570 [Accessed September 4, 2014].	0	1	0	0
N75	Rowe, F., 2014. What literature review is not: diversity, boundaries and recommendations. <i>European Journal of Information Systems</i> , 23(3), pp.241–255.	1	1	1	0
N78	Shove, E., Walker, G. & Brown, S., 2014. Material culture, room temperature and the social organisation of thermal energy. <i>Journal of Material Culture</i> , 19(2), pp.113–124.	1	1	1	1
N79	Simpson, A.V., Clegg, S. & Pitsis, T., 2014. Normal Compassion: A Framework for Compassionate Decision Making. <i>Journal of Business Ethics</i> , 119(4), pp.473–491.	1	1	1	1
N80	Smets, M. et al., 2014. Charting new territory for organizational ethnography: Insights from a team-based video ethnography. <i>Journal of Organizational Ethnography</i> , 3(1), pp.10–26.	1	1	1	1
N82	Strong, D.M. et al., 2014. A Theory of Organization-EHR Affordance Actualization. <i>Journal of the Association for Information Systems</i> , 15(2), pp.53–85.	1	1	1	1
N83	Taylor, J.R. & Lovell, S.T., 2014. Urban home food gardens in the Global North: research traditions and future directions. <i>Agriculture and Human Values</i> , 31(2), pp.285–305.	0	1	0	0
N84	Thompson, M., 2014. Similarity and difference: The shared ontology and diverse epistemologies of practice theory. <i>Ephemera</i> , 14(2), pp.289–295.	1	1	1	0
N85	Valente, F.J., Dredge, D. & Lohmann, G., 2014. Leadership capacity in two Brazilian regional tourism organisations. <i>Tourism Review of AIAEST - International Association of Scientific Experts in Tourism</i> , 69(1), pp.10–24.	1	1	1	1
N87	Vogel, E. & Mol, A., 2014. Enjoy your food: on losing weight and taking pleasure. <i>Sociology of Health & Illness</i> , 36(2), pp.305–317.	0	0	/	/

Table 14: Articles excluded from the literature review (cont.).

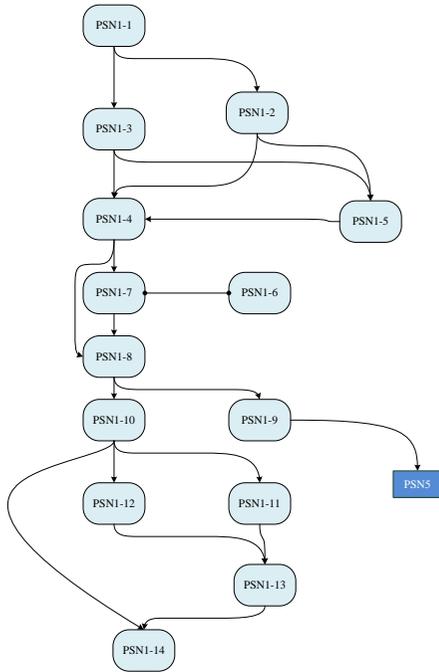
Identifier	Reference / citation	Relevant field of research	Full text available	Passing mention	Empirical study
N88	Vogel, E. & Mol, A., 2014. Enjoy your food: on losing weight and taking pleasure. <i>Sociology of Health and Illness</i> , 36(2), pp.305–317.	0	1	1	1
N89	Wakunuma, K.J. & Stahl, B.C., 2014. Tomorrow's ethics and today's response: An investigation into the ways information systems professionals perceive and address emerging ethical issues. <i>Information Systems Frontiers</i> , 16(3), pp.383–397.	1	1	1	0
N90	Zaharia, C. & Zaharia, I., 2014. The Greening of Consumer Culture. <i>Economics, Management and Financial Markets</i> , 9(1), pp.136–141.	0	1	1	0

Table 14: Articles excluded from the literature review (cont.).

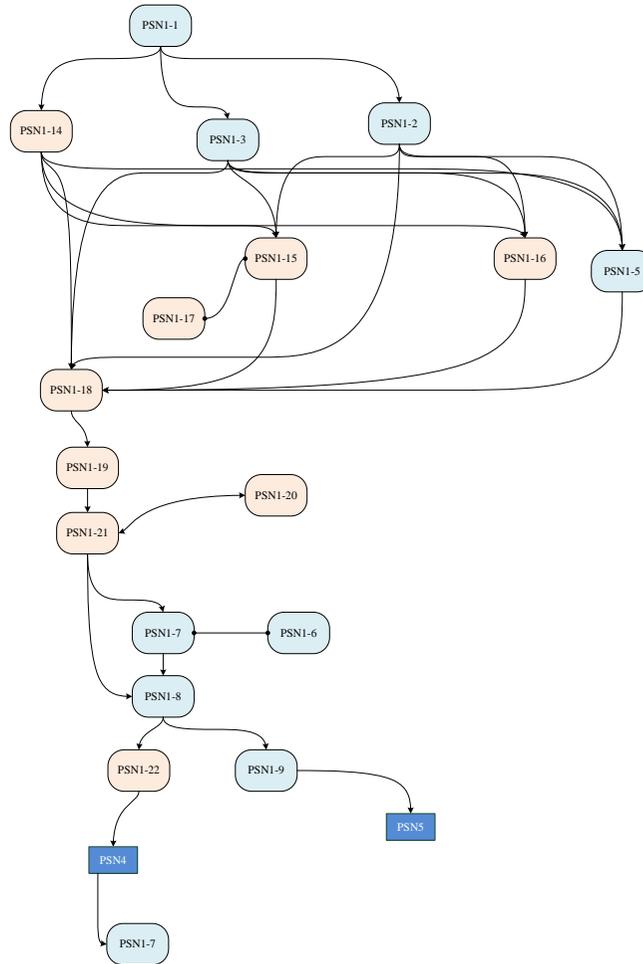
Appendix C: Narrative networks

The following figures show the Narrative Networks of the routines discussed above for the three waves. Blue rectangles represent fragments existing from Wave 1 on, light orange rectangles represent fragments included in Wave 2 and, orange rectangles represent fragments included in Wave 3. The descriptions of the fragments for each routine are presented on the page following the figure related to the respective routine.

