

## Digitalization of Work Systems—An Organizational Routines' Perspective

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### Abstract

*Digitalization is a hypernym that denotes the ground-shifting impact IT artifacts have on organizations. The term implicitly refers to core topics in Information Systems research, which now enfolds at increasing magnitude, speed, and reach. However, digitalization often lacks explicit references to domestic theories, concepts, and constructs in the Information Systems literature. Fundamental mechanisms that constitute digitalization as an interplay of organizations and information systems remain unexplored. The purpose of this paper is twofold. First, based on extending extant theory on organizational routines, we propose four patterns that conceptualize digitalization mechanisms as an interplay of organizational routines and IT artifacts. Second, we demonstrate how more complex transformation trajectories of routines unfold, by concatenating our patterns to form transformation stories. On either level of abstraction, further research can build on the proposed patterns to theorize on how the interplay of IT artifacts and organizational routines constitutes the digitalization of work systems.*

### 1. Introduction

The accelerating design and diffusion of new (digital) technologies reshape all elements within and around organizations [15, 31]. Despite the wide recognition and potential of digital technologies, most organizations are still struggling with digitally transforming their organization [65]. On top of that, digitalization is still a hyped concept that lacks reference to the constructs that constitute the Information Systems (IS) discipline. In general, digitalization refers to “[...] changes that are associated with the application of digital technology” [40]. Digitalization is not a completely new phenomenon since it is related to the concept of IT-induced change. Related research has mostly focused on substantial changes and underestimates the significance of the micro-dynamics that constitute a change process [71].

To connect digitalization with the properties of organizations, we use the work system framework (WSF) [1]. We position our research at the center of the WSF, i.e., processes and activities, as a suitable lens to discover micro-dynamics of digitalization in organizations. Thereby, we focus on how digitalized processes and activities are carried out to provide innovative products and services, and how processes and activities in an organization are orchestrated by participants, information, and technology [50].

To examine digitalization in processes and activities, we draw on the established theory of organizational routines [13, 62], which, in turn, is rooted in structuration theory [34]. Organizational routines, in the following simply referred to as routines, are key for understanding how organizations accomplish their tasks, how they change [29], and how capabilities are accumulated, transferred, and applied [18]. As a construct, a routine comprises two mutually constitutive dimensions, namely ostensive aspects (i.e., abstract structures of a routine) and performative aspects (i.e., enactments of a routine). Apart from this interplay, both aspects are influenced by technology, and vice versa, they influence technology [62]. In particular, IT artifacts enable and constrain the ostensive and performative aspects of routines [13]. The imbrication of human and material agency can create new routines and induce changes of IT artifacts that employees utilize for performing work activities [53]. In IS literature, artifacts and routines have been conceptualized through a micro-dynamic lens with artifact either at the periphery [13, 62] or center of routines, balancing each other out [24]. However, the routines' perspective has not been used to systematize digitalization as an endogenously changing pattern that occurs in work systems.

To fill the gap between the importance of digitalization for organizations and the available body of knowledge on the micro-dynamics of IT-induced change in IS research, we strive to answer the following research question: *How does the digitalization of organizations unfold, when viewed from the micro-dynamic perspective of endogenously changing routines?* In this regard, the paper offers two important contributions. First, we use qualitative data

to conceptualize four patterns of how the ostensive and performative aspects of routines interplay with IT artifacts. Second, we illustrate how the patterns can be concatenated to describe more complex transformation trajectories in digital work systems. Subsequent research can use our patterns to empirically identify and analyze mechanisms of process digitalization, from isolated events to longitudinal transformation paths.

The paper unfolds as follows. In Section 2, we systematize current literature on digitalization by looking at the elements within a work system, pointing out that processes and activities in digitalized organizations are under-researched. Therefore, we reflect on routines as a theoretical lens to investigate the interplay of activities/processes and information technology in an organization to enhance the current understanding on the micro-foundations of IT-induced change. In Section 3, we describe and justify our qualitative empirical research approach and analyze, code, and categorize the data to conceptualize four patterns that frame the micro-dynamic interplay of routines and IT artifacts. In Section 4, we illustrate how the identified patterns manifest in work systems and how they can be concatenated to form transformation stories. Section 5 concludes the paper.

