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Double-edged Social Mechanisms at Work in the 21st century Information System: Opportunities and Challenges

Completed Research Paper

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Abstract

A long hold explanation in IS-Research is that any change in the Information System (IS), through the introduction of new IT-artefacts, trigger a chain of events leading to institutionalized routines and synchronized social practices. This explanation no longer covers the dynamic outcomes in the work-place set in motion by different types of IT-artefacts. We adopt a critical realist philosophy that entails to illuminate how IT-artefacts trigger social mechanisms in the human enterprise. We review IS-literature on the IT-artefact phenomenon from 2001 and forward. We find that the mechanism of individualization is forcefully triggered by new generative IT-artefacts, while enterprise IT-artefacts trigger institutionalization and socialization. We critically asses the opportunities and challenges this present for managers and designers when managing an IS that holds both types of artefacts. We draw a conceptual model of the now dual-IS, with double-edged mechanisms, that correspondingly can empower ambidextrous organizational forms.

Keywords: IT-artefacts, enterprise IT-artefacts, generative IT-artefacts, social mechanisms, critical realism, dual-IS

Introduction

The enterprise world has undergone tremendous changes in recent years, as evidenced by proliferating new theories in different areas of business management (Lee, 2016). New management and organizational theories has lately promoted theories of ambidexterity (O'Reilly and Tushman, 2013). Kotter (2012) promotes a dual-structure in which both a hierarchy and a network serve as a holistic platform for organizing. These theories reflect the complex task of managing in the 21st century enterprise that involves holding an eye on both stability and agility; control and autonomy; long-term and short-term; exploitation and exploration. Basically these theories promote a simultaneous *both/and* approach to management (Smith, Lewis and Tushman, 2016). In our opinion, the IS-discipline lacks a little behind in conceptualizing how the IS - seen as a holistic arrangement - supports this *both/and* perspective. Predominantly, because of a long hold focus on developing IS-theories in which the purpose of IT-artefacts i.e. enterprise systems, is to establish deep stable structures, through institutionalization (Currie and Swanson, 2009; Besson and Rowe, 2012; Avgerou, 2013).

Under the label “New Ways of Working” (NWOW) different types of technologies have recently entered the enterprise (Lee, 2016). Technologies denoting social, mobile, analytics and cloud (SMAC) capabilities. These have set in motion sequences of events that leads to increased autonomy (Mazmanian, Orlikowski and Yates, 2013) new work-modes (Legner et al. 2017) and looser organizational structures (Fischer and Baskerville, *forthcoming*). The ability of these technologies can best be described by the concept of generativity from Zittrain: “Generativity denotes a technology’s overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences” (Zittrain, 2006, p. 1980). In the remainder of this paper we refer to generative IT-artefacts. Generative IT-artefacts distinguish from the enterprise IT-artefacts, in their malleability and varied outcomes. We suspect that these out-comes challenge long hold explanations: that users sharing same context and technology, after a while, find synchronous ways of interacting with the technology-in-practice (Orlikowski, 2000); likewise, that IT-artefacts impose and enforce stable and deep structures (Besson and Rowe, 2012). The differences in outcomes represent both challenges and opportunities. Challenges, if managers and designers assume synchronized practices and stable structures from *any* IT-artefact; and react with countervailing approaches, setting up strict work-flows, when autonomous sequences are set in motion; Opportunities if managers and designers act knowledgeable on how these forces complement and enable both stability and agility, just as the newer management literature on ambidexterity prescribes. Zammuto et al. (2007) argue the importance of developing IS-theories that reflect the changes in the phenomena we study, otherwise we risk that IS-theories become irrelevant.

In this conceptual paper, we set forward a discussion of the basic motors of change in the IS. We follow the advice from Avgerou (2013) who sees a need to “strengthen the explanatory capacity of IS-research, by developing causal claims by tracing social mechanisms that bring about IS phenomena” (ibid p. 400). The main purpose of this paper is to draw a conceptual and holistic model of the IS, that explains the social mechanisms that are triggered by different IT-artefacts. The task of tracing mechanisms in the IS, entails to contribute to a research practice, that can explain the outcomes of persistent innovation by uncovering phenomenon-specific causal paths in the human-technology interaction and the IS (Avgerou, 2013). This is the second purpose of this paper.

We apply a critical realist (CR) perspective. CR’s core tenet is that the real world consists of mechanisms not events and that mechanisms combine to generate the flux of phenomena that constitute the actual states and happenings of the world. These events are caused by causative structures and mechanisms, and when new events happen, our theories about the workings of the world must be renewed (Bhaskar, 2008). We ask: *What are the social mechanisms beyond the IS and how can we explain the causal paths of how IT-artefacts trigger different outcomes in the IS?*

First, we must explain the concept of social mechanisms, how they work, and how they potentially trigger outcomes in the IS. Then we review IT-artefact literature, as a proxy of the flux of phenomena spanning a period of 16 years. We interpret to infer mechanisms and change over time. We observe four combinations of mechanisms that explain different outcomes related to the two meta-categories of IT-artefacts: enterprise IT-artefacts and generative IT-artefacts. As an exploratory exercise, we then draw a holistic model that illustrates the ambidextrous organization and the now dual-IS, and we focus on the layer of social mechanisms and outcomes. We discuss the practical importance of increased awareness of how mechanisms influence the IS and how this understanding can help IS-managers and designers, to create opportunities and tackle challenges, to enable ambidextrous organizing.

