Change of Organizational Routines under Malleable Information Technology: Explaining Variations in Momentum

Completed Research Paper

Tim Lehrig
University of Bern
Engehaldenstr. 8
3012 Bern, Switzerland
tim.lehrig@iwi.unibe.ch

Oliver Krancher
IT University of Copenhagen
Rued Langgaards Vej 7
2300 Copenhagen S, Denmark
olik@itu.dk

Abstract

Malleable technology bears the promise of allowing users to flexibly change organizational routines. Although the benefits from malleable technology depend on the extent to which users make use of such technology to change organizational routines, we know little about the factors that shape the intensity of routine change. We report the results of a case study in which we analyzed changes of 24 routines under malleable technology over a period of three years. Our results show that actors often perform a series of consecutive changes rather than one discrete change. We build on the concept of momentum to describe the intensity of these changes. Our emergent theory suggests that momentum is affected by the embeddedness of routines, by existing artefacts, by lead actor traits, and by external knowledge. Our study contributes to theory of routine change by developing explanations for variations in momentum of routine change under malleable technology.

Keywords: Momentum, Organizational Routines, Artefacts, IT-enabled Change, Malleable IT

Introduction

The relationship between organizational routines and information technology (IT) has always been of key interest to information systems and organizational scholars alike (e.g. Becker 2004; D'Adderio 2011; Edmondson et al. 2001). Recently, attention has focused on the change of routines that is enabled by IT (e.g. Berente et al. 2016; Goh et al. 2011; Leonardi 2011; Polites and Karahanna 2013). Theory of IT-enabled routine change has become of increasing practical relevance given the increasing diffusion of *malleable IT*, i.e., IT that users can modify on their own (Kallinikos et al. 2013; Richter and Riemer 2013; Schmitz et al. 2016). Malleable IT bears the promise of allowing actors to flexibly change artefacts and the routines supported by the artefacts. Yet, this puts a high burden on actors. Since routines are patterns of interdependent work that involves multiple actors (Feldman and Pentland 2003), actors may typically need to perform a series of consecutive changes to the routine and to artefacts until they arrive at a new version of the routine that satisfies all involved actors' needs and that leverages the potential offered by the malleable IT. In this paper, we explore such series of consecutive changes, aiming to explain why they occur with different intensity under different conditions.

The literature on routines and artefacts provides some insights into IT-enabled change of routines, focusing on the nature of change, the role of artefacts, and the factors that affect the intensity of change. The routine literature suggests that routines change due to exogenous events, such as when a new technology becomes available (Edmondson et al. 2001), and due to endogenous dynamics, such as when actors learn from past performances of the routine and strive to do better (Feldman 2000; Feldman and Pentland 2003). Artefacts play an important role in both types of change. Artefacts may be a source of exogenous change when they afford new ways of performing the routine (Leonardi 2011). But artefacts also shape endogenous change, such as when the tight entanglement of artefacts and the routine makes it more difficult for actors to change the routine, or when the use of the artefact yields outcomes (e.g. learning) that subsequently enable new ways of performing the routine with the artefact (D'Adderio 2011; Goh et al. 2011; Leonardi 2011). Indeed, studies of technology-enabled change show that the availability of a new artefact is often followed by a long process in which actors perform a series of consecutive changes to routines and to artefacts, emphasizing the key role of endogenous change (e.g. Boudreau and Robey 2005; Goh et al. 2011; Leonardi 2011; Orlikowski 1996; Volkoff et al. 2007). While much research focusses on the nature of change and the role of artefacts, a few studies have turned their attention to the intensity of change. Jansen (2004) examined the *momentum of change*, loosely defined as the energy or force associated with a change (p. 277). She found that momentum depended both on top-down sources, in particular the change leader's commitment, and on bottom-up sources, in particular social interaction through which individuals gain support from other individuals. Other work did not use the term momentum but also examined factors that affect the intensity of routine change. These factors include actor characteristics, such as innovativeness (Goh et al. 2011), intention, and orientation (Howard-Grenville 2005), and characteristics of the routine, in particular its embeddedness (Howard-Grenville 2005). Embeddedness, defined as the degree to which the routine overlaps with other organizational structures (Howard-Grenville 2005), is argued to constrain change.

While these studies have yielded important insights into routine change and the role of IT, our knowledge about the routine change associated with malleable IT is limited in three important regards. First, there is little research on the momentum of routine change under malleable IT. Although the work on momentum by Jansen (2004) is potentially informative, her study focused on organizational-level strategic change. In contrast to such a rather macro-level focus, it is likely that routine change enabled by malleable IT is characterized by a stronger focus on micro-level, bottom-up processes in which the actors involved in the routine initiate changes to the routine and to the technology. Second, although the routine literature emphasizes embeddedness as a factor that influences momentum (Howard-Grenville 2005), the literature concentrates on strongly embedded routines, such as consulting routines in hospitals (Goh et al. 2011) and procurement routines (Berente et al. 2016). Strongly embedded routines often involve individuals from many departments and are, hence, relatively inert. Yet, many routines that are suitable for malleable IT are weakly embedded, such as the coordinated organization of documents or tracking of open issues. Third, the literature remains silent about the role of pre-existing artefacts. Nowadays, many routines are already supported by some type of IT artefact. Yet, many studies focus on situations in which organizations replace existing artefacts by completely new ones (e.g. Berente et al. 2016; Edmondson et al. 2001; Goh et al. 2011). Such disruptive changes naturally generate momentum given that actors have to find ways to perform the routine without their previous artefacts. However, in the case of malleable IT, actors can often incorporate existing artefacts into new versions of a routine, such that the new routine relies on both the malleable IT and the existing artefact. Given these three gaps, it is unclear what affects the momentum of routine change under malleable IT. This lack of knowledge is unfortunate given that malleable IT will often require a series of consecutive changes from actors (e.g. changes to the configuration of the malleable IT, changes of the routine) before the actors fully leverage the potential offered by the malleable IT. Without sufficient momentum, these change processes become stuck or may not even start. Knowledge about the factors that influence momentum is thus important if organizations wish to fully leverage the potential for improving organizational routines that is offered by malleable IT.

Our study addresses the following research question: *Why does the momentum of routine change associated with malleable IT vary between routines?* To answer this question, we conducted a case study in an organization that implemented Microsoft SharePoint (SP), a malleable IT product that invites configuration by end users and that aims at supporting interdependent work. Our primary data source were 59 interviews conducted with 14 users over a period of more than three years. We identified 24 routines and the changes to these routines and to the SP-based artefacts that the actors used in these routines. Based on these data, we identified four factors that affect momentum of routine change: embeddedness of routines, the relationship to existing artefacts, lead actors' personal traits, and external knowledge. We analyzed different combinations of these factors and identified five configurations of factors associated with particular levels of momentum. Our key contribution is an emerging theory of the momentum of IT-enabled routine change under malleable IT.