Wave 1



Wave 2



Wave 3

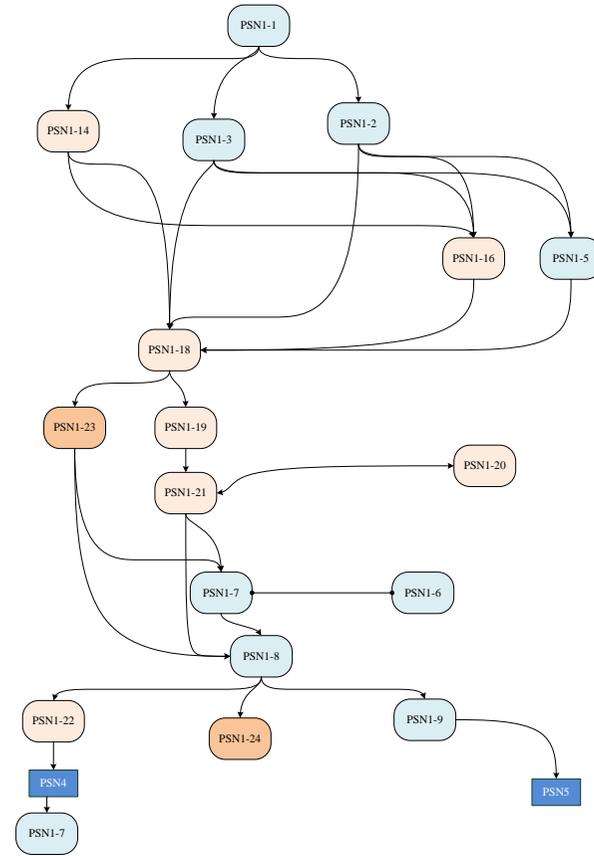
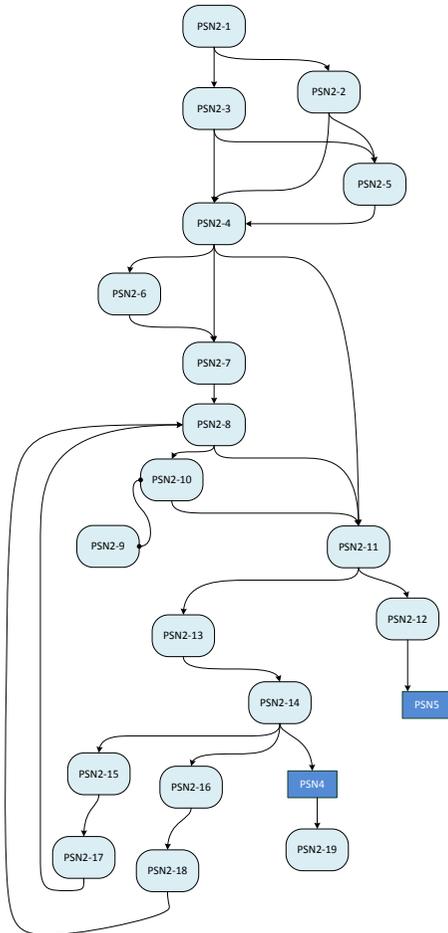


Figure 23: Narrative Networks of routine PSN1

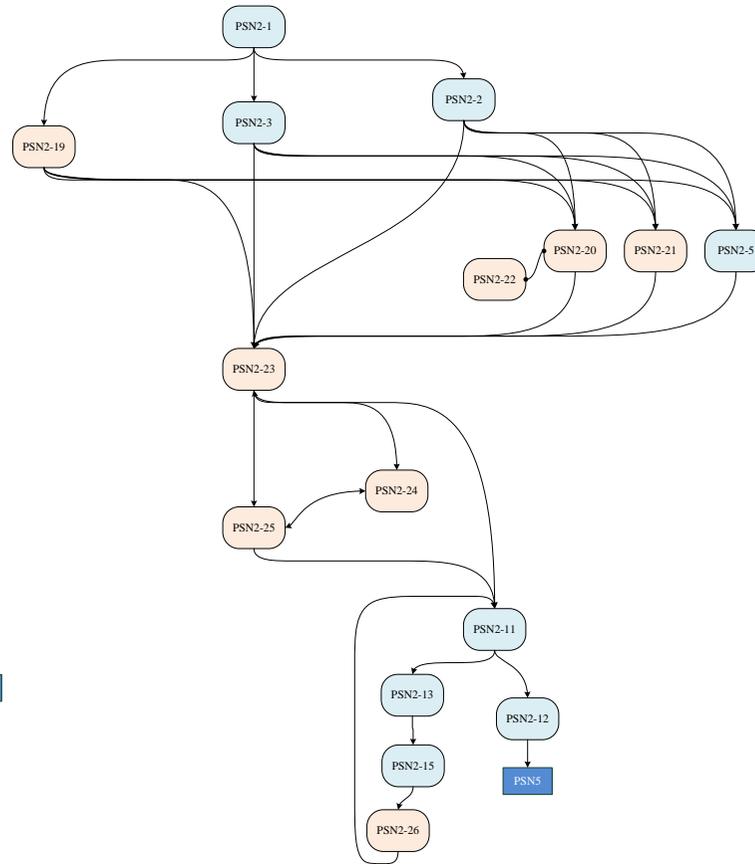
Identifier	Description
PSN1-1	PSN employee consults workflow system
PSN1-2	PSN employee selects requests with process number he/she can handle in workflow system
PSN1-3	PSN employee access currently oldest request in workflow system list
PSN1-4	PSN employee checks data automatically transferred into OLMS system from credit manager
PSN1-5	PSN employee consults process description
PSN1-6	PSN employee creates letter/email using mailing module in workflow system
PSN1-7	PSN employee creates cover letter and sends contract to customer
PSN1-8	PSN employee adds note to request in workflow system
PSN1-9	PSN employee sets status of request in workflow system to "repair"
PSN1-10	PSN employee sets request status in workflow system to "complete"
PSN1-11	PSN employee puts case to tickler file
PSN1-12	PSN employee sets reminder for request in workflow system
PSN1-13	PSN employee corrects data in OLMS after opening the account the day before
PSN1-14	PSN employee sends contract to customer
PSN1-14	PSN employee filters workflow system list for urgent requests
PSN1-15	PSN employee consults LMS teaching cases
PSN1-16	PSN employee consults email folders for process changes
PSN1-17	PSN employee works with LMS teaching cases
PSN1-18	PSN employee checks data automatically transferred into LMS system from credit manager
PSN1-19	PSN employee switches from credit manager to LMS
PSN1-20	PSN employee asks colleague for help
PSN1-21	PSN employee enters new payment mandate data into LMS
PSN1-22	PSN employee sets request status in workflow system to "approval required"
PSN1-23	PSN employee finishes checking LMS data
PSN1-24	PSN employee sets request status in workflow system to "complete"