## 2. Related research

### 2.1. Digitalization of work systems

The acceleration of technology innovation cycles and the integration of digital technologies into daily business affect every part of an organization [58]. Potential benefits are manifold, including process innovation, product innovation, and digital innovation [44]. Organizations have recognized these advantages. Hence, digital transformation is an emerging term that is part of many C-level executives' top priorities [78].

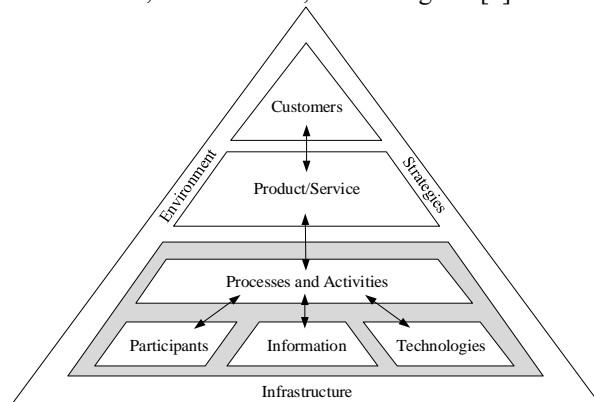
To understand digital transformation, it is necessary to know the concepts of digitalization and digitization. Both in literature and organizations, no common understanding of these terms exists [39]. Digital transformation, digitalization, and digitization are often used as synonyms [32], even if they differ conceptually.

*Digital transformation* is defined as “[...] a technology-induced change on many levels in the organization that includes both the exploitation of digital technologies to improve existing processes and the exploration of digital innovation” [11]. It is characterized as a disruptive or incremental change process that transforms an organization fundamentally for a new digital economy [41, 42]. Digital transformation is driven by economic trends (e.g.,

globalization and sharing economy), a demand for technology, and consumer trends [72]. Evidence shows that 84% of organizations struggle [69] with developing visions, plans, and implementations for transforming digitally because they regard digital transformation as a prerogative of the IT department [32] and not as an organizational task [69].

We propose that digital transformation is implemented through the digitization and digitalization of work systems—a concept argued to be “a natural unit of analysis for thinking about systems in organizations” [2]. *Digitization* describes the conversion of analogue source material into a digital format, and into binary digits [42, 76]. *Digitalization* refers to a socio-technical process of applying digitization techniques to a broader social and institutional context [76]. Hence, digital transformation is applied through emerging digital technologies [67] intertwined with digitization (i.e., turn analogue signals into digital variants) and digitalization (i.e., apply digitization techniques on an organizational level).

Digitalization has a fundamental impact on many aspects of an organization, including processes, resources, and internal and external parties [40]. An organization can be conceptualized as a socio-technical system consisting of multiple actors and/or machines that perform processes and activities, using information and technology to produce products and services [2]. Therefore, we take the WSF [1] as a theoretical lens to discuss extant literature and locate our research focus in an organization's structure. The WSF [1] “identifies nine elements that are part of [...] a work system: customers, products and services, processes and activities, participants, information, technologies, environment, infrastructure, and strategies” [3].



**Figure 1. The work system framework [1]**

Elements *within* a work system, i.e., participants, information, technologies, processes and activities, product/services, and customers, serve as concepts to address the changes that occur within organizations, triggered by emergent digital technologies. These

concepts enable us to logically structure and discuss the internal transformation of organizations triggered by digitalization—closing the gap between what is known and what still needs to be discovered to explain digitally induced change in work systems.

In regard to the concept of digitalization, uncertainty and confusion are evident in many papers that use digitalization as a synonym for digital transformation [12, 32, 40, 47, 68]. Current research focuses on digitalization as a challenge for participants that use technology in their day-to-day work and to explain how work is redesigned in the digital era [12, 16, 27, 60, 70, 73, 77, 80]. Furthermore, many articles conceptualize information as digitized data [5, 17, 33, 37, 74], refer to technologies as an enabler of digitalization [14, 47, 48, 68], or focus on digitized value propositions of products/services [4, 19, 46, 59, 66] that are adapted to changing customer demand or customer feedback [26, 52, 65, 75].