The remainder of this paper is organized as follows. We next review the literature on organizational routines and, in particular, on the role of artefacts in organizational routines. We then present our methods, findings, and our emerging theory before we discuss implications and contributions.

Related Literature

We base our research on the existing organizational routines literature. We next review the literature on organizational routines and their change. We then review the relationship between artefacts and organizational routines and their change.

Organizational Routines and Change

Organizational routines (in brief: routines) are defined as "repetitive patterns of interdependent organizational actions" (Parmigiani and Howard-Grenville 2011). Examples of routines include hiring people at a university (Feldman and Pentland 2003), conducting crash tests at an automaker (Leonardi 2011), and patrolling transit operations at a law enforcement organization (Glaser 2017).

Given that the concept of routines focusses on what organizations repeatedly do, it is not surprising that routines have a long lasting history in organizational research (Becker 2004). During this period, their conceptualization has advanced from being a source of stability (Cyert and March 1963; Nelson and Winter 1982) to being a source of stability and change (Feldman 2000; Feldman and Pentland 2003). In their seminal work, Feldman and Pentland conceptualize routines as generative systems and explain why routines endogenously change over time (Feldman and Pentland 2003). They argue that routines change because actors aim to "repair" problems in the routine, because actors strive to improve the routine, because actors improvise to cope with particular circumstances in particular executions of the routine, and because actors learn from past performances of the routine (Feldman 2000; Feldman and Pentland 2003).

Although the foundational work by Feldman and Pentland explains why routines can change, it does not aim to explain why the intensity of routine change varies. Important insights into the mechanisms that affect the intensity of routine change have come from Jansen's (2004) study of momentum in strategic change. She introduced the concept of *change-based momentum*, which describes "the energy associated with pursuing a new trajectory" (p. 277). Thus, high change-based momentum (or in short: high momentum) describes situations where strong forces are present to substantially transform the way how a routine is performed. Conversely, low momentum describes situations where the forces that aim to initiate changes to a routine are weak and, hence, at best minor changes to a routine materialize.

The concept of momentum is particularly promising in the context of IT-enabled routine change because IT implementation studies found that actors often perform a long series of changes to the routine and to the technology before they arrive at a satisfactory new version of the routine. This suggests that high momentum is often required to allow teams or organizations to leverage the full potential that a technology offers, because only high levels of energy will allow the actors to accomplish the long series of changes. Conversely, when momentum is low, attempts to improve a routine will become stuck at early stages or not even materialize. Explaining momentum is thus critical for explaining the impact associated with a technology.

Existing research provides some insights into factors that affect momentum (although not in the context of malleable IT). In her study, Jansen (2004) found that at early stages, momentum depended strongly on top-down sources, in particular the change leader's commitment, while at later stages bottom-up sources, in particular social interaction through which individuals gain support from other individuals, turned more important. Moreover, momentum was lower when the trajectory gap, defined as the distance of the current state and the goal state, was high. Other work did not use the term momentum but also examined factors that affect the intensity of routine change. Work on agency emphasizes the key role of actors and their characteristics (e.g. Feldman 2003; Leonardi 2011), while work on embeddedness emphasizes the nature of the particular routine (e.g. Howard-Grenville 2005; Polites and Karahanna 2013), as we will point out next.

A*gency*, is the "capacity for action" (Giddens 1984). More specifically, agency attributed to actors (or human agency), is a person's ability to form and realize own goals (Giddens 1984). By enacting their agency, actors can change routines. For example, a human resource (HR) representative may need to conduct an interview (*goal*) in a hiring routine. The standard way of performing the routine may be that the HR representative interviews the applicant in person. However, since this applicant lives abroad, an interview in person is not possible. Thus, the HR representative can enact her agency and alter the routine to conduct the interview in a video call. Researchers identified different personal traits of actors that are beneficial for enacting agency, such as the actor's innovativeness (Goh et al. 2011) or the actor's future orientation (Howard-Grenville 2005). Thus, we expect differences in change induced by personal traits of leading actors.

Embeddedness is the degree the routine overlaps with different organizational structures, including technology, control and coordination systems, and norms (Howard-Grenville 2005). For example, medical surgeries are routines of strong embeddedness since they are based on control and coordination structures that manifest in detailed plans how to conduct the surgery. Researchers see embeddedness as a hindering factor for routine change (Feldman 2003; Howard-Grenville 2005). In this paper, we focus on coordinative embeddedness, defined as "interdependence of action between multiple actors when accomplishing a complex task" (Howard-Grenville 2005, p. 630). Coordinative embeddedness (henceforth in brief: embeddedness) can constrain changes since changes require consensus among actors. Embeddedness increases the complexity of the consensus building process and, thus, sustains the status quo. The existing literature focusses predominantly on routines of strong embeddedness, such as consulting routines in hospitals (Goh et al. 2011) or procurement routines in governmental organizations (Berente et al. 2016). Routines with strong embeddedness display a low likelihood for change (Howard-Grenville 2005). Conversely, weakly embedded routines are less frequently examined in literature. For these routines, the momentum of change could be much higher since actors can overcome the low coordinative obstacles relatively easily and change the routines and related artefacts. Therefore, we expect higher momentum of change for weakly embedded routines. However, the influence of these factors under malleable IT remains empirically unexplored.

Artefacts and Organizational Routines

Artefacts are material objects produced by human activity (Pratt and Rafaeli 2006). They shape routines and their change (D'Adderio 2011). Artefacts can manifest in different forms such as in written instructions, physical settings, or software. We focus on digital artefacts, i.e., artefacts based on IT, which differ from other artefacts because they integrate deeply into routines (Volkoff et al. 2007). Thus, digital artefacts, like a form in a software, may have a stronger potential to shape routines than a pure instruction manual. The properties of digital artefacts (henceforth in brief: artefacts) depend on the underlying technology and its application, which includes how easily actors can modify the artefacts. For example, many users can modify a formula in a worksheet (*malleable IT*) but cannot update an SQL statement in a database of an Enterprise Resource Planning (ERP) system (*hard-to-change IT*). When users cannot perform their desired actions using hard-to change IT, they may invent workarounds (Boudreau and Robey 2005). Malleable IT, in contrast, bears the promise of allowing users to change the artefacts to their demands.