Table 15: Fragments of routine PSN1

Wave 1



Wave 2



Wave 3

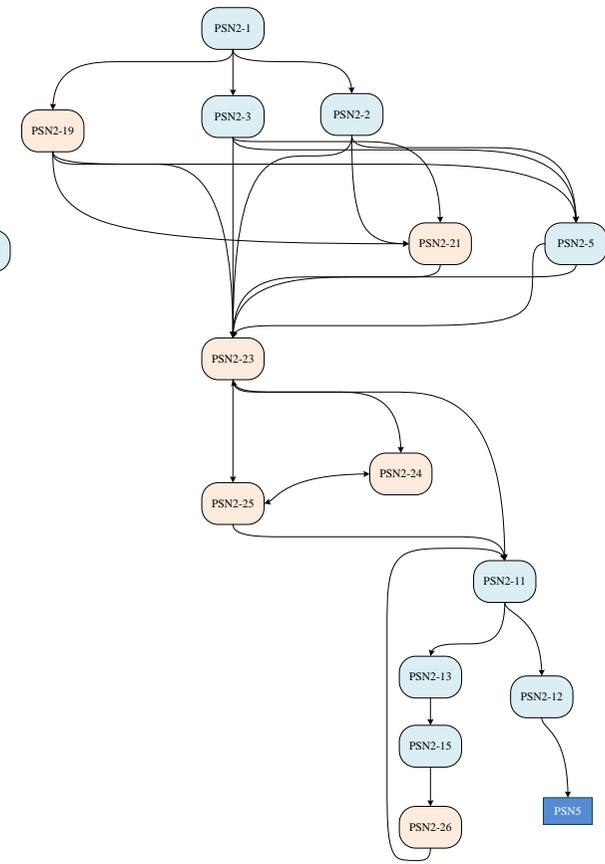
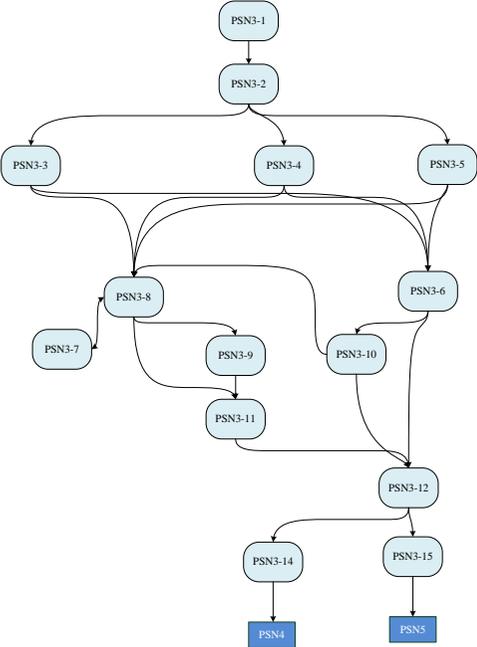


Figure 24: Narrative Networks of routine PSN2

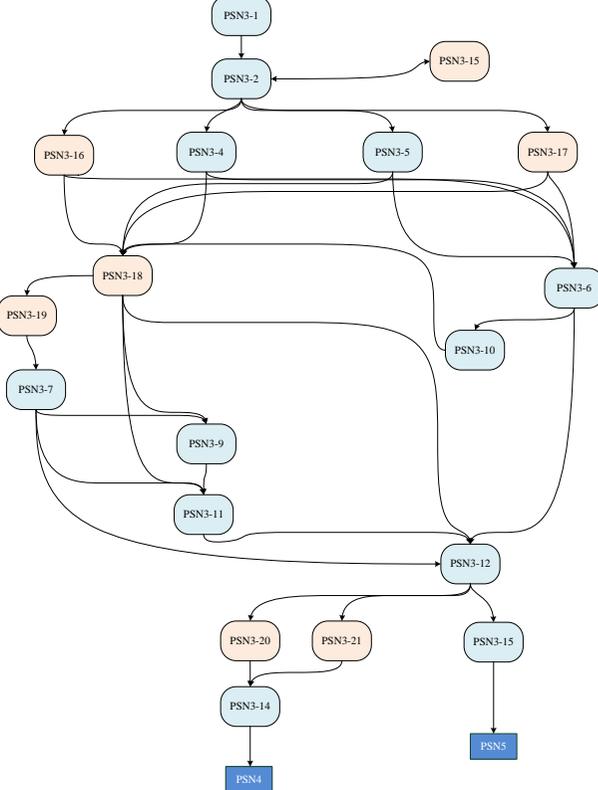
Identifier	Description
PSN2-1	PSN employee consults workflow system
PSN2-2	PSN employee selects requests with process number s/he can handle from the workflow system
PSN2-3	PSN employee access currently oldest request in the workflow system list
PSN2-4	PSN employee consults OLMS system
PSN2-5	PSN employee consults process management system for process description
PSN2-6	PSN employee takes note on sheet of paper to facilitate transfer of data from one contract to another
PSN2-7	PSN employee enters new contract data into OLMS system
PSN2-8	PSN employee prints change summary in OLMS system for approval
PSN2-9	PSN employee creates letter/email using a specific module of the workflow system
PSN2-10	PSN employee creates cover letter and sends contract to customer
PSN2-11	PSN employee adds note to request in workflow system
PSN2-12	PSN employee sets status of request in the workflow system to "repair"
PSN2-14	PSN employee puts change summary printout to approval basket
PSN2-15	PSN employee sets reminder for request in the workflow system
PSN2-16	PSN employee puts case to tickler file
PSN2-17	PSN employee enters additional data in OLMS later
PSN2-18	PSN employee corrects data in OLMS after opening the account the day before
PSN2-19	PSN employee sends contract to customer
PSN2-19	PSN employee filters the workflow system list for urgent requests
PSN2-20	PSN employee consults LMS teaching cases
PSN2-21	PSN employee consults email folders for process changes
PSN2-22	PSN employee works with LMS teaching cases
PSN2-23	PSN employee enters new payment mandate data into LMS
PSN2-24	PSN employee asks colleague for help
PSN2-25	PSN employee enters new contract data into LMS system
PSN2-26	PSN employee enters additional data in LMS later