In contrast, research seldom examines digitalization from the viewpoint of processes and activities in a work system [6, 43, 51]. Some authors investigate how organizations converted business activities into a digital format, e.g., through internet-enabled digitalization [6]. Others describe disruptive trends that impact how processes and activities are performed [51]. One article describes a specific case of how digitalization can restructure a manufacturing process to improve efficiency, responsiveness, and reduce costs [43]. Even though previous research provides important insights, it fails to identify the mechanisms that constitute transformation as a micro-dynamic interplay of processes/activities and IT artifacts.

Digital technologies have become an integral part of daily routines [65], impacting what work is done and the way how work is done [60]. Work within an organization can be described in business processes as a sequence of activities [13]. Subsequently, we focus on how processes and activities evolve through new IT artifacts, and vice versa. Focusing on processes and activities as core units of analysis is in line with the WSF, since processes and activities, participants, information, and technologies are the key components that constitute a work system [3].

## 2.2. Organizational routines in work systems

Processes in a work system can be described as patterns of activities. This concatenation of procedural activities—which is primed by and priming the actions of others—is manifested as a routine [18]. Processes constitute a subset of routines [8] and statically follow a given logic and structure. Routines incorporate both flexibility and stability and describe patterns of day-to-

day work in a work system—including those tasks that are not orchestrated in a process.

Routines are often defined as repetitive and recognizable behavior that can be carried out collectively (multi-person) or individually (single-person) [9]. Actors, other routines, or external cues can trigger routines [8]. Further, routines can denote a set of rules or standard operating procedures [18, 21, 28, 56, 64]. Both definitions do not give credit to rapidly changing organizations and innovations [8] but emphasize the properties of routines as (social) structures that increase stability and oppose organizational change. To equally highlight routines as social structures and as vehicles for change, we consider routines as “continuously emerging systems with internal structure and dynamics“ [8]. Routines are not mindless actions, but rather are effortful accomplishments [63]. They can refer to formalized and standardized procedures—such as mass transaction processes—as well as to tacit competencies, like coordination schemes in teams [79].

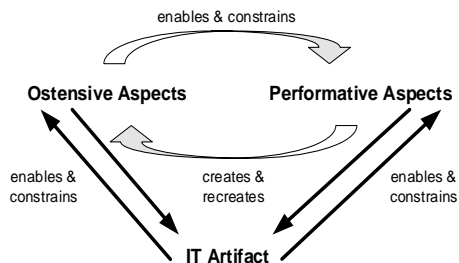
Routines are performed by participants who are capable of learning from experience, making routines “generative systems that produce repetitive, recognizable patterns of interdependent action” [61]. Hence, routines are an important source for endogenous change in organizations [45]. On a micro-level perspective, routines comprise two aspects. First, routines consist of ostensive aspects, which are abstract patterns that represent an ideal or schematic form of a routine and guide desired and offset undesired performances. Participants use the ostensive aspects to guide, account for, and refer to specific performances of a routine [61]. Second, the performative aspects of a routine are specific enactments, carried out at a specific time and under specific conditions [13].

Ostensive and performative aspects are mutually constitutive since ostensive aspects are the social structure that enables and constrains human actions, while the performance of a routine produces and reproduces the ostensive aspects through recurrent enactments [30]. The similarity or dissimilarity of the ostensive aspect and the performance of a routine indicates a change [23]. Each iteration of a routine can differ from the previous one, leading to an endogenous change of the overall routines [22]. Actors can decide to deviate from ostensive structures consciously or unconsciously through human agency [53].

In IS literature, routines have been studied in relation to (IT) artifacts that are either at the periphery [13, 62] or the center of routines, balancing each other out [24]. IT artifacts, such as constructs, models, methods, and software instantiations [57], are distinct from a routine and have a recursive relationship to the ostensive and performative aspects of a routine [62].

An IT artifact has a material agency that influences the emergence and persistence of routines [24].

Imbrication of human and material agency can change both routines and IT artifacts [53]. Hence, the ostensive and performative aspects of a routine are enabled and constrained by IT artifacts [13]. Vice versa, IT artifacts are designed and shaped by routines that are influenced by the work system in which rules and norms of behavior apply.



**Figure 2. Framework of routines and IT artifacts (adapted from [13, 62])**

While the interplay of routines and IT artifacts has been discussed extensively, research needs to go beyond conceptualizing routines as a single pattern [63], to address the endogenously changing dynamics of digitalization that changes both, routines and IT artifacts. This view is in line with conceptualizing information systems as socio-technical systems that consist of technological components and organizational structure. These socio-technical systems are subject to ever fastening innovation cycles that create a constant demand for new IT artifacts and, therefore, the continuous adaption of routines.