Artefacts shape routines by affording or constraining particular behaviors (D'Adderio 2011; Pentland and Feldman 2008). Actors can actualize affordances (i.e., action potentials) offered by the artefact and change the routine by using the artefact in a new way for the routine (Leonardi 2011). For example, actors can use notifications to receive e-mails on updates instead of frequently checking for updates of a document. However, actors can also ignore these potentials and leave them unused (Goh et al. 2011). Thus, the pure existence of affordances is not a sufficient condition for high momentum of routine change. Artefacts also shape routines by constraining behaviors. For example, a digital form can enforce predefined options for fields that limit the possible entries. Such configurations of artefacts are the result of the enactment of human agency. Thus, actors inscribe their views into the artefacts (D'Adderio 2011). The artefacts then possess their own agency, i.e., material agency, and possess capacity to act on their own (Leonardi 2011). This transition from human to material agency may be paralleled by struggles among competing views among actors (D'Adderio 2011). Thus, actors use the artefact to resolve struggles among them by inscribing logic into the artefact. These struggles may fuel momentum of change.

Over time, artefacts can become the result of repeated inscriptions. Although the agency still is distributed (D'Adderio 2011) or imbricated (Leonardi 2011) between actors and artefacts, it is likely that the material agency steadily increases. Thus, over time, more and more of the logic that underlies the routine is inscribed in the artefact (Volkoff et al. 2007). Similar to coordinative embeddedness, the increasing inscription of logic into artefacts makes future changes more difficult and, hence, less likely (Howard-Grenville 2005). This also holds true for malleable IT since the reversal of changes would create high efforts. Thus, we expect that ongoing inscriptions drain momentum over time.

In summary, recent research has contributed valuable knowledge about change of organizational routines, the role of artefacts in the change process, and factors that affect the momentum of change. However, there is little empirical evidence on the influence of these and potentially other factors on momentum under malleable IT. To explore these relationships, it was paramount to observe routines with varying embeddedness levels and different actors under malleable IT over time. We therefore conduct a longitudinal case study of the momentum of routine change under malleable IT, the method which we present next.

Method

We conducted a longitudinal case study (Yin 2003). We chose the case study method because it allowed us to observe the change of routines enabled by malleable IT in real organizations. Furthermore, the case study method was likely to reveal differences in momentum of change between instances of routines, which was important for developing explanations in our emergent theory (Eisenhardt 1989).

Case Set-up

We chose Alpha, a medium-sized mechanical engineering organization, as the context for our case study. Alpha's primary locations were in Germany and Switzerland, but it also operated offices and factories in several other countries including China and the USA. Historically grown, Alpha consisted of highly specialized and autonomous divisions with partly redundant structures, e.g. several research and development units. Given the barriers for collaboration presented by different physical locations and by expertise distributed across divisions, Alpha decided to implement SP in 2013 in order to support coordination in organizational routines within and across the divisions. Being highly configurable, SP offered many potential usage scenarios. Users could create and configure collaboration spaces (called sites) that would support the routines in which they were involved. Given this configurable and generic nature, SP was clearly an instance of malleable IT.

Two characteristics of our case study are important to acknowledge. First, Alpha allowed discretion in the usage of SP and did not prescribe any usage scenarios or routines. Second, the IT department had scarce resources for implementing particular user demands and could only ensure the availability of the SP infrastructure. The IT department had thus little influence on the way how users created and configured their collaboration spaces. Given these two circumstances, it was particularly likely that we would observe bottom-up, user-driven change of routines, rather than top-down, management-driven change.

Our units of analysis were routines. While all routines shared the same underlying technology (SP) and the same organizational context, we expected routines to vary in their momentum of change due to characteristics of the involved actors and of the routine itself.

Data Collection

We started our data collection in November 2014 shortly before the planned go-live of SP. Our data sources consisted of archival data, which included project documentation and the actual SP sites, and interviews, which were our primary data source. We conducted 59 interviews with 14 users between November 2014 and December 2017 in nine rounds. We selected users from five teams: (1) Production planning, (2) internal consulting, (3) quality management, (4) customer care support and (5) research and development (R&D) support. We based our team selection on two factors: Early adoption of SP and high variance of possible routines. The five teams were part of the first adopters of SP at Alpha and provided a broad range of different routines. Within the teams, the key users were our most important interview partners but we also searched for complementary interview partners within the teams during our study. We also had to replace interview partners, since some interview partners left Alpha during our study. We substituted these interview partners with members of the same team and followed up on previously identified routines. Beside these five teams, we also conducted interviews with members of the IT department to learn about current developments regarding SP at Alpha. During the first interview round, we asked the interviewees how they planned to use SP for their routines and about their previous experiences with the technology. Furthermore, we asked them about the set-up of their teams and their perception of the organization regarding change and particularly IT-enabled change. After the first interviews, we scheduled the subsequent interview rounds on intervals of three to five months. In these interviews, we asked the users to report important changes related to SP, e.g. trainings or management decisions. If they mentioned routines that were supported by

SP, we inquired into potential changes in these routines. The interviews took between 30 and 120 minutes. We used the archival data for triangulation. For example, we asked for the sites related to the routines and analyzed them for changes. We documented the sites through screenshots and used them in following interviews to stimulate conversations.

Data Analysis

We followed an inductive data analysis approach (Eisenhardt 1989). The process consisted of four steps. First, we created write-ups of the interviews. Second, we identified routines in our data. We coded a routine when a user described recurrent organizational activities, for which she used SP. For example, one user reported that his team used SP to organize documents in projects. Then we searched and coded artefact changes for these routines. For example, the same user reported in a later interview that his team changed SP and added an additional column in the library to organize documents by events. Artefact change describes structural changes on the artefact (e.g. adding a column) and not the usage of the existing artefact, (e.g. adding a row in a table). Based on the codes, we created visual maps (Langley 1999) for each routine to visualize the changes and related events. Third, we developed a classification scheme for changes by comparing instances of changes (Glaser and Strauss 1967). We elaborated categories out of these classifications and displayed them in an ordinal scale with following values: minor change, moderate change and major change. Fourth, we built explanations for different momentum of change based on these categories. To this end, we compared momentum of change between different routines over time. We conducted step three and four iteratively. Thus, we developed potential categories and dismissed or retained them and used the different categories to build our explanations. Furthermore, we relied on investigator triangulation (Yin 2003) by regularly discussing preliminary results in our research team and giving our raw data to independent students for analysis. We also compared our unfolding findings with the routine literature (theoretical integration) (Eisenhardt 1989).

Findings

We observed remarkable differences in the momentum of change between routines. For the ease of presentation, we begin by introducing the constructs that explain these differences according to our analysis. We then present our emerging theoretical model, which identifies five configurations of factors that differ in the resulting momentum of change, and we illustrate each configuration with one routine.