Table 16: Fragments of routine PSN2

Wave 1



Wave 2



Wave 3

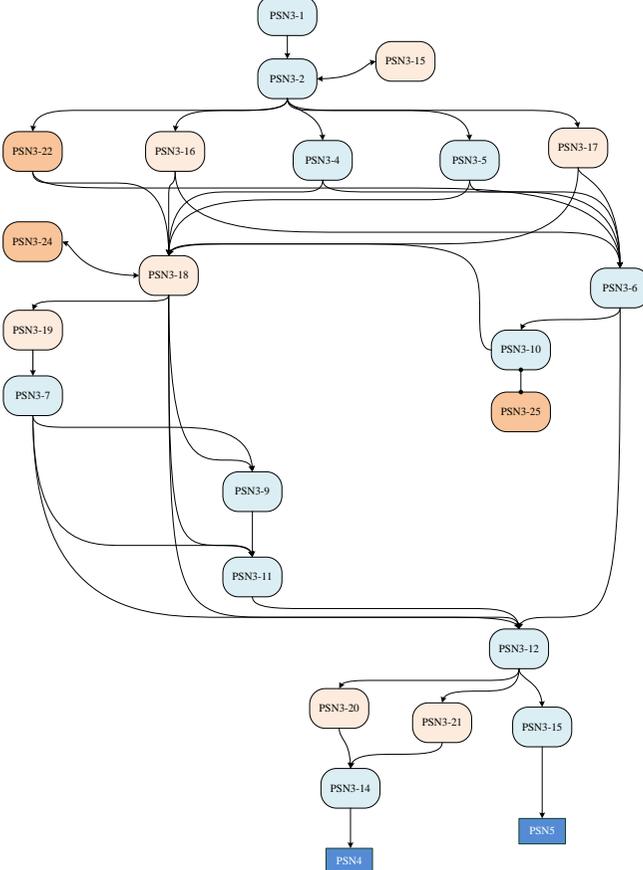
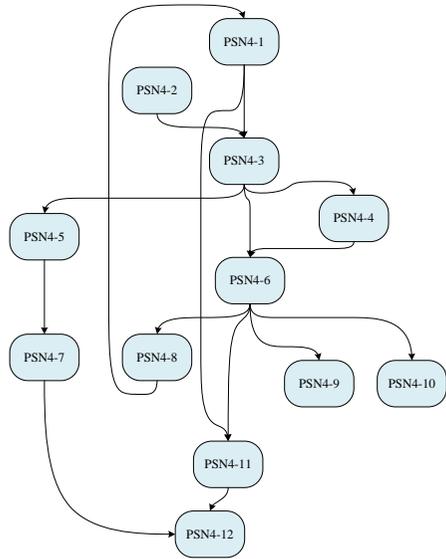


Figure 25: Narrative Networks of routine PSN3

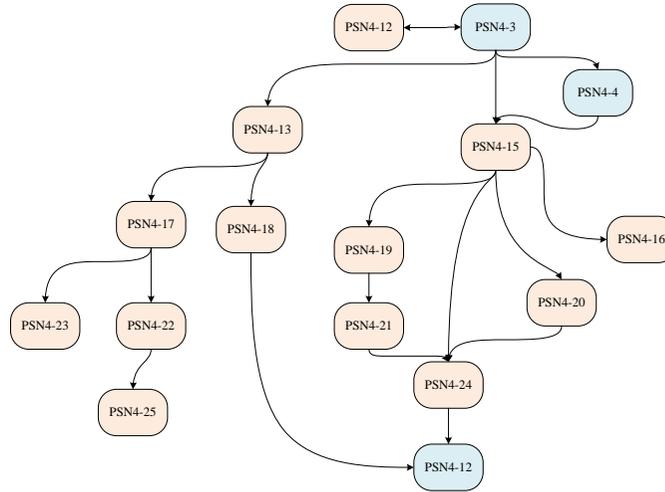
Identifier	Description
PSN3-1	PSN employee consults the workflow system
PSN3-2	PSN employee access currently oldest request in the workflow system list
PSN3-3	PSN employee uses OLMS to calculate redemption value
PSN3-4	PSN employee checks collateral security system
PSN3-5	PSN employee checks electronic contract documents
PSN3-6	PSN employee discovers problem with contract
PSN3-7	PSN employee enters payment in OLMS
PSN3-8	PSN employee enters new payment data into OLMS system
PSN3-9	PSN employee creates letter related to payment request
PSN3-10	PSN employee contacts sales to clarify issue with request
PSN3-11	PSN employee prints payment document
PSN3-12	PSN employee adds note to request in the workflow system
PSN3-13	PSN employee puts payment document to approval basket
PSN3-14	PSN employee sets request status in the workflow system to "approval required"
PSN3-15	PSN employee sets status of request in the workflow system to "repair"
PSN3-16	PSN employee consults OLMS to get account or check if it is available
PSN3-17	PSN employee checks and (if required) changes migrated data
PSN3-18	PSN employee enters new payment data into LMS system
PSN3-19	PSN employee writes vales for payment on sheet of paper to facilitate work with different systems
PSN3-20	PSN employee enters date of future payment into an unused field of the workflow system
PSN3-21	PSN employee enters into an unused field of the workflow system that request paper-based
PSN3-22	PSN employee manually calculates redemption value
PSN3-23	PSN employee checks contract data in LMS system
PSN3-24	PSN employee asks colleague to approve intermediary step
PSN3-25	PSN employee sends email to sales in case of problems with payments

Table 17: Fragments of routine PSN3

Wave 1



Wave 2



Wave 3

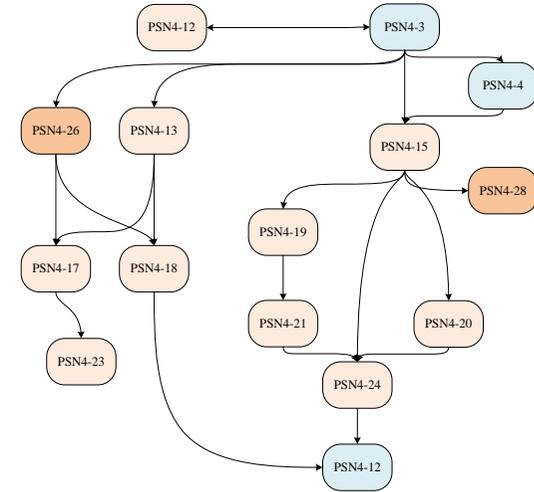


Figure 26: Narrative Networks of routine PSN4

Identifier	Description
PSN4-1	PSN employee gets payment letter for approval
PSN4-2	PSN employee takes requests from approval basket
PSN4-3	PSN employee consults approval list in the workflow system
PSN4-4	PSN employee checks electronic contract documents
PSN4-5	PSN employee checks contract data in OLMS system
PSN4-6	PSN employee checks payment data in OLMS system
PSN4-7	PSN employee approves contract data in OLMS
PSN4-8	PSN employee puts post it to payment letter, if the payment is to be send out later (payments entered in advance)
PSN4-9	PSN employee marks errors found during approval on printout
PSN4-10	PSN employee notes customer number on sheet of paper if error was found during approval
PSN4-11	PSN employee approves payment data in OLMS system
PSN4-12	PSN employee sets request status in the workflow system to "approved"
PSN4-12	PSN employee checks date of future payment in the workflow system
PSN4-13	PSN employee checks contract data in LMS system
PSN4-15	PSN employee checks payment data in LMS system
PSN4-16	PSN employee finds error while approving LMS data and gives feedback to colleague
PSN4-17	PSN employee finds error while approving LMS data
PSN4-18	PSN employee approves contract data in LMS
PSN4-19	PSN employee writes vales for payment on sheet of paper to facilitate work with different systems
PSN4-20	PSN employee calls/sends email to colleague to speed up approval of contract
PSN4-21	PSN employee checks payment in OLMS
PSN4-22	PSN employee takes screenshot of LMS to mark error and explain it to colleague
PSN4-23	PSN employee gives feedback to colleague using workflow system notes
PSN4-24	PSN employee approves payment data in LMS system
PSN4-25	PSN employee discusses (potential) errors with colleagues
PSN4-26	PSN employee consults change history in LMS system
PSN4-28	PSN employee finds error while approving LMS data and gives feedback to colleague