We have structured the paper as follows: In section 2, we give a brief account of social mechanisms and how they potentially can trigger outcomes in the IS. In section 3, we describe how we infer mechanisms from the chosen literature on IT-artefacts. We also describe the literature search. In section 4, we present the findings from the interpretation and draw an overarching model that simplifies the complex contemporary dual-IS. In section 5, we discuss the reality revealed and how it contributes to the IS-field. In section 6, we conclude by posing new questions.

Mechanisms at work in the IS

Asking what, why and how the IS change, are enduring questions in IS-Research. What triggers change? How does change occur? Why does it occur? These are different aspects of a very relevant question in the contemporary IS: how does the phenomena we study change? In a social system, change is often a ceaseless process of change governed by simple yet universal patterns (Van de Ven and Poole, 1995). These patterns are basic motors of change that can explain how and why changes unfold in the organization.

In different ways IS-scholars has contributed to answer these questions, by reviewing and studying drivers and affordances from different type of technologies. Lee (2016) study of smart technologies in relation to NWOW demonstrate such an effort. They demonstrate through a comprehensive systematic literature review, that an impressive amount of technological drivers has transformational impacts in the enterprise. Lee (2016) find 16 constructs at the individual level of which aspects such as independency, creativity, flexibility and control is found to drive transformation. At the organizational level 15 constructs are found, in which many of the same drivers from the individual level are inferred. Volkoff and Strong (2010) are obtained by the organizational changes set forward by the implementation of ERP-systems. They show how affordances are a specific form of generative mechanism and that “affordances are the generative mechanisms we need to specify” (Volkoff and Strong, 2010, p. 1). They find 19 specific affordances from a case-study using critical realism. They group them in four categories: 1) recording data, 2) standardizing and integration 3) visibility and 4) control. Similarly, Treem and Leonardi (2012) find four affordances, by reviewing case-study literature on social-media. They find: 1) visibility, 2) persistence, 3) editability, and 4) association, and suggest that the activation of some combination of these four will influence many of the processes in the enterprise that alters socialization, information sharing, and power processes in organizations. Henfridsson and Bygstad (2013) focus on three generative mechanisms 1) innovation, 2) adoption and 3) growth. These three mechanisms constitute and explain the success-full adoption and development of digital infrastructures in a case-study using critical realism.

We will contribute to these researchers work, and to the practice of tracing mechanisms in the IS. We will focus on social mechanisms as Avgerou states: “While social mechanisms thrive in IS theory they are rarely explicitly identified and mentioned in the theories” (Avgerou, 2013, p. 407). We apply a critical realist perspective in which the search is aimed at gaining an increasingly comprehensive and deep understanding of causal mechanisms i.e. the more basic forms of mechanisms that can be said to underlie other drivers and affordances in the IS.

According to Sayer (1992) looking for mechanisms entails that we ask into “the cause of something, ‘what makes it happen’ or, more weakly, what ‘enables’ or ‘leads to it’ “ (Sayer, 1992, p.104.). Sayer (1992) also argues that particular interpretations (of causality) can only be justified in terms of their compatibility with our most reliable beliefs. Put another way, our interpretation of mechanisms in the IS rely on an assumption which, together with other assumptions, create a system of thinking about the world that we find acceptable. We must have reason to believe that what we study have the powers or liabilities to cause events to occur. As presented in the introduction institutionalization is one of IS-Research’ assumptions. Our assumption is that this mechanism is halted or complemented by other social mechanisms not yet explicitly identified. In the critical realist approach mechanisms are seen as triggered causal powers (Gross, 2009).

When we study information systems, we often inhabit a systems perspective. Systems theory is used to understand the complexity of real situations, rather than analysing separated aspects (Ropohl, 1999). According to Ropohl (1999) specific causal mechanisms in a [socio-technical] system can best be described by the mechanisms of institutionalization and socialization. Ropohl (1999) presents two mechanisms that explains the outcome of a successful relationship between humans and technology in the IS. *Technical institutionalization* can best be described by the assumption that every technical product incorporates functions which prior has been a personal ability, knowledge and intention and thus inside a certain individual person. This is externalized and objectified in the technical system, and thus generalized beyond the individuals. This process of transindividual generalization of value and behavior patterns is called

institutionalization in sociology, and hence, technical development has to be understood as technical institutionalization (Ropohl, 1999). *Technical socialization* means the process of when institutions (in the abstract meaning), channel and shape the behavior of the individuals, and *integrate them into a common culture*, an effect which is called socialization in sociology. Formerly, this happened through human communication mainly, but nowadays technical products exhibit the same performance. When utilized within the IS, *the technology transfer their institutional power to the individual*. This mechanism is labeled technical socialization (Ropohl, 1999). When Orlikowski (2000) articulates that eventually synchronized behavior will emerge over time, we infer this as evidence of the powers institutionalization and socialization. When Avgerou (2013) indicates institutionalization as the mimic social mechanism underlying a vast amount of IS-theories, we draw the same inference. Evidently, these two mechanisms are assumed to be triggered, upon introduction of IT-artefacts in the human enterprise.