Constructs

Momentum of Change. Our data analysis pointed us to the usefulness of the concept of momentum of change, as introduced by Jansen (2004). Although we define momentum of change, in line with Jansen's work, as the energy associated with changing a routine, we needed to operationalize the construct in a way that reflects the context of our study. Our analysis suggested that, in our study, momentum of change manifested through two dimensions. The first dimension was the complexity of a single change, which can be minor, moderate, or major (see Table 1 for definitions of change complexity). Changes of high complexity require (and thus indicate the presence of) high amounts of energy, much like changing the direction of motion of heavy objects requires high amounts of energy. The second dimension is the frequency of these changes. Making a long series of changes requires (and thus indicates the presence of) high amounts of energy, much like throwing an object far requires high energy. Momentum of change is the combination of these two dimensions. Figure 2 shows an example of low momentum, where only two minor changes were performed over a period of three years. Figure 6 shows an example of high momentum, where seven moderate or major changes were performed over the same period.

Our comparison between cases led us to identify the following influencing factors for momentum of change: Relationship to existing artefact, embeddedness of routine, lead actor traits (personal technical knowledge and commitment), and external knowledge. We next define and illustrate these constructs. Table 2 provides an overview of definitions.

Relationship to Existing Artefact. Momentum of change depended on the relationships to existing artefacts, i.e., the ways in which actors related SP to the artefacts that actors used before starting to use SP. We observed three different relationships to existing artefacts: incorporation (existing artefact enhanced with SP), replacement (logic of existing artefact inscribed to SP), and absence (no existing artefact). In *incorporation*, users left the existing artefact unchanged but integrated or supplemented it with SP. For instance, in the machine reservation routine, actors used a worksheet (*existing artefact*) to execute the routine. The actors then uploaded the worksheet to SP to improve access and to enable notifications about updates. The new routine thus relied on both the existing worksheet and on SP. In *replacement*, actors transferred the business logic from the existing artefact to SP and abandoned the existing artefact. For example, in the experimental trial documentation routine, the actors abandoned the file share (*existing artefact*) and transferred its business logic to SP. In *absence*, there is no existing artefact. For instance, a quality manager wanted to enable the organization to share information about production norms. Since no artefact existed, he created a SP library to store and to structure the production norms.

Change Complexity	Definition
Minor	Actors incorporate out-of-the box functionalities of SP (i.e., functionalities that do not require configuration) in their routine.
Moderate	Actors configure SP standard elements or incrementally configure previously created artefacts and incorporate the configured artefact into the routine.
Major	Actors configure and combine several functionalities and/or technologies for the first time and incorporate the created artefact into the routine.

Table 1. Change Complexity

Embeddedness of Routines. Momentum of change also depended on the embeddedness of routines. In our data analysis, we operationalized embeddedness as a two-dimensional construct. The first dimension refers to the level at which the routine is performed, which can be team, department, or organization. At higher levels, routines display stronger embeddedness since it is more likely that actors with different competencies and interests are involved. For instance, the investment controlling routine involved controllers from different business units of the organization and required the integration of figures from all these business units. This routine was, hence, at the organizational level. An example for a routine on team level was the process management routine. The quality managers created a repository for all documented processes and managed it within their team. The second dimension refers to the degree of specialization of the tasks that are part of the routine. Specialization refers to the difficulty with which actors can be replaced by other actors in the performance of the tasks that are part of the routine. Specialization is high if many tasks require to be executed by specific actors. Higher specialization means stronger embeddedness of the routine because the routine requires coordination among the specialists. An example of high specialization was the product portfolio management routine. In this routine, product managers had to provide detailed information about their products—information that only these particular product managers were able to provide. An example for low specialization was the company report routine. In that routine, three secretaries composed a company report. Any secretary could update the document and finalize the report. We coded embeddedness as strong when actors had to interact at least on department level and if specialization was high. Otherwise, we coded embeddedness as weak.

Lead Actor Traits. Momentum of change also depended on lead actor traits. Lead actors were actors (either a single person or a small group) that performed the routine and initiated the use of SP for the routine. We identified two important lead actor traits that affected momentum of change: Personal knowledge and commitment. *Personal knowledge* refers to the lead actor's knowledge about malleable IT. Lead actors with strong technical knowledge were able to configure SP based on their demands. Actors with low technical knowledge had a limited amount of experience and were able to use only out-of-the box functionalities of SP. Actors with medium personal knowledge were able to conduct a narrow range of configurations that they had experienced before. Actors with high personal knowledge were able to conduct a wide range of configurations and learn new configurations on their own. *Commitment* denotes the lead actor's willingness to expend energy and effort to improve the routine. While in some cases lead actors were highly committed to improving routines and to having performed the artefact changes that are necessary to this end, in other cases lead users lacked commitment, often because the routine was not of high importance to them. An example of high commitment was the manager of the consulting team that performed the project organization routine. The manager placed high importance on providing other project members with effective project management templates. He, hence, did not eschew efforts to develop the artefact in order to achieve this goal. An example for low commitment was the lead actor in the machine reservation routine. She created the initial artefact with SP but did not see it in her responsibility to configure the artefact further.

External Knowledge. Momentum of change also depended on external knowledge. By external knowledge, we mean the active involvement of actors that had strong technical knowledge of SP but that were not involved in the routine (hence qualifying as external). In our data, lead actors often had to initiate the contact to and mandate changes to such external resources. For example, the lead actor in the helpline routine searched for help to configure SP and found it by a SP consultant.

Construct	Definition
Embeddedness of Routine	Interdependence between tasks of multiple actors within the routine. Conceptualized with specialization of actors in the routine and the level of the routine within the organization: Team, department or whole organization.
Relationship to Existing Artefact	The way how actors relate the new malleable IT to existing artefacts (i.e., artefacts that actors used as part of the routine before starting to use the new malleable IT).
- Incorporation	The existing artefact, as a whole, is integrated into or supplemented by malleable IT. Malleable IT thereby extends the existing artefact with new functions. The existing artefact remains part of the routine.
- Replacement	The business logic from the existing artefact is transferred to malleable IT. The existing artefact is abandoned.
- Absence	No existing IT artefact is part of the routine.
Personal Traits	Personal capabilities of lead actors of the routine.
- Personal Knowledge	The lead actor's technical knowledge about malleable IT.
- Commitment	The extent to which the actor is willing to expend effort and energy to improve the routine.
External Knowledge	Active involvement of actors, who have no relationship to the routine, in the configuration of malleable IT.

Table 2. Construct Definitions

Model

Our analysis revealed five configurations that led to three different levels of momentum. Our model in Figure 1 displays these configurations by showing five paths starting on the left-hand side with "Relationship to Existing Artefact" and ending on the right-hand side with the level of momentum. Each path presents one configuration. We present each configuration in the subsequent paragraphs, including one example routine in detail. For each example, we also visualize the routine changes in Figure 2 to Figure 6. In these diagrams, the primary axis shows when changes occurred while the secondary axis shows the complexity of the change (see Table 1 for definitions). Table 3 summarizes the configurations and the resulting momentum for all examples.