Table 18: Fragments of routine PSN4

Waves 1-3

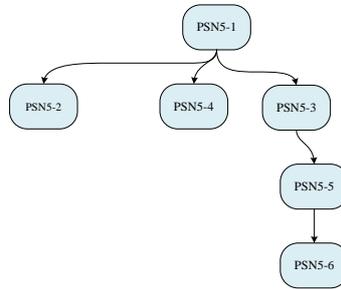
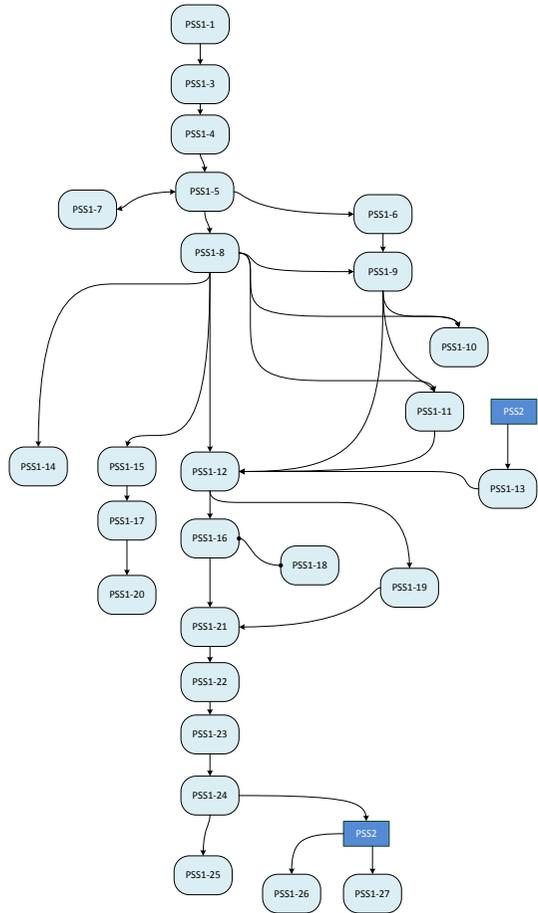


Figure 27: Narrative Network of routine PSN5

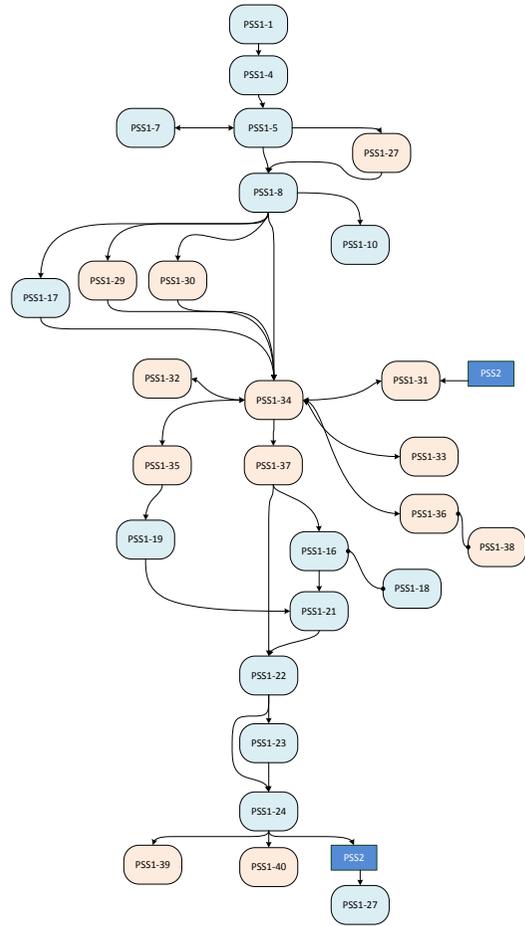
Identifier	Description
PSN5-1	PSN employee consults repair list in the workflow system
PSN5-2	PSN employee marks request as "non-standard task"
PSN5-3	PSN employee requests original documents
PSN5-4	PSN employee calls sales to clarify issue with request
PSN5-5	PSN employee uses specific module in the workflow system to contact sales and request missing information/documents/signature
PSN5-6	PSN employee sends contract back to sales