Mechanisms denote a linear causal process of change that produce the tendencies towards a specific change in the relational organization of a social order (Archer, 2015). However, each such tendency can be halted, suspended or distorted by the co-existence of other countervailing mechanisms. Archer (2015) argues, when the mechanisms are not triggered countervailing mechanisms can be in place that are triggered more forcefully (Archer, 2015). Hofkirchner (2014; 2015) describe a dialectic dynamic nature of social mechanisms that can explain such events. He identifies that the opposite of socialization is individualization. Actually, he indicates that they are both an end in a continuum. This continuum denotes a dialectic between individualization and socialization. He explains that members of societal systems are different individuals. Through their actions they bring about the formation of social relations that integrate. This in turn allows the individual to differentiate. The more individuals are individualized, the better they socialize (Hofkirchner, 2014; 2015). This mechanism holds the system together. Individualization in isolation, is a force-full social mechanism in society, denoting that people more and more act as individuated individuals not influenced by social norms and institutions (Castells, 2010). Individualization can, as a negative side effect, lead to egoism and isolation. Socialization can also trigger negative side effects, because it can lead to system-rigidity and inertia (Besson and Rowe, 2012). In both cases, the social system breaks down.

As said, mechanisms, however, “operate [only] when suitably triggered” (Gross, 2009, p. 62) and they coexist with a host of other mechanisms, processes, and factors that inhibit that triggering or otherwise interfere with the causal relationship. In critical realism (CR) the real exists independent of human thought. This reality consists of structures, mechanisms and entities that are unobservable. Their existence can only be observed through the actual events that they cause. Critical realists make sense of the world, based on their understanding of the mechanisms that generate these events. On the other hand, critical realists can only experience the world, through empirical observations, which in nature are subjective. According to the CR ontology, generative mechanisms underlie the change of reality that may be contingently actualized and, perhaps, empirically identified by humans. The identification of mechanisms involves analytic movement across three ontological domains: from the empirical, where scientists access experience; to the actual, where they identify the events that generate that experience; to the real, wherein lie the causal mechanisms—usually unobservable. Bhaskar (2016) says “*theoretical explanation proceeds by description of significant features, retroduction to possible causes, elimination of alternatives and identification of the generative mechanism or causal structure at work*” (ibid, p 60). While we cannot directly study mechanisms, we must study the actual outcomes. The CR method of science is that of retroduction, in which the goal is to discover the interacting mechanisms and structures which generate a phenomenon (Mingers, Mutch and Willcocks, 2013). In table 1, we have collected the social mechanisms we propose to look for, representing a historically possibility of actually being real (Gross, 2009). We will look for the unidirectional mechanisms, but also the bi-directional mechanisms. The goal of critical realist research is to determine these proposed mechanisms and then eliminate some while supporting others (Henfridsson and Bygstad, 2013; Bygstad, Munkvold and Volkoff, 2015). In the following we present the methodology for conjuring the more universal social mechanisms triggered by IT-artefacts, over the course of 16 years.

Table 1. Mechanisms and outcomes

<i>Unidirectional mechanisms and outcomes</i>	
Technical institutionalization Technical socialization	When the particular IT-artefact theory and description of features displays effects/intentions of institutionalization and socialization i.e. shared ways of working.
Technical individualization Technical diversity	When the IT-artefact denotes different outcomes, individualized behaviors and increased autonomy. When the IT-artefact is malleable and denotes generativity.
<i>Bi-directional mechanisms and outcomes</i>	
Integration & diversity Socialization & Individualization	When the particular IT-artefact <i>theory</i> displays effects of the dialectic nature between integration and diversity and socialization and individualization.

Method

We have chosen to interpret the social mechanisms underlying the flux of the IT-artefact phenomena in the 21st century enterprise as studied and reported by fellow scholars within the IS-research community. More specifically, we seek descriptions specifically covering a theoretical definition of what constitutes an IT-artefact. In 2001, Orlikowski and Iacono, call for research that view technology as artefacts, not just as objects, denoting an understanding that IT-artefacts are not universal or neutral, they are embedded in their context, made of fragments and are neither fixed nor independent (Orlikowski and Iacono, 2001). This call inspired other researchers to contribute to the *IT-artefact theorizing* trajectory. We are interested in reviewing these articles, because the layer of the actual, consists of our theories of how the world works. Logically, when the mechanisms that caused the theories in the first place, change, then our theories must change as well (Bhaskar, 2008). This entails that *when-ever* a new theory of the IT-artefact surface, the mechanism must have changed or mechanisms must combine in new ways.

Literature search

A manual search (in October 2016) first in AIS Journals and Conference Proceedings¹ with the word “IT (technology/digital) + arte(i)fact (s)” in titles, abstracts and keywords, and after closer scrutiny yielded 22 relevant articles published from 2001 – 2016. Two additional searches were carried out with the same search term and search criteria. One in Google Scholar. This yielded two more articles marked with italic in table 3. The entire sub-set of articles cover 23. We did conduct a similar search in Journal of Organizational Science. None matched the search in titles, abstracts or keywords. When applying “everywhere” only 6 papers matched. One was relevant to the RQ, but was already covered in a MIS Quarterly paper.