Since routines are mutually constitutive systems that are enabled and constrained by cognitive, social, and physical structures, routines are a fundamental construct to identify drivers of change and their impact on organizations [10]. By taking a micro-dynamic routine's perspective, we extend the literature on the relationship of routines and IT artifacts as well as imbrication of human and material agency and conceptualize how digitalization of work systems unfolds.

### 3. Research method

#### 3.1. Research design

To identify how IT artifacts affect routines and vice versa, we employed a qualitative empirical research approach and took the framework of routines and IT artifacts [13, 62] as a theoretical. Empirical research strategies are a valid methodology for gathering data on routines [79]. A qualitative research approach

allows us to access the context in which individuals perform their day-to-day work in organizations.

Our sampling strategy is based on purposeful and maximal variation sampling by conducting semi-structured interviews in different organizational settings. The interviews were conducted face-to-face and via telephone with 14 informants at different points in time over a period of ten months. To avoid biased data, the informants were chosen carefully, to represent different company sizes, regions, and industries—including automotive, machine tools, financial sectors, management consulting, accounting, IT, machinery/equipment supplier, and agriculture. Since routines within an organization can evolve over extended periods of time [79], we chose informants that had at least ten years of work experience in their organization or were responsible for steering transformation projects. Each interview took approximately 35 minutes, and we recorded 502 minutes of audio data. The informants reported on what routines constitute their work systems and how these routines transformed through digitalization.

We analyzed, coded, categorized, and examined the data we obtained from the transcribed interviews and additional field notes, by focusing on the content and meaning of statements. The data in the transcripts were coded independently by three researchers. Data were analyzed using an adapted grounded theory approach [35], in which we conducted three phases of analysis: open coding, axial coding, and selective coding [36]. The coding process was not linear but rather a recursive and analytical procedure [55].

First, we were sampling the statements that denote digitalization of work systems. Sampling was conducted in two phases starting with nine interviews that were the basis for a subsequent sampling phase, in which we conducted five additional interviews.

Through an initial open coding of the data [20], we identified broad themes, e.g., triggers of digitalization and changes within routine activities. The aggregated categories paved the way for the second phase of axial coding [20], in which we identified similarities and differences among the categories. Through selective coding, we linked the emergent themes to theoretical concepts that were identified in literature, describing mechanisms and trajectories of digitalizing routines.

Since we use an adapted approach of grounded theory, we deviated from the original procedure of iterative cycles in theoretical sampling. After the second phase of sampling and analyzing, we already discovered theoretical saturation since the data matched with initial categories and did not reveal any additional categories or sub-categories that would advance our theoretical understanding of digitalization. Therefore, we completed the sampling process at the

“point of redundancy” [54], which we reached in our study after completing two phases. We used peer debriefings to avoid incorrectly or misinterpreted data and ensure validity [20]. We discussed the patterns we identified with impartial researchers, who were not involved in this study before.

To develop a conceptual framework that links, aggregates, and abstracts the theoretical concepts we identified, we refer to a framework of endogenously changing routines to explain and discuss digitalization patterns that can be used to explore transformation trajectories in organizations. Each areas of the resulting framework that illustrated the triggers of digitalization in work systems encompasses a different pattern that can be represented by a specific manifestation of the framework of transformational routines.

### 3.2. Data analysis

In two sampling phases, we analyzed the data by using open coding, axial coding, and selective coding [36]. The emergent concepts from each sampling phase were compared and validated with concepts from the literature. The concepts from the first sampling phase served as guides for a more focused data analysis, which is presented henceforth.

In the first step of open coding, we analyzed and aggregated critical events in the transformation stories reported by the informants, to identify recurring statements and categories. We compared recurring statements, aggregated them, and grouped them into

categories, each illustrated by two to five aggregated statements (1st order categories in Figure 3). The 1st order categories refer to different triggers for a digitalization of work systems. The data show that individuals participating in a work system are one crucial enabler for digitalization— regarding their capabilities and the design of (digital) workarounds. Changing customer expectations are another driver for digitalization. Also, the informants stated that the availability of digital technologies on the market and the institutionalized transformation of an organization by management were crucial starting points for the digitalization of their work systems. After identifying 1st order categories, we applied axial coding to identify any relationships among the categories to form more abstract 2nd order themes.