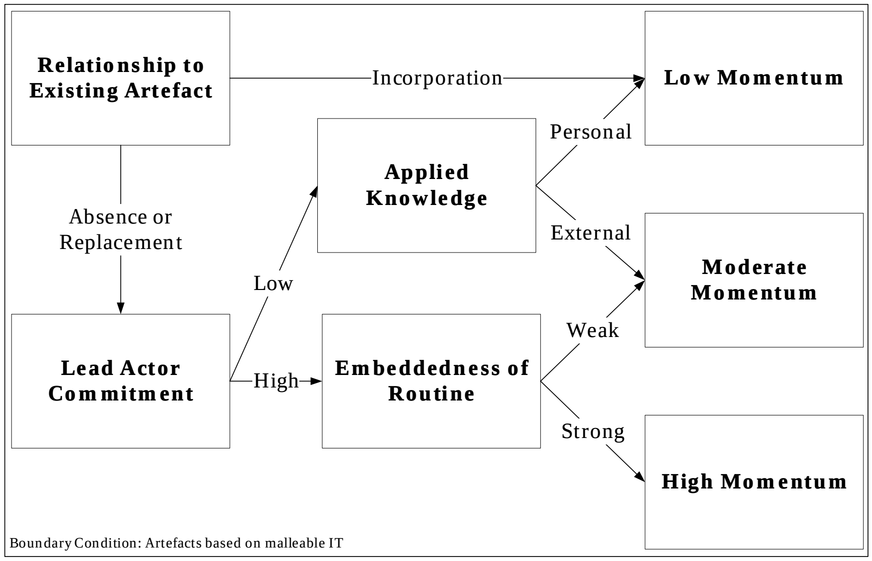

Figure 1. Emergent Theory

Configuration	Momentum of Change	Embedded-ness	Relation to Existing Artefact	Commit-ment	Knowledge (Personal or External)
Dominant Existing Artefact	**Low**	Weak	*Incorporation*	Low	Low
Quick Win	**Low**	Weak	*Absence*	*Low*	*High*
External Knowledge Infusion	**Moderate**	Weak	*Replacement*	*Low*	*External*
Dominant Lead Actor	**Moderate**	*Weak*	*Replacement*	*High*	High
Complex Change	**High**	*Strong*	*Absence*	*High*	High

Table 3. Examples Routines Configurations

Configuration 1: Dominant Existing Artefact

The incorporation of the existing artefact is the dominant property of the first configuration and leads to low momentum of change. We observed six routines that incorporated the existing artefact into SP and displayed similar patterns. One of these routines is the machine reservation routine in the production planning team, which we use as an example to illustrate this configuration.

In the machine reservation routine, production planners and sales people coordinated machine deliveries to customers in China. The existing artefact of the machine reservation routine was a worksheet, which contained all orders and their status. Actors from both teams updated the worksheet whenever the status of an order changed. Once they updated the sheet, they sent the new version to all actors by e-mail. This artefact usage led frequently to inconsistencies in the worksheet.

The production planners became aware of SP in late 2014 and wanted to test the technology in the machine reservation routine: "We are interested in the possibilities of SP especially regarding collaboration in boundary crossing projects." Therefore, the production planners set up a SP site based on an out-of-the box template including a library to store documents (minor change, see change no. 1 in Figure 2). In this library, they uploaded the existing worksheet and stored it such that is was accessible to all actors (*relationship to* *existing artefact: incorporation*). Henceforward, the actors tracked any order status change in the worksheet uploaded on SP. In the beginning, the actors needed to check frequently whether other actors had updated the worksheet, given they did not send e-mails anymore. To reduce the need for frequent checking, they activated e-mail alerts, a standard functionality of SP that sends notification e-mails on updates (minor change, see change no. 2 in Figure 2). No further changes to the routine occurred during the subsequent 2.5 years.

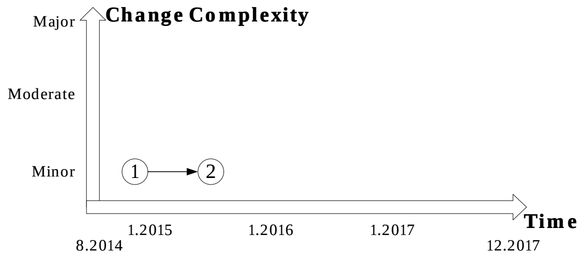

Figure 2. Machine Reservation Routine

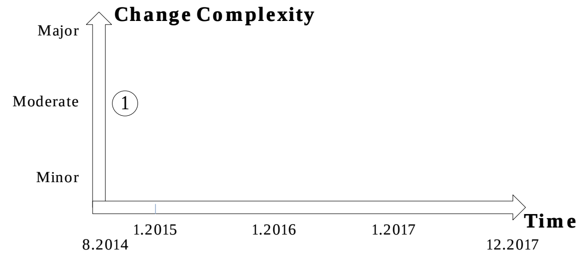

Figure 3. Event Documentation Routine

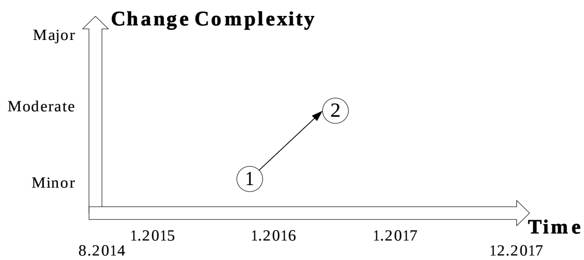

Figure 4. Experimental Trial Documentation

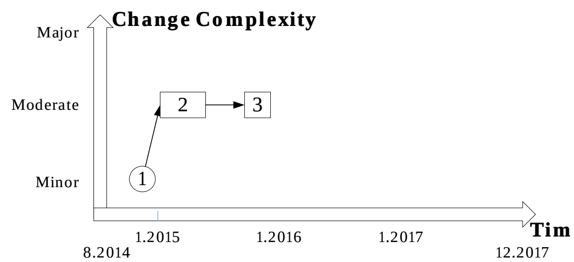

Figure 5. Project Organization Routine

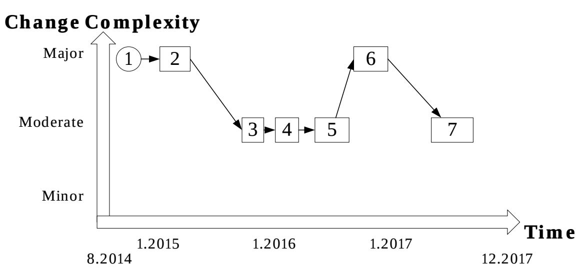

Figure 6. The Product Portfolio Routine

Without changing the routine, the actors forewent potential for improvement. For example, the actors were still unable to update the worksheet concurrently (i.e., only one actor at a time could edit the worksheet). The actors could have replaced the worksheet with a list in SP, which would have allowed editing several rows concurrently. Although the lead actor knew about this possibility, she did not initiate the change since it would have significantly modified the performance of the routine. The other actors would have to understand the unknown feature of SP lists instead of the known worksheet. Thus, they were satisfied with the current artefact and did not invest any further efforts.