Table 19: Fragments of routine PSN5

Wave 1



Wave 2



Wave 3

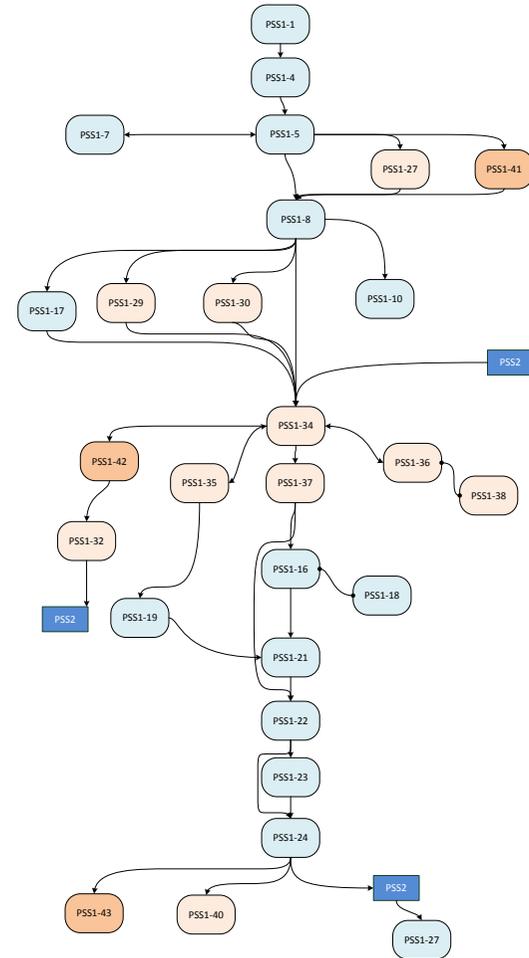


Figure 28: Narrative Networks of routine PSS1

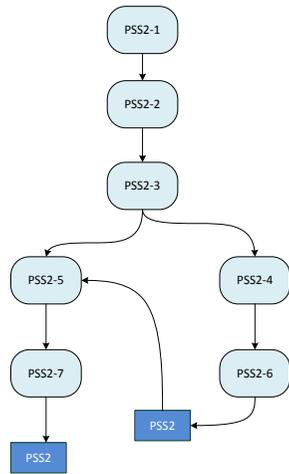
Identifier	Description
PSS1-1	PSS employee starts computer and opens all required systems
PSS1-3	PSS employee consults tickler/reminder file every morning
PSS1-4	PSS employee consults the workflow system
PSS1-5	PSS employee access currently oldest request in the workflow system list
PSS1-6	PSS employee consults Adonis for process description
PSS1-7	PSS employee identifies high priority requests based on process numbers in the workflow system
PSS1-8	PSS employee checks request documents for completeness
PSS1-9	PSS employee discusses problems with request with team lead
PSS1-10	PSS employee returns request to SSG because of missing data
PSS1-11	PSS employee contacts sales to clarify issue
PSS1-12	PSS employee makes changes in OLMS system
PSS1-13	PSS employee returns request with errors to colleague
PSS1-14	PSS employee makes changes in OLMS system without approval
PSS1-15	PSS employee makes calculations using OLMS and other tools
PSS1-16	PSS employee creates letter for customer
PSS1-17	PSS employee uses calculator to calculate redemption
PSS1-18	PSS employee creates email to sales using specific module in the workflow system
PSS1-19	PSS employee prints screenshots for approval and documentation
PSS1-20	PSS employee sends email to collateral securities team with redemption value
PSS1-21	PSS employee makes printouts related to request
PSS1-22	PSS employee adds note to request in the workflow system
PSS1-23	PSS employee puts printouts related to request to approval basket
PSS1-24	PSS employee sets request status in the workflow system to "approval required"
PSS1-25	PSS employee uses tickler/reminder file to as reminder to check success of changes in OLMS
PSS1-26	PSS employee uses tickler/reminder file to organize work divided over several days
PSS1-27	PSS employee sends letters to customer
PSS1-27	PSS employee consults job instructions
PSS1-29	PSS employee uses Excel tool to calculate interest rate
PSS1-30	PSS employee logs in into different mode for specific customers
PSS1-31	PSS employee discusses mistake with colleague
PSS1-32	PSS employee asks colleague to approve intermediary step
PSS1-33	PSS employee asks colleague / change agent for support
PSS1-34	PSS employee makes changes in LMS system
PSS1-35	PSS employee makes changes in OLMS system
PSS1-36	PSS employee takes note on sheet of paper to facilitate transfer/comparison of data
PSS1-37	PSS employee checks cash flow simulation before saving entered data

Table 20: Fragments of routine PSS1

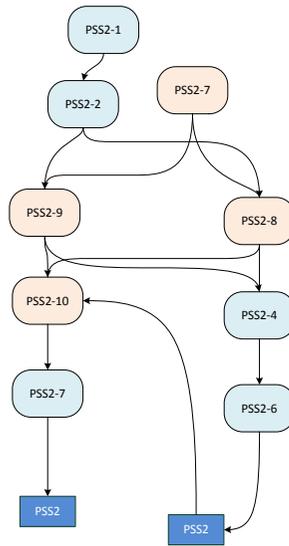
Identifier	Description
PSS1-38	PSS employee uses additional LMS modus to facilitate transfer/comparison of data
PSS1-39	PSS employee uses team tickler file to schedule tasks in case of problems related to frozen zone
PSS1-40	PSS employee uses tickler/reminder file to as reminder to check success of changes in LMS
PSS1-41	PSS employee consults process management system for process description
PSS1-42	PSS employee uses paper-based list for coordination of approvals
PSS1-43	PSS employee uses team tickler file to schedule tasks in case of problems related to frozen zone

Table 20: Fragments of routine PSS1 (cont.)

Wave 1



Wave 2



Wave 3

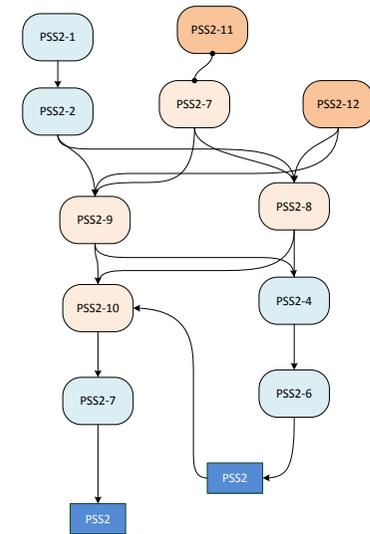
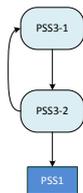


Figure 29: Narrative Networks of routine PSS2

Identifier	Description
PSS2-1	PSS employee checks approval basket and if full retrieves request printouts
PSS2-2	PSS employee consults approval list in the workflow system using information on request printouts
PSS2-3	PSS employee checks data/changes in OLMS system
PSS2-4	PSS employee finds mistake while approving request
PSS2-5	PSS employee approves data/changes in OLMS system
PSS2-6	PSS employee discusses mistake with colleague
PSS2-7	PSS employee returns printouts to colleague
PSS2-7	PSS employee consults approval list in the workflow system for new requests
PSS2-8	PSS employee checks change history in CML
PSS2-9	PSS employee checks data/changes in CML system
PSS2-10	PSS employee approves data/changes in CML system
PSS2-11	PSS employee consults the workflow system for approvals
PSS2-12	PSS employee uses paper-based list for coordination of approvals