We discussed the themes iteratively until they were conceptually clear and disjoint. At this point, we recognized a strong need to group the themes, since some of them were based on the same fundamental principles. We identified the first group of themes as the digitalization of a work system by individuals (in particular, participants, and customers). A second theme emerged to describe digitalization as planned re-design of a work system by management. A third theme referred to the adoption and use of digital technology (mostly hardware, e.g., mobile devices) by people in organizations. A fourth theme identified the appropriation of tools from outside the work system.

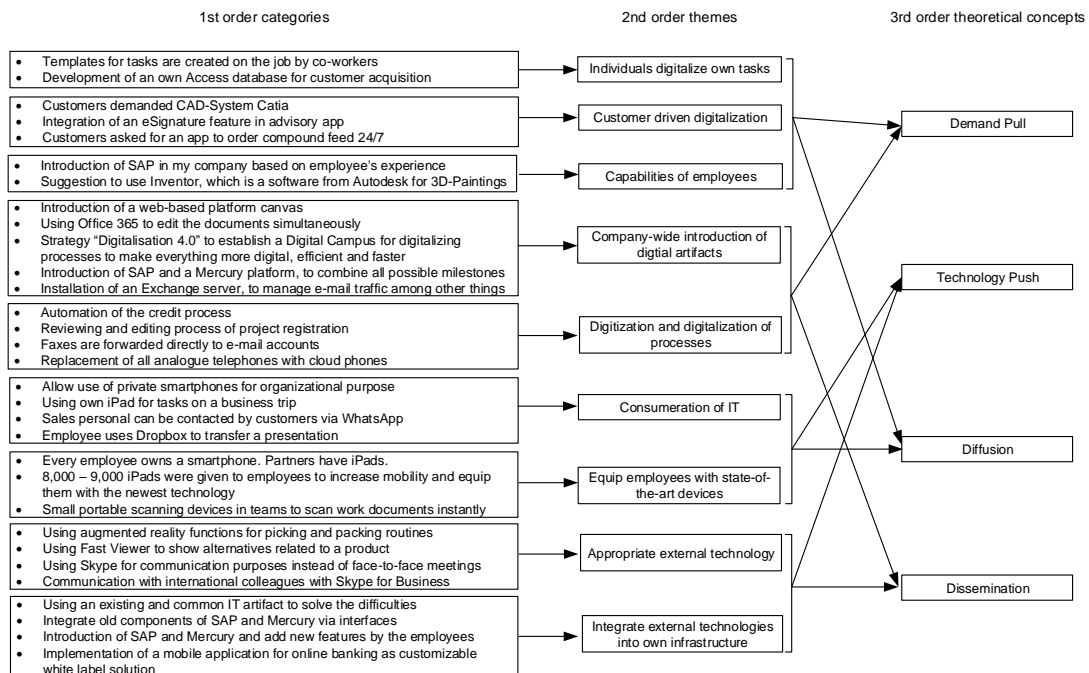


Figure 3. Identification of concepts [35]

In the final phase of our data analysis, we searched for similarities between the 2nd order themes and matched them with theoretical concepts we identified in IS literature to form four 3rd order theoretical concepts. On the one hand, our data were mapped with constructs from IT-induced change, which describe that technological change is either triggered by demand pull or technology push. Demand pull is induced by individuals who formulate the need for an IT artifact, whereas technology push describes that an IT artifact is a driving factor for change [7, 51]. On the other hand, we found comparable concepts to our data in the innovation literature. The spread of innovation in organizations was often described by informants with reference to the two concepts of diffusion and dissemination [25, 38]. Diffusion is the untargeted and unplanned spread of new practices (sometimes also referred as a bottom-up change process), whereas dissemination is the active spread of new practices using a planned strategy (sometimes also referred as a top-down change process).

## 4. Digitalization of work systems

### 4.1 Interplay of organizational routines and IT artifacts, as mechanisms of digitalization

Four patterns of digitalized routines emerged from our data. The patterns show that processes and activities—represented as routines—are the core of digitalization in work systems since they connect all elements in a work system.