As an example of a paper that met the inclusion criteria of *IT-artefact theorizing* is Benbasat and Zmud (2003). Herein an IT-artefact is defined as “...the application of IT to enable or support some task[s] embedded within a structure[s] embedded within a context[s]” (ibid, p 186) and theorized to exhibit backwards and forward causation on usage and management. A text that did not meet the inclusion criteria was from Currie and Swanson (2009). Even though the term IT-artefact is in the title and in the abstract, the IT-artefact is only used in the last sentence of the paper. It is used as an umbrella term, to cover different IT-systems and technologies. No definition or development of the IT-artefact theorizing was explicated. Table 2, is an overview of the 23 selected papers. They all represent a contribution to the *theorizing of IT-artefacts*.

Table 2. Overview of papers

#.	Author (s)	Year of origin; short title and outlet
1.	Orlikowski and Iacono,	2001. "Desperately seeking the IT-artefact". Inf. System Research
2.	Kallinikos,	2002. "Blackbox of technology artefacts and change". ICIS proceedings
3.	Benbasat and Zmud.	2003. "The identity crisis within the IS-discipline" in MIS Quarterly
4.	Alter,	2003. "Sidestepping the IT-artefact" in Comms. of Association of Information Systems
5.	Mazino and Zamarian,	2003. "IT artefacts as structuring devices". <i>Interact. with Computers</i>
6.	Whinston and Geng,	2004. "The essential role of the IT Artifact in ISR". MIS Quarterly
7.	Agarwal and Lucas.	2005. "The IS-Identity Crisis" in MIS Quarterly
8.	Alter,	2006. "Work-systems and IT artifacts" in Comms of Association of Information Systems
9.	Chiasson and Green,	2007. "Questioning the IT Artefact: user practices" European Journal of IS
10.	Matook and Brown,	2008. "Conceptualizing the IT Artefact" in ICIS proceedings
11.	Caroll,	2008. "Theorizing the IT artifact for Mobility" in ICIS Proceedings
12.	Evermann and Tate,	2009. "The lost world of the IT-artefact" in Journal of Ass. of Inf. Sys.
13.	Ponto, Rossi and Zamarian,	2009. "Coop. design for the complex IT-artefact". <i>IT and People</i>
14.	Nevo, Nevo and Ein-dor,	2009. "Core artefacts" in Comms. of the Association of Inf. Systems
15.	Strong and Volkoff,	2010. "A path to theorizing the IT-artifact" in MIS Quarterly
16.	Agresti,	2011."Toward an IT agenda" in Communication of Association of Information Systems
17.	Zang, Scialdone and Ku,	2011. "IT Artefacts and the State of IS Research" in ICIS proceedings
18.	Robey, Anderson and Raymond,	2012. "IT, Materiality and Change" in Jour. Ass. of Inf. Sys.
19.	Lee, Thomas and Baskerville,	2013. "From the IT artefact to the IS artefact" in AMCIS proc.
20.	Reimer and Johnston,	2014. "Rethinking the place of the artefact in IS" in Eur. Jour. of Inf. Sys.
21.	Eck, Uebernicket and Brenner,	2015. "Generative capacity of digital artifacts" in PACIS proc.
22.	Alter,	2015. "The IT-artifact has outlived its usefulness" in Comms. of the Ass. of IS
23.	Nevo, Nevo and Pinnensault,	2016. "Self-agency theory and IT-reinvention" in MIS Quarterly

The distribution over years, of the 23 articles is very consistent with one to three every year. This distribution exhibits a consistent interest in theorizing about the IT-artefact from 2001 and forward. Out of the 23 articles 15 articles comes from respected IS-journals (1 from ISR, 5 from MIS Quarterly, 5 from CAIS, 2 from JAIS and 2 from EJIS), 2 articles from other relevant journal out-lets: Information Technology and People; and Interacting with Computers. We selected 6 articles from conference proceedings (4 from ICIS, 1 from AMCIS and 1 from PACIS).

Interpretation and explanations

In the social sciences, explanation takes the form of breaking events down into elements, identifying the mechanisms that generate them, and determining, through empirically grounded reflection on the conditions of historical possibility, whether and how those mechanisms brought about the events (Gross, 2009). The cornerstone of realism is a distinctive viewpoint on how interventions bring about change. It is only by understanding and probing into the change that one can evaluate a theory. According to realist evaluation, sequences are theories, they are embedded and active (Pawson et al., 2004). Realist evaluation stresses four key linked concepts. The mechanisms describe what it is about the theory that bring about any effects. Identifying the sequence is the first step, while context describes those features of the conditions in which the sequence is introduced that are relevant to the operation of the mechanisms. Lastly, outcome-patterns comprise the intended and unintended consequences of theories, resulting from the activation of different mechanisms in different contexts. Thus we seek to convey the "context-mechanism-outcome pattern configuration" (Pawson et al., 2004 p. 6). In table 1 we presented the mechanisms that most likely will cause different outcomes in the context of the 21st century enterprise.

Inferring mechanisms is an iterative and creative task (Bygstad, Munkvold and Volkoff, 2015). We analyzed each paper several times. We asked: What changes can we infer from the new IT-artefact theory? Which new events, new conditions and/or new observed dynamics are highlighted in the IS, that need theoretical elaboration? This gave a general understanding of the change motivating each article. Then we asked: How is the change related to the IT-artefact? Can we derive a sequence? Are changes intended or un-intended? What mechanisms from table 1, can possibly and most reliably be the cause of these outcomes?