Table 21: Fragments of routine PSS2

Wave 1



Waves 1 and 3

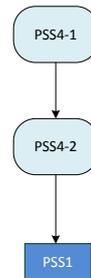
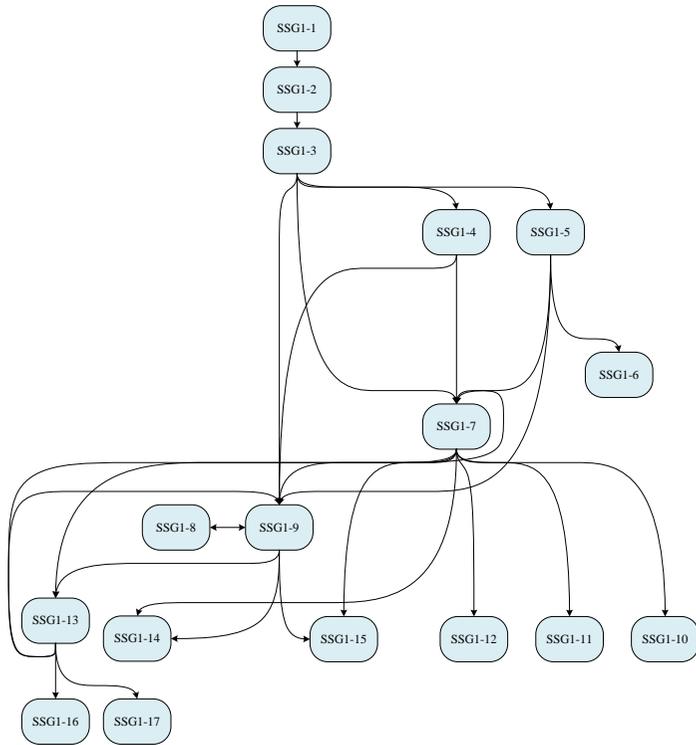


Figure 30: Narrative Networks of routines PSS3 and PSS4

Identifier	Description
PSS3-1	PSS employee prints error info lists received by email
PSS3-2	PSS employee enters item from error info list into the workflow system and starts case
PSS4-1	PSS employee checks general account
PSS4-2	PSS employee enters task into the workflow system and starts case

Table 22: Fragments of routines PSS3 and PSS4

Wave 1



Wave 2

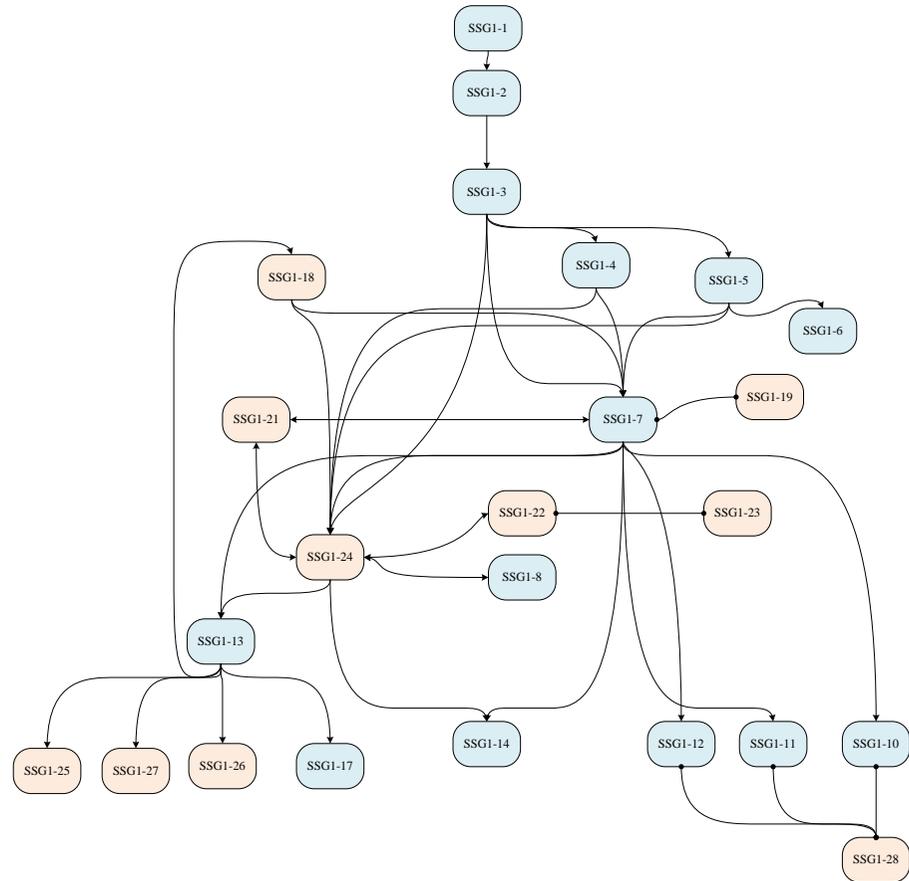


Figure 31: Narrative Networks of routine SSG1 (Waves 1 and 2)