In summary, the incorporation of the existing artefact did not provide enough impulse to generate lasting momentum. We conclude that the continued presence of the existing artefact leads to low momentum for two reasons. First, the actors have to adapt their performances only marginally, e.g., open the worksheet from SP and not from e-mail attachment. Thus, they do not feel disrupted in their performances. Second, actors do not have to dive deep into the functionalities of SP since only minor adaptations are required to incorporate the artefact. This draws the attention away from SP and the potentials for change it affords. We term this configuration dominant existing artefact because the continued presence of the existing artefact draws attention away from potential improvements, keeping the momentum for routine change low.

Configuration 2: Quick Win

The second configuration is characterized by the absence of existing artefacts, low lead actor commitment, and high personal knowledge, a combination that led to low momentum of change. We observed two routines that were instances of this configuration. One of these is the event documentation routine in the internal consulting team, which we subsequently use as an example.

The consulting team conducted many workshops, which generated many output documents (i.e., documents that recorded the outcomes of workshops). Since the workshops were parts of bigger projects or programs, an important question for all involved actors was where to store, and find, output documents. No technical solution for this problem existed (*relationship to existing artefact: absence*).

One consulting team member possessed high personal knowledge about SP, which he had gained during his involvement in the SP implementation project (*high personal knowledge*). He realized that a combination of the SP features of pages, views, and metadata could help resolve this problem. He placed all output documents in a central library in SP. For each workshop, he created a page and used views and metadata to display only the relevant outputs of the workshop (moderate change, see change no. 1 in Figure 3). He used this approach in his projects to document workshops in late 2014. However, as a lead actor, he had no interest to further develop or promote this use of SP since he created it to solve a problem at hand and not to invest into the routine (*low lead actor commitment*). Other actors copied his idea but also perceived it as a quick solution and did not modify or enhance it. The lead actor and those that copied from him made no further changes to the routine during our observation period.

The actors did not leverage the full potential that SP would have offered them in improving their routine. For example, the creation of the event sites required a lot of manual work. One user stated: “It looks really nice but it is too much effort.” With additional artefact changes, these steps could have been simplified, standardized, and automated in all instances in which the solution was used. Nevertheless, this was not in the interest of the lead actor, for whom the manual steps were less challenging than for other users. The other users, in turn, did not have access to the knowledge that would have been required to make these improvements.

In sum, when lead actors are knowledgeable but lack commitment, they tend to improve that part of the routine in which they are involved but eschew efforts for helping to improve the other parts of the routine. In other words, they focus on quick local rather than on more effortful global improvements of the routine although their personal knowledge would allow them to move beyond quick local changes. Given this focus on quick short-term gains, we term this configuration quick win. Malleable IT invites quick wins given that artefacts can be modified fast by single users.

Configuration 3: External Knowledge Infusion

Configuration 3 differs from configuration 2 in that the applied knowledge is not the personal knowledge possessed by a lead actor but external to the routine. This configuration led to moderate momentum of change. We observed four routines that were instances of this configuration. One of these routines was the experimental trial documentation routine in the test team of the R&D department.

The test team executed experiments upon requests by customers. In these tests, the test team prepared machines and conducted trials. The team needed to document the tests with pictures and documents to answer the customer requests. Since the work was conducted on team level and specialization in this team was low, this routine qualified as weakly embedded. Before the implementation of SP, the test team stored the pictures and documents on a file share.

A R&D manager, who was not part of the test team, suggested that the test team use SP to support the experimental trial documentation routine. He supported the team with the implementation in late 2015. Initially, he suggested storing the documents on SP instead of the file share (*relationship to existing artefact: replacement*). Therefore, he created a standard site and showed it to the team (minor change, see change no. 1 in Figure 4). He advertised further advantages of SP, such as full-text search and versioning. In a next step, the manager and the test team discussed ways to improve data organization by metadata, which led to changes in the library structures through configurations (moderate change, see change no. 2 in Figure 4). After this, the test team migrated all data from the file share to SP to have a standardized structure. Due to automation desires and security concerns, the test team searched for a solution to centralize basic data (e.g. customer names) and to add permissions to certain documents. The manager tried to support the test team also in these demands and suggested some solutions. However, since the experimental trials were not part of his core tasks, he did not invest too much effort in finding solutions and reduced his efforts when he had other, more pressing tasks. The test team members showed no initiative to initiate changes on their own (*low lead actor commitment*). Thus, the actors did not actualize the additional potential for change, such as creating a repository for customer master data or compiling reports from different documents. Although they were aware of the possibility of making these changes, they did not perform them within our observation period.

In summary, when lead actor commitment is low, the presence of external knowledge provide some impetus by showing potentials for improvement of the routine based on the malleable IT. In such scenarios, the combination of external knowledge and the actors' needs leads to moderate momentum for change. Although in particular the external knowledge stimulates the momentum by bringing in ideas, low lead actor commitment and the limited interests of external resources curtail the momentum to a moderate level. We term this configuration external knowledge infusion.

Configuration 4: Dominant Lead Actors

The configuration 4 and 5 differ from configurations 2 and 3 in that lead actor commitment is high. Specifically, configuration 4 combines absence or replacement of existing artefact, high lead actor commitment, and weak embeddedness and leads to moderate momentum for change. We observed seven routines that were instances of this configuration. The project documentation routine, which we subsequently use for illustration, was one them.

The consulting team was a small team of four members, but it conducted many projects within Alpha. Each project was unique while all projects had in common that project members had a need to share information throughout the project. The project members used documents for this purpose and administered the created documents within the project team. The routine was of low specialization given that virtually any actor was able to upload, move or change a document. Therefore, this routine qualified as a routine with weak embeddedness.

Before the implementation of SP, the consulting team administered documents in file shares, which created some problems: "The users forgot the links and were unable to find the documents." The consulting team became aware of SP because one team member managed the implementation project. This project manager became an important source of technical knowledge in his team (*high personal knowledge*) since he learned much about SP during the project and implemented several artefacts based on SP. He initiated the use of SP in his team. At the end of 2014, the consulting team started to manage all new projects with SP. In the beginning, they used standard project sites (minor change, see change no. 1 in Figure 5) and replaced the folder structures in file shares with libraries in SP (*relationship to existing artefact: replacement*). Beside these out-of-the box functionalities, the consulting team used the metadata columns functionality of SP to define attributes for documents and, thus, make them easier to find. The project managers had the discretion to create and modify metadata to suit their demands in the projects. In the first months, the project managers used this discretion to configure new metadata columns like columns for events or document owners (moderate change, see change no. 2 in Figure 5). These changes affected the performances of the routine. The actors had to think about who added and changed the metadata, how documents were classified, and how they presented the documents in different views.