Extending theory on routines [13, 62], our patterns illustrate how routines and IT artifacts interplay as mechanisms that constitute the digitalization of work systems from a micro-dynamic perspective (Figure 4). The framework identifies four directions between the ostensive/performative aspects and IT artifacts and adds two triggers for transforming routines (technology push, demand pull) as well as two forms of adopting IT artifacts for routines (dissemination, diffusion). The patterns are framed as follows:

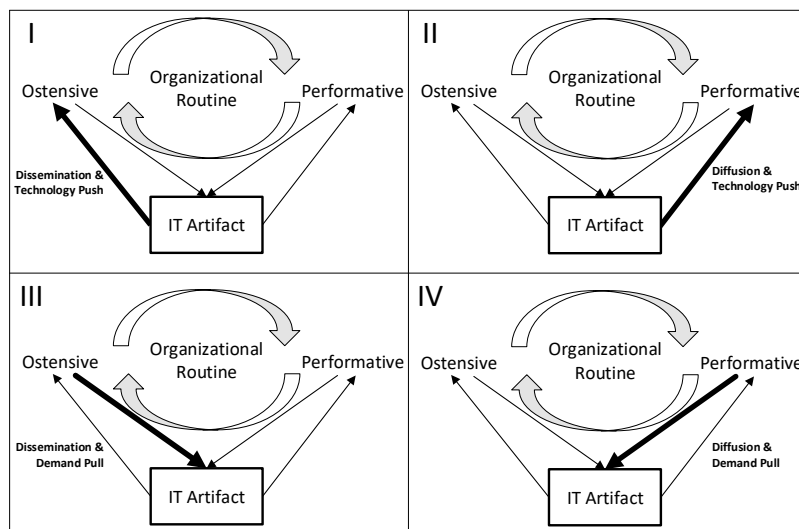


Figure 4. Extending patterns for digitalizing organizational routines in work systems [13, 62]

**Pattern I:** An IT artifact is designed in the environment of a work system; it is then adopted by management to transform ostensive aspects of a routine inside a work system. IT artifacts like software (e.g., data analytics tools or mobile applications) or hardware (e.g., smartphones) that are available on the market are adopted by an organization through management: “Annual auditing is a routine process that complies with official auditing standards. Our management decided to introduce SAP and Mercury as a platform, to combine all possible milestones in auditing, e.g., order planning, acceptance, and processing to

facilitate work of employees and merge all activities related to this process.”

**Pattern II:** An IT artifact is designed in the environment of a work system; it is then adopted by employees to transform performative aspects of a routine inside a work system. IT artifacts designed in a work system’s environment can be brought into an organization by employees. The artifacts then enable and constrain the performative aspects of a routine. Participants may include the IT artifact into their day-to-day work consciously or even unconsciously: “One year ago, we gave our employees 8,000 – 9,000 iPads to increase mobility

*and equip them with the newest technology. We have no guidelines using these iPads and provide our employees a lot of flexibility. They integrated these IT artifacts in their daily routine raising the need for the development of advisory applications that we have implemented subsequently.”*

**Pattern III: Work systems can transform ostensive aspects of a routine, leading to the design and implementation of IT artifacts that enable and constrain the transformed patterns.** Transforming routines on an organizational level can lead organizations to design new IT artifacts. The altered ostensive aspects of a routine define the requirements that affect the desired form and function of new IT artifacts. This pattern illustrates that digitalization can be triggered by routines—as a concatenation of procedural actions—within a work system: *“In the past, customers could only order compound feed online or through their local retail partners. However, customers demanded an app to order compound feed. Therefore, our salesforce redefined their standardized routine and initiated the development of an app to simplify order processes and boost availability to 24/7h service.”*

**Pattern IV: Work systems can transform performative aspects of a routine, leading to the implementation of IT artifacts that enable and constrain the transformed performances.** Participants that carry out a routine might alter the performative aspects of a routine themselves. The new routine may lead participants to request or implement an IT artifact that supports them in performing their day-to-day work. Whether a new IT artifact is designed or an existing one is brought into an organization depends on the accessibility of suitable and usable IT artifacts on the market. If an artifact is unavailable, a routine’s specific enactment can trigger the development of a new IT artifact. The design of individual IT artifacts might be authorized, but it can also happen secretly, without authorization and beyond the control of management: *“An employee used Dropbox to transfer a presentation (50 MB) to a third party since the organization’s e-mail system could not send this large file. The security function flagged this as a critical breach of security policies. The existing IT infrastructure was not providing the needed functionality, and therefore, we created a secure solution to transfer large files.”*

## **4.2 Longitudinal transformation trajectories**

In more complex digitalization projects, the patterns can be concatenated to document and analyze *longitudinal transformation trajectories* of

activities or processes in a work system. This concatenation can be exemplified by data we collected on the digitalization of an annual audit.