We inferred 4 different ways of how these mechanisms combine to produce outcomes from the implementation of the IT-artefact in focus. The interpretation and retrodution of mechanisms from table 1 are highlighted with different shades of grey in appendix A. In table 3, we explain four categories, denoting how mechanisms combine and produce certain outcome patterns over the course of 16 years. The first category represent 8 IT-artefact theories that explain outcomes, caused by mechanisms of technological socialization and institutionalization; The second combination represent other 8 IT-artefact theories that explain how the IS evolves more rapidly responding to the environment, based on a combination of different types of enterprise systems and applications, that trigger socialization, institutionalization and integration. The third combination represent 5 theories showing that mobile and generative IT-artefacts trigger individualization and diversity in the IS. The fourth combination are found in two theories that mirrors bi-directional mechanisms.

Table 3. The four combinations of IT-artefact outcomes

<p>1. Enterprise IT-artefacts trigger institutionalization and socialization (2001-2015)</p>
<p>The first combination, are theories of IT-artefacts that holds institutionalizing and socializing purposes, supporting the socio-technical system understanding of how main mechanisms create a well-functioning system. Orlikowski and Iacono (2001) define IT-artefacts as "...those bundles of material and cultural properties packaged in some socially recognizable form such as hardware and/or software" (ibid, p. 121) as such they are not universal or neutral and embedded in their context. Benbasat and Zmud (2003) define IT-artefacts "as the application of IT to enable or support some task(s) embedded within a structure(s) that itself is embedded within a context(s)" (ibid, p. 186) and underline the importance of understanding the causality between context, structure and tasks as IT becomes artefacts embedded in routines, norms and values. In Mazino and Zamarian (2003) IT-artefacts are conceived as negotiated, embedded, and sedimented sets of rules and can be seen as vessels carrying the rules influencing users' behavior. Even though Alter (2003; 2006) subscribe to IT-artefacts as tools, they are integrated parts of the work-system, with the purpose of creating competitive advantage and productivity. In Volkoff & Strong (2010) IT - artefacts imposes a structure to work; that are intentionally designed into the Enterprise Systems (the focus of their study). Just as socialization follows institutionalization (Ropohl, 1999). Volkoff & Strong (2010) find that new latent structures of a social nature arise as second order structures. These structures are organizational culture, roles and control-mechanisms. This structural approach to technology is supported in Robey, Anderson and Raymond (2012) in which IT-artefacts denote structure, but also a perception, because IT-artefacts are embedded in routines that are vital to the organization. Alter (2015) describes an IT-enabled work system in which human participants and/or machines perform processes and activities using information technology to produce products and services.</p>
<p>2. The IS consists of diverse IT-artefacts, that combine and trigger institutionalization (2004-2011)</p>
<p>In the second combination we see IT-artefacts that intentionally trigger institutionalization, socialization and integration, but also holds a variability in relation to different roles and purposes in a more complex and networked IS. Whinston and Geng (2004) describe IT-artefacts as evolving rapidly and innovatively, driven by business intent and strategies. Lucas and Agarwal (2005) explains how IT-artefacts are "...the integration of the processing logic found in computers with the massive stores of databases and the connectivity of communication networks" (ibid, p. 394). Martook and Brown (2008) map a diversified IT-artefact landscape, and describe four IT-artefacts with different roles and purposes in the IS. Some</p>

are open and dynamic to change (Knowledge Management Systems and Business Intelligence) others are closed and static (Decision Support and Enterprise-IS). In general, IT-artefacts are defined as systems or applications in a larger system, with distinct purposes, that compliments each other and facilitates the enterprise in achieving its goals. Nevo, Nevo and Ein-dor (2009) conclude that the “IS discipline has a central and enduring core, which, while not completely static, may be characterized by persistent attention to a small set of IT Artifacts and a similarly small set of IS [...] this enduring focus [...] reflects on our discipline” (ibid, p. 234). The focus being on decision support, enterprise systems, infrastructures and collaboration tools, triggering institutionalization, socialization and integration. Evermann and Tate (2009) points to the importance of designing artefacts that are based on knowledge of human psychology, so that each individual can create relevance at the operational and actionable level in a work-system. Ponto, Rossi and Zamarian (2009) explores how users cooperate when designing an IT-artefact and eventually how this impact the relationship between the IT-artefact and organizational structuration. Agresti (2011) takes a more pragmatic view and describe the IT-artefact as a phenomenon that encompass all the elements that are involved with the practice-use of technology in work, enabled by information processing capabilities. IT-artefacts consists of physical systems, hardware, software, tools, techniques, methods, policies, protocols, methodologies, and practices which make up the information system. Zang, Scialdone and Ku (2011) take stock of the IT-artefact in IS research and describe IT-artefacts as “an entity/object, or a bundle thereof, intentionally engineered to benefit certain people with certain purposes and goals in certain contexts. It is developed, introduced, adopted, operated, modified, adapted, discarded, and researched within contexts and with various perspectives” (ibid, p. 3). Thus we infer IT-artefacts have various purposes that combines to full-fill the strategic intent of the enterprise.