The document organization diverged between projects and led to inefficiencies due to diverging ways of using metadata. After a few months, the manager of the consulting team tackled this problem. Since he perceived the project sites in the responsibility of his team (*high lead actor commitment*), he forced his project managers to discuss their experiences. In winter 2015, he stated: "I decided that we will standardize our project sites in SP. [...] We discussed our experiences and defined a new template for our sites." This template contained several custom metadata columns (moderate change, see change no. 3 in Figure 5) and became the standard for projects sites of the consulting team. Although the template became compulsory, the project managers still had discretion to adapt their projects. However, our interview partners did not report any further changes until the end of our observations.

In summary, committed lead actors can drive momentum for weakly embedded routines. The lead actors have goals (e.g. to improve project documentation) and initiate changes that help achieve these goals. Because of their high commitment, lead actors do not stop after a first change but make a sequence of changes, where the results of each change point to ways for further improvement. Weak embeddedness plays a dual role in this configuration. On the one hand, weak embeddedness facilitates making these changes, since other actors can still do their work in similar ways as before and, hence, are unlikely to voice their objections. On the other hand, the lack of input from others also limits momentum for change because suggestions for improvement are only made by the lead actor, resulting in overall moderate momentum of change. Given the dominant role of the lead actor as the source for momentum, we term this configuration dominant lead actor.

Configuration 5: Complex Change

Configuration 5 differs from configuration 4 in that the routine is strongly embedded. It was the only configuration that resulted in high momentum of change. We observed five routines that were instances of this configuration. The product portfolio management routine in the R&D department was one them.

The product portfolio management routine aimed at consistent reporting of Alpha's product portfolio within the R&D department. Previously, the different divisions of Alpha had different routines for reporting the status of their product portfolios. Since these reports relied on different data and contained different information, the managers were not able not aggregate them to a global report (*relationship to existing artefact: absence*). Due to the high specialization of the tasks of providing information about the products and due to the high level (department) on which the routine is conducted, this routine qualified as strongly embedded.

The management made the decision to build a new artefact for the product portfolio management routine (*high lead actor commitment*). The responsible project manager decided to build the artefact based on SP because he wanted to involve the different product managers directly. He said: "We get the numbers from the ERP system. However, the pure numbers are not that important. I am interested in the statements. This is information that I can collect with SP." Therefore, in summer 2014, he created a SP site and defined a structure to represent the portfolio. He used lists and libraries for this representation and combined them in a sophisticated manner by creating columns and using look-ups to connect the lists (major change, see change no. 1 in Figure 6). He used this version to discuss the artefact with product managers, who were the target users of the routine. In spring 2015, he realized that his chosen structure was not manageable and did not fit the existing structures of the product portfolio management. He created a new SP site and re-created the structures based on his made experiences (major change, see change no. 2 in Figure 6). Additionally, he became aware of a new technology, Microsoft Power Pivot that he could use to visualize the data. Until January 2016, he made a few more configuration changes to improve the routine (moderate change, see change no.3 in Figure 6). The project manager presented the current version to the management, who were pleased about the improvements.

In March 2016, the CEO announced that the use of the created artefact was compulsory. This led to more feedback by the users to meet their requirements. The project manager collected this feedback and tried to incorporate it. He summarized: "The main contributors do not gain much value out of using the artefact. I try to resolve this issue, which will hopefully lead to more acceptance." In a first step, he adjusted the structures of the sites again based on the feedback (moderate change, see change no. 4 in Figure 6). In a second step in autumn 2016, he provided the users with automatic updates of data through configurative changes (previously he had to update visualizations manually) (moderate change, see change no. 5 in Figure 6). He still had not satisfied all actors but focused on improvements in the integration of Power Pivot with ERP data and SP. This change demanded complex adaptations of the SP sites (major change, see change no. 6 in Figure 6). In summer 2017, the project manager focused on the other user demands. He planned to improve the existing input forms with autocomplete and standardized values to allow faster data input (moderate change, see change no. 7 in Figure 6). The project manager stated in one of the last interviews: "Adaptations to SP to support the routine led to discussions about the routine. This was the real benefit."

In summary, our analysis suggests that high momentum of change is created when actors decide to support a strongly embedded routine with a new artefact (either replacement or absence of existing artefact). This decision implies high commitment to the change by lead actors. The strong embeddedness leads to major change complexity since actors have to combine the generic functions of SP to support the routine. It also leads to tensions between the artefact and the routine understanding of different actors in all perceived cases. Actors may give feedback that the artefact does not match with their understanding of the routine. The lead actor may react to this feedback and may change the artefact. Hence, high momentum of change results from strong embeddedness, which mobilizes all actors involved in the routine and makes the changes to be performed relatively complex. We therefore term this configuration complex change.

Discussion

In this paper, we investigated the complex relationship between routines and artefacts under malleable IT and built on the concept of momentum to describe the intensity of a series of interrelated changes to a routine and to its related artefacts. We found that momentum varied substantially between routines. By comparing routines, we identified the embeddedness of routines, the relationship to existing artefacts, lead actors' personal traits (particularly personal knowledge and commitment), and external knowledge as influencing factors on momentum of change (represented by change frequency and change complexity). Our emerging theory suggests that different configurations of these factors lead to different momentum of change under malleable IT.

Contributions

Our research contributes to the literature on organizational routines and artefacts by (1) proposing a model to explain momentum of routine change under malleable IT, (2) uncovering differences between weak and strong embedded routines, and (3) shedding light on the role of existing artefacts in shaping routine change.

Our first contribution lies in proposing an emergent theory that explains the momentum of routine change under malleable IT. The literature on the role of artefacts implicitly acknowledges the key role of momentum by emphasizing long series of changes (e.g. Goh et al. 2011; Leonardi 2011; Volkoff et al. 2007), but it has not theorized or attempted to measure momentum. An important contribution to this stream of research is thus to propose the construct of momentum of change and show how to measure the construct. In line with the literature on artefacts (e.g. Goh et al. 2011), we find that lead actors play a key role for generating sufficient momentum. While our emphasis on lead actors is in line with the literature on artefacts, our study goes beyond that literature by pointing out commitment and personal knowledge as two lead actor characteristics that are particularly relevant under malleable IT. Commitment and personal knowledge are important because malleable IT puts a heavy burden on actors, by requiring them to initiate changes and to conceive ways to configure the malleable IT such that the new version of the routine becomes possible.