The annual audit is a predefined routine task that needs to comply with official standards for auditing. The organization used a lot of proprietary software for distinct transactions and tasks that were unconnected. For the accountants, auditing was a cumbersome and time-consuming routine. Recently, the organization decided to introduce the existing IT artifacts SAP and Mercury (a platform for streamlining processes in SAP) to facilitate participants’ auditing routine—including order planning, order acceptance, and order processing—with a neat platform. The platform was selected by management and transformed the ostensive aspects of a routine (dissemination & technology push) inside a work system, which can be coded as Pattern I.

The informant further reports that the organization designed an interface to integrate previously used components and software programs with SAP. The integration was based on an organizational decision, and thereby, the trigger for the design of a new IT artifact again came from management. The interface represents a new IT artifact (demand pull) that was initiated by a change of the ostensive aspects of a routine, enabling participants to perform the routine as designed (dissemination)—representing Pattern III.

Participants of the work system were trained to use the software in their routine as specified in the ostensive aspects. Simultaneously, they already used the software in their day-to-day routines. Negative aspects and ideas for improvement were reported, leading to improvement and adaptation of the software. The employees reported those ideas from performing the auditing routine (diffusion). Functionalities of the software were adapted to participants’ requirements, e.g., granting accessibility through a web-based service. These enhancements resulted in a new IT artifact (demand pull). Therefore, we code this effect as Pattern IV.

Employees of the auditing organization were accessing data through the web-based platform by using their smartphones to be more flexible in their day-to-day work. Thereby, they were changing the performative aspects of the routine (diffusion) without having been told to use their smartphones for this purpose (technology push). This transformation of the routine equals Pattern II.

The concatenation of these patterns illustrates how the audit routine was digitalized over time through the interplay of routines and IT artifacts in a work system.

## 5. Contribution and outlook

Our paper offers two main contributions to research and management. First, we elucidate key properties of the digitalization of work systems and locate our research at the organization's center, which are processes and activities that can be described through routines. Although many papers seem to explore the attributes and triggers of digitalization, the term itself is used rather hazily as technology-induced change. Seldom, research is focused on disruptive change, and no agenda is issued to research the detailed mechanisms related to transforming activities and processes in work systems. Our contribution is to connect digitalization to established concepts in the Information Systems discipline, to provide a strong set of constructs that others can use to perform empirical research on the digitalization of work systems.

Second, based on qualitative data, we identified four patterns that explain the mutually constitutive relationship of IT artifacts and routines. We showed that the patterns can be used for analyzing isolated effects that occur in the digitalization of work systems, while they can also be concatenated to code longitudinal transformation trajectories.

One limitation refers to the impact of digitalization on the outer elements of the WSF. Extending research by analyzing the effect on the ecosystem can help to understand digital transformation as a holistic concept. Considering the interplay of IT artifacts and routines, it remains unexplored what types of IT artifacts (including constructs, models, methods, and instantiations) [57] have sufficient potential to change routines. It seems conceivable that only instantiations, i.e., implemented software and hardware, exhibit this potential. Another limitation refers to the number of interviews we conducted. In qualitative research, data collection usually stops when saturation is reached. While we conducted interviews in two phases until the interviewees reported no new aspects, additional insights could have emerged from conducting interviews in different organizations.

Subsequent research can use our patterns to empirically investigate transformation projects in detail, describing trajectories of routines based on the interplay of IT artifacts and the routines' ostensive and performative aspects. Furthermore, clusters of routines, which form around technological complementarities might be identified [49]. Additional studies might also extend the proposed patterns or even identify additional patterns required to describe (digital) transformation stories. These results might enable us to identify why some routines

are more or less generative in the vicinity of digitalization, depending on the way they are related. Unintended consequences, drift, and reach of digitalization [81], as effects that refer to the system's properties of organizations are particularly interesting and challenging fields of research that can benefit from applying the results offered by this paper.

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