3. Generative IT-artefacts trigger individualization and diversity (2008-2016)

The third combination denotes theories of IT artefacts that in important ways reflect the existence of *the individualization mechanism* at work in the IS. We identify that individualization and diversity are triggered and combine in ways that lead to new hierarchies, structures and functions in the IS. The outcomes are rapidly changing and evolving systems of systems, that leads to looser structures and network formations. Carroll’s (2008) study of mobile technology theorize that IT-artefacts, previously fixed in a specific physical context, are now adopted by individual mobile workers, who constructs a portfolio of technologies, where use is diverse and unexpected. These workers have a temporal orientation towards the situation that determines the individualized portfolio in the moment. The IT-artefact can no longer be viewed as a single stranded design with a defined purpose, instead it evolves rapidly, increasing diversity and it is operated by the individual user (Carroll, 2008). Reimar and Johnston (2014) describes these outcomes a little differently and see IT as equipment used-in-practice. They explain, that the use of IT is conceived as the appropriation of IT into a holism of other equipment, work practices and user identities. This view replace the understanding of IT artifacts, as a bundle of features or properties and it dissolves the linear cause and effect that dominates the IT-artefact theorizing in combination 1 and 2 between design, intent and use. Practices and equipment are constitutive of the self to the degree that individuals express their (professional) identities through the equipment they use. Lee, Thomas and Baskerville (2013) advocate that IT artefacts must in fact be seen as IS artefacts that holds information, technology and social constructs created by individuals and groups. They view an IS as made-of any number of individual and collective IS-artefacts. Nevo, Nevo and Pinnensault (2016) calls this re-invention of technology and finds, just like Carroll (2008), that changes are continuous and short-termed. Individuals change technology to perform better and to master work. Temporally situated self-agency is driving the adaption in pursue of a goal, changing the purpose and intent embedded in the technology that supports a task. Eck, Uebernickel and Brenner (2015) introduce the concept of generativity as the capacity of a technology or a system to be malleable by diverse groups and actors in unanticipated ways. Innovation brought about heterogeneous groups of actors is universally regarded as the goal of generativity, but it also represents the possibility of exploiting generative systems towards other valuable ends such as organizational agility. The outcomes are complex, networked and evolving systems in systems.

4. Integration and socialization/diversity and individualization (2002-2007)

Two articles describe theories of IT-artefacts that mirrors outcomes from the bi-directional mechanisms denoting diverse agents that bring about a structure that integrates; this structure leads to socialization that in turn leads to individualization. Kallinikos (2002) puts word to these mechanisms by saying that IT-artefacts must predominantly be a part of individual sense-making and appropriation. IT-artefacts are first and foremost created by humans in a social but defining setting. Likewise, inscription of technology by designers may be either deterministic and detailed, or emergent and general (Chiasson and Green, 2007). Kallinikos (2002) describes different degrees of controls, denoting IT-artefacts as being everything between very malleable to very predictable. Some IT-artefacts are sketches for work, inviting actors to mend and fit the technology; some are scores open to interpretation while imposing some form of predictability in outcomes. Others such as Enterprise IT-artefacts represent stricter scripts for work. The theories cover different outcomes from different IT-artefact that most likely trigger socialization and individualization at the same time. We did not categorize Martook and Brown (2008); Lee, Thomas and Baskerville (2013) or Eck, Uebernickel and Brenner (2015) in combination 4. However the theories do hold a *both/and* perspective that possibly supports both processes and practices, and enable agility and stability.

Overall, the four combinations of mechanisms constitute a larger narrative of causal paths in the 21st century digital workplace. From the theorizing in category 1, we conclude that IT-artefacts that hold enterprise scripts with specified purposes and intentions trigger technological institutionalization and socialization. The power of these mechanisms does not seem halted. They endure from 2001-2016. During the period from 2003 - 2011 the theorizing in combination 2 involves technological innovation. Various and more tasks are supported by different IT-artefacts, thus concurrent enterprise information processes and practices with strategic intent combines and integrate in the IS. This entails that we can theorize that the meta-category of the enterprise IT-artefact trigger unidirectional mechanisms of first and foremost institutionalization, socialization and integration. 16 articles hold this perspective. In 2008 and forward, new digital technologies of mobility and connectivity enters the theorizing. In combination 3, we observe that outcomes are now oriented towards the individual user, short-termed and fast changing. These outcomes influence hierarchy, structure and relations through the mechanisms of technological individualization and diversity. These outcomes are generative. Thus the other meta-category of generative IT-artefact is now theorized to trigger unidirectional mechanisms of individualization and diversity. This perspective is mirrored in a smaller number of articles from 2008. We ascribe the fewer theories of generative IT-artefacts the fact that they have arrived more recently and as such, represent 5 out of 13 articles, since 10 articles were produced before Carrol (2008) and 12 after. Combination 4 covers two articles from 2002 and 2007 with theories of dynamic outcomes arising from a more holistic view inhabited by both types of IT-artefacts, triggering bi-directional mechanisms. Despite the limited number representing this perspective, we make the logical inference that bi-directional social mechanisms are most likely triggered in the IS. However, we categorize it as under-researched.