It is also insightful to compare our emerging theory with Jansen's (2004) work. Whereas Jansen examined one case of strategic, cultural change in which IT did not play a prominent role, our study examined 24 instances of rather micro-level changes in which change was enabled by the potential of malleable IT. While Jansen's results point to an important role of the commitment of executive change leaders, our findings emphasize the commitment of lead actors. In contrast to executive change leaders, lead actors need not be managers. A lead actor can be any actor involved in a routine who takes the initiative to improve the routine by exploiting the potential offered by malleable IT. Hence, in contrast to strategic change initiatives, routine change enabled by malleable IT requires at least one committed individual that leads the change process, often in absence of any formal mandate. In contrast to Jansen's study, we found not only the commitment but also the knowledge of this actor to be of high importance, which is likely due to the complexity associated with configuring malleable IT (Lehrig et al. 2017).

Our second contribution lies in new insights how embeddedness affects change of routines. Although we had expected that weakly embedded routines would show higher momentum of change than highly embedded routines (Howard-Grenville 2005), we found the opposite. Indeed, few weakly embedded routine artefacts changed more than once within the observation period, whereas strongly embedded routines changed more often. We attribute this to the missing reactions of actors to changes for weakly embedded routines. Thus, when routines were weakly embedded, actors did not enact their agency regarding changes to the artefact (D'Adderio 2011). These struggles among different agencies are an important source of momentum. When routines are weakly embedded, actors do not voice competing views, and the lead actor carries the burden of creating momentum for these routines. Conversely, when routines are strongly embedded, other actors engage more strongly in discussions about how artefacts should support the routine, which drives momentum. Additionally, strongly embedded routines needed a bigger initial change impulse (i.e., higher change complexity) to initiate a change at all. Like a heavier stone needs more effort to start rolling, once it rolls inertia prolongs its movement compared to a smaller stone. Similarly, the higher efforts for initial changes provided more momentum to strongly embedded routines and kept them "rolling". Although our findings deviate thus from the often articulated idea that strong embeddedness is associated with lower intensity of change (Howard-Grenville 2005), our findings are in line with existing research on routines under hard-to-change IT in which big investments lead to high momentum despite strong embeddedness (e.g. Berente et al. 2016; Goh et al. 2011). In conclusion, we contribute to deepen our understanding of the role of embeddedness in routine change under malleable IT. Higher embeddedness keeps routines persistent in phases of stability since the initial thresholds are higher to initiate changes. But higher embeddedness also keeps routines going in phases of change since the invested efforts mobilize resources and trigger agency.

Our third contribution is the identification of how different relationships to the existing artefacts influence the routine change under malleable IT. Although the importance of artefacts for routines is undisputable (D'Adderio 2011), their role in change processes remains blurry. Existing literature analyzes the replacement or creation of artefacts and their following evolution (e.g. Goh et al. 2011; Leonardi 2011) but does not consider the incorporation of existing artefacts with new IT. Malleable IT facilitates such changes. Incorporation of existing artefacts can easily been overseen since its created momentum for change is minimal. Nevertheless, it is important to understand that incorporation can generate value by allowing the adoption of new IT as SP with minimal change efforts. For replacement and creation, we encountered higher momentum under malleable IT. Although these two scenarios create similar results for momentum, the underlying mechanisms differ. Replacement can drive changes through comparison with and recreation of the existing artefact whereas creation in the absence of existing artefacts can drive changes through the origination and the related struggles (D'Adderio 2011). The differentiation between these three scenarios provides a new perspective that moves attention from properties of the artefact to the relationship of the new artefact with existing artefacts. In sum, we introduce incorporation as a new relationship scenario of existing artefacts in routine change and propose that researchers should pay more attention to the different relationship scenarios of existing artefacts, since this might explain differences in routine changes that cannot be attributed to the properties of the artefact alone.

Future Research

Our research opens avenues for future research. It would be interesting to have more case studies that analyze routine change under malleable IT. Additional factors as organization related factors could be uncovered that contribute to the extension of our emergent theory. Furthermore, additional case studies with this set-up could test our model. Studies with longer observation periods would also be beneficial. Longer observation periods like in the work of Leonardi (Leonardi 2011, more than 10 years) would help to identify whether momentum of change may varies for artefact that emerge later, e.g. these artefacts may display a lower change frequency than in the beginning because of existing experiences. Our data show antecedents for this possibility. Future research could also widen the scope of observed artefacts and their technologies. Most routines do not solemnly rely on one artefact but on multiple artefacts (D'Adderio 2011). In our study, we focused on SP related artefacts only. The relationship between multiple artefacts could influence momentum of change and would generate a more complete picture of IT induced changes. Advanced analysis methods as the one suggested by Gaskin et al. (2014) could help to achieve this goal. Finally, it would be interesting to generate models for momentum of change under different technologies, e.g. hard-to change IT, and compare them to our model for malleable IT.

Practical Implications

Our findings have also implications for praxis. Organizations can use our findings to support adoption of malleable IT. A first insight for praxis is that malleable IT on its own does not create change in organizations. Without commitment of actors, malleable IT only creates low momentum. Actors must give the generic functions of malleable IT a purpose in their routines to change and improve them. This requires commitment and knowledge about the technology. Organizations can use this insight and foster commitment for artefacts among lead actors to generate higher momentum. A second insight for praxis is the effect of different adoption patterns of existing artefacts on momentum. The incorporation of artefacts leads to low momentum whereas replacement and creation of artefacts create higher momentum. Organizations or lead actors can use these different strategies to generate or prevent momentum of routines depending on available capacities. A third insight for praxis is the huge effect of lead actors on momentum under malleable IT. With malleable IT, knowledgeable and committed lead actors can generate momentum in weakly embedded routines easily. This entails that they can inscribe their perception of routines in the artefacts and use the technology to their advantage. This may lead to complex artefacts, which few actors can maintain. In high fluctuation environments, this could become a problem and lead to repeated creation of artefacts by changing lead actors, which increases efforts. Organizations should be aware of this problem and encourage lead actors consciously hand over artefacts to new lead actors in cases of personnel changes.

Limitations

Our study has some limitations. First, we relied on data from a single case study, i.e., we observed the identified dynamics only in one organization for one specific technology. In a different set-up, other factors may occur that would extend or alter our emergent theory. We leave this to future research as well as possible replications of our findings. Some conditions from our case may have also hindered the identification of different factors. We have to mention two important conditions. First, due to scarce resources the IT department could not support changes in SP. This put the burden of knowledge acquirement to the actors or their possibilities to fund external support from the consultancy. Second, managers questioned the future of SP during our data collection, which undermined trust of the actors in SP. This led to periods in which actors did not conduct any changes because of the lack of trust. However, we identified similar patterns before and after this period. Thus, we assume that they did not have a lasting effect on our theory.

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