Wave 3

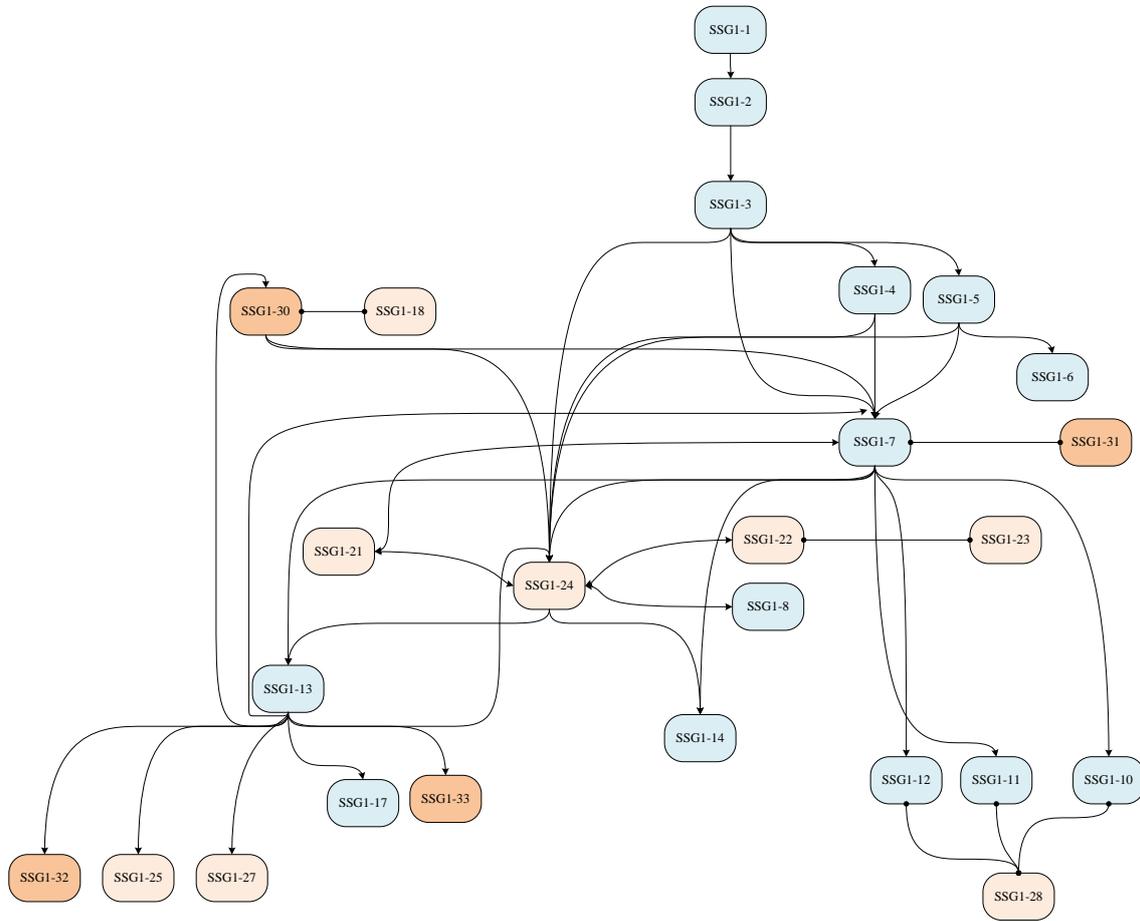


Figure 32: Narrative Networks of routine SSG1 (Wave 3)

Identifier	Description
SSG1-1	External contact calls SSG employee
SSG1-2	Call center telephone system selects next free SSG employee
SSG1-3	SSG employee answers call
SSG1-4	SSG employee uses paper notes to capture content of telephone call
SSG1-5	SSG employee notes customer number on sheet of paper when called
SSG1-6	SSG employee retrieves information from card box
SSG1-7	SSG employee consults the workflow system
SSG1-8	SSG employee starts inquiry using different systems
SSG1-9	SSG employee queries OLMS system
SSG1-10	SSG employee sends email to production employee to speed up handling of urgent request
SSG1-11	SSG employee call production employee to speed up handling of urgent request
SSG1-12	SSG employee contacts production via the workflow system to speed up handling of urgent request
SSG1-13	SSG Employee ends call
SSG1-14	SSG employee sends email to production to clarify issue
SSG1-15	SSG employee call production employee to clarify issue
SSG1-16	SSG employee repairs request in OLMS
SSG1-17	SSG employee enters telephone request into the workflow system
SSG1-18	SSG employee logs out of telephone system to finish handling complex request
SSG1-19	SSG employee consults the workflow system for amount of tasks in production lists
SSG1-20	SSG employee tells colleague about solution (related to LMS)
SSG1-21	SSG employee asks colleague/change agent for support
SSG1-22	SSG employee consults system that sales uses for accessing LMS data
SSG1-23	SSG employee consults system that sales uses for accessing LMS data to explain issue to sales colleague
SSG1-24	SSG employee queries LMS system
SSG1-25	SSG employee collects questions and call back notes
SSG1-26	SSG employee repairs urgent request in LMS system
SSG1-27	SSG employee contacts production via the workflow system to trigger repairing of request
SSG1-28	SSG employee informs PSN or PSS about urgent tasks
SSG1-29	SSG employee keeps sales person on phone until task completed
SSG1-30	SSG employee logs out of telephone system to finish handling current request
SSG1-31	SSG employee consults the workflow system for amount of tasks in production lists
SSG1-32	SSG employee repairs urgent request in LMS system
SSG1-33	SSG employee sends task to LMS team

Table 23: Fragments of routine SSG1

Wave 1

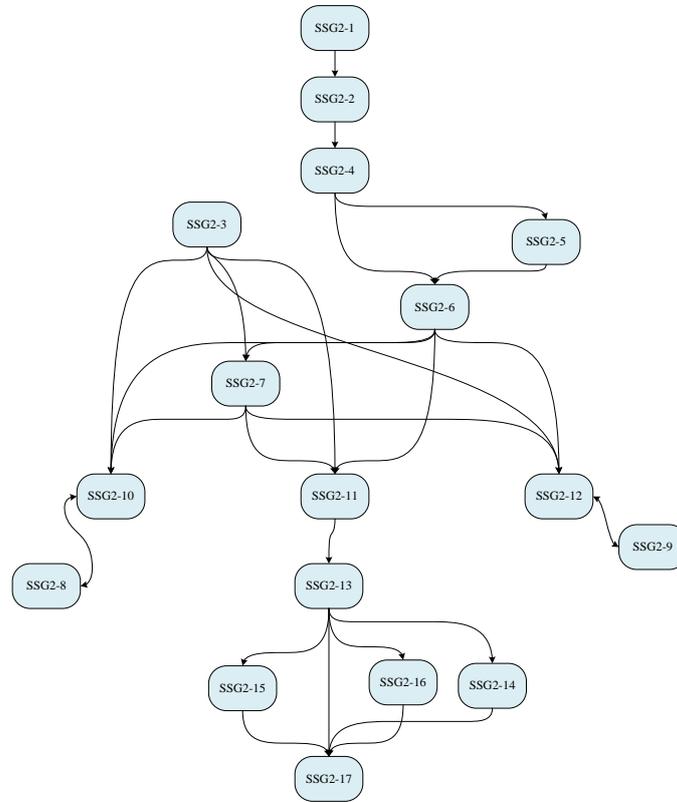


Figure 33: Narrative Network of routine SSG2

Identifier	Description
SSG2-1	Other contacts send letters that are transferred to the workflow system
SSG2-2	SSG employee consults the workflow system
SSG2-3	SSG employee works on tasks in tickler file/stack
SSG2-4	SSG employee filters the workflow system list for own regions
SSG2-5	SSG employee logs out of telephone system to work on urgent requests
SSG2-6	SSG employee access currently oldest request in the workflow system list
SSG2-7	SSG employee prints texts to organize non-standard tasks around telephone call interruptions
SSG2-8	SSG employee prints screenshots to enable transfer of data from one contract to another
SSG2-9	SSG employee uses own templates for email requests
SSG2-10	SSG employee enters non-standard requests into OLMS
SSG2-11	SSG employee works on requests in the workflow system list
SSG2-12	SSG employee creates letter for external contact
SSG2-13	SSG employee queries OLMS system
SSG2-14	SSG employee sends email to PSN or PSS to clarify issue
SSG2-15	SSG employee contacts sales employee to clarify issue
SSG2-16	SSG employee calls PSN or PSS employee to clarify issue
SSG2-17	SSG employee repairs request in OLMS

Table 24: Fragments of routine SSG2

Appendix D: Empirical Data

The empirical data collected in this doctoral thesis have been uploaded at the Mannheim Research Data Repository (MADATA).

The uploaded data set includes the interview guidelines and transcripts related to the three waves of the interpretive case study presented above. The documents can be accessed using the following link:

<https://madata.bib.uni-mannheim.de/id/eprint/118>

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