The larger narrative signifies a reality in which out-comes, predominantly from unidirectional mechanisms, are observable. The forces from bi-directional mechanisms are less observable, but they most likely combine, and are triggered concurrently by the two different meta-categories of IT-artefacts in the IS: 1) enterprise IT-artefacts with aspects of predictability, fixed within an enterprise context, defined by purpose and supporting a process, that triggers socialization, institutionalization and integration. 2) Generative IT-artefacts, with aspects of malleability, flexibility and agility, and supporting the day-to-day practices that trigger technological individualization and diversity. Both meta-categories of IT-artefacts inhabits the 21st century workplace. IT-artefacts work side by side and produce outcomes in what we now label as a dual-IS. As an exploratory exercise we draw a model that visualize the layer of social mechanisms, the IT-artefacts and their outcomes. We combine them with the present perspective of the ambidextrous organization from Kotter (2012) and Smith, Lewis and Tushman (2016).

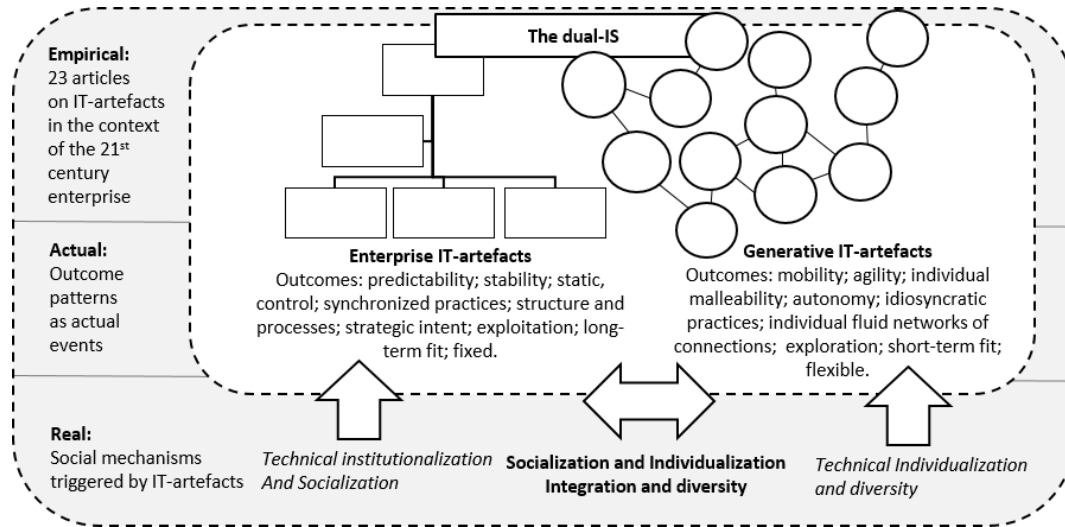


Figure 1. The dual IS and social mechanisms in the 21st Century Organization

The model of the dual-IS in figure 1, shows how two meta-categories of IT-artefacts support two different but important organizational platforms in the ambidextrous organization: that of a hierarchy (the left side in the white box) and that of a network (the right side of the white box). It pictures the possible explanation of how generative IT-artefacts trigger the social mechanisms that set in motion sequences of technical individualization and diversity among actors, with outcomes of individual fluid network-like structures, speed, agility, autonomy, thus supporting exploration in the ambidextrous organization. Simultaneously the enterprise IT-artefacts, trigger socialization and institutionalization in the more stable and hierarchical part of the ambidextrous enterprise, with outcomes supporting exploitation. These apparently contradictory mechanisms possibly enables and enforce each-other through the bi-directional social mechanisms represented by the white arrow in the middle. In figure 1, the three strata from critical realism are highlighted in the grey area. The articles served as the empirical layer, the outcomes described are the actual layer, and the layer of the real, are the social mechanisms that most likely will be triggered. In the following we discuss the contribution and the practical and theoretical implications derived from this interpretation.

Discussion

Our review contributes to approaching opportunities and challenges in the digitized enterprise. Specifically, it contributes in five key ways.

First, we inferred the real layer of mechanisms that are triggered by the implementation and adoption of different types of IT-artefacts in the 21st century workplace. As such we contribute to the discussion of mechanisms and causal paths in IS (Avgerou, 2013).

Second, Lee (2016) study of smart technologies, Treem and Leonardi (2012) study of social media, Henfridson and Bygstad (2010) study of digital infrastructures and Strong and Volkoff (2010) study of ERP-system are examples of research answering the question of possible causal paths by focusing on affordances, drivers and generative mechanisms in relation to *one* specific IT. Our study focus on the social mechanisms beyond these levels triggered by two meta-categoris of IT-artefacts. As such we contribute to, extends and elaborate prior work by looking at the more universal social mechanisms that are triggered and set in motion by the human-technology relationship.

Third, As Van de Ven and Poole (1995) we infere universal patterns that are the most likely explanations to the dynamic and complex forces at work in the enterprise. Our findings contributes with an IS-domain specific perspective and explanation on how technology implementation aimed at individual practices and

at organizational processes trigger outcomes that the theory of ambidexterity seek to deliver (O'Reilly and Tushman, 2013). As such we deliver an IS-elaboration path that mirrors the management-literature on dual-systems (Kotter, 2012) and *both/and* thinking (Smith, Lewis and Tushman, 2016).

Fourth, as critical realists we understand the world in different strata, and by parting the world into the empirical, actual and real, it is possible to keep a clear focus on the social mechanisms beyond drivers and actualized affordances from specific IT-artefacts otherwise operating in the enterprise. The critical realist approach reveals a reality in the human enterprise where a few basic mechanisms are triggered simultaneously by two different meta-categories of IT-artefacts in the IS. Our reproduction of social mechanisms at work in the IS serves as a particular explanation of causality that are compatible with reliable beliefs from the field of philosophy of technology (Ropohl, 1999; Hofkirchner, 2014;2015).

Fifth, and most importantly, our review reveals a new dimension of the dynamic work-place and serves as *a most likely* explanation as to why the former explanations, of how IS-change follows unidirectional mechanisms of institutionalization and socialization, no longer holds. We have shown that the opposite side of institutionalization and socialization are now triggered, by the more recent entrance of generative IT-artefacts with outcomes that can be explained by the mechanism of individualization. When viewed in a larger picture we surmise that the bi-directional mechanisms hold the now dual-IS in balance. But only if the mechanisms are properly and proportional activated. A present and future challenge will be to tackle these mechanisms, so that the system does not become overtly rigid and strict - resulting in inertia and stagnation; or overtly loose - resulting in chaos and no-direction. The opportunities of a well-functioning dual-IS lies in how well these double-edged mechanisms are triggered - and set in motion - to secure both stability and agility. Thus it relies on how well a *both/and* perspective can apply to IS-activities. This will become increasingly important to IS-managers and IS-strategists.

Our study has several limitations. Our model of the contemporary IS and its mechanisms are conjured from other scholars polished work on the IT-artefact and on the basis of few but influential works on social mechanisms relevant to field of technology philosophy and the information society. Our inclusion criteria of IT-artefacts in titles, abstract and keywords, is narrow. The word IT-artefact is often not used in articles, instead papers mention the specific type of IT/ES. While theory and conceptual development from literature reviews are a traditional research activity, our paper present a weakness of reliability of the inferences. Inferences are basically subjective and in this case they are based on 23 articles and a single author's interpretation. Going forward we will expand the search to include works outside of AIS, include more researchers and expand the search to other inclusion criteria. We will also conduct a systematic review of social and generative mechanisms in the IS in order to elaborate and develop the subset of mechanisms that we have reproduced.

Conclusion

The purpose of this paper was to contribute to a renewed understanding of the motors of change, by presenting a model that includes the level of social mechanisms at work in the 21st century enterprise. The model explains how different mechanisms are triggered by different types of IT-artefacts in the IS. This knowledge is use-full for scholars researching new theories about the changing workplace, and it can be use-full for designers, managers and strategists when they plan and explain expected successful outcomes from their *interventions* into the complex current dual-IS. The model of the dual-IS can also help managers to succeed in delivering on both stability and agility from there IT-artefact interventions.

Many questions are still unanswered. We suggest further research that can answer the following: How does individualization affect the relations and structures in the IS? Will ever more differentiated individuals, integrate into looser structures that eventually becomes to lose? Will the response from managers be to create ever more strict structures, thus producing negative outcomes from halting the activation of the double-edged mechanisms? How do we trigger the bi-directional outcomes of agility and stability in a 21st century enterprise? How is balance achieved? We invite other scholars to answer these questions with us.

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Appendix A. Mechanisms and nature of IT-artefact

Paper	What IT-artefacts	Mechanisms						
		TS	TI	ID	SI	I	D	
Year and Authors	Unspecified/specified; Intended or generative							
2001 Orlikowski and Iacono	Unspecified-intended							
2002 Kallinikos	Both/and, intended/generative							
2003 Benbasat and Zmud	Specified/intended							
2003 Alter	Unspecified/intended							
2003 Mazino and Zamarian	Specified/intended							
2004 Whinston and Geng	Unspecified/intended							
2005 Lucas and Agarwal	Unspecified(intended							
2006 Alter	Unspecified/intended							
2007 Chiasson and Green	Specified/intended and generative							
2008 Matook and Brown	Specified/intended and generative							
2008 Caroll	Specified/generative							
2009 Evermann and Tate	Specified/intended							
2009 Ponte, Rossi and Zamarian,	Specified/intended							
2009 Nevo, Nevo and Ein-dor	Specified/intended							
2010 Strong and Volkoff	Specified/intended							
2011 Agresti	Unspecified/intended							
2011 Zang, Scialdone and Ku	Unspecified/intended							
2012 Robey, Anderson and Raymond	Unspecified/intended							
2013 Lee, Thomas and Baskerville	Unspecified/generative							
2014 Reimer and Johnston	Unspecified/generative							
2015 Eck, Übernicket and Benner	Unspecified/generative							
2015 Alter	Unspecified/intended							
2016 Nevo, Nevo and Pinnensault	Unspecified/generative							

Legend. *Paper*: Year of publication and authors. *Unidirectional mechanisms*: TS: technical socialization; TI: technical institutionalization; I: technical individualization; D: technical diversity. *Bi-directional mechanisms*: ID: integration and diversity; SI: socialization and individualization.