BEYOND RESISTANCE: TOWARDS A MULTI-LEVEL PERSPECTIVE ON SOCIO-TECHNICAL INERTIA IN ORGANIZATIONAL TRANSFORMATION

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Research paper

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Abstract

In the wake of the discourse on Digital Transformation, the phenomenon of socio-technical inertia has caught the attention of Information Systems researchers. As a latently present theme in both practical and theoretical discourse, it is recurrently referred to as an explanation for the large share of transformation initiatives going awry. Despite its prevalence, socio-technical inertia remains an undertheorized, elusive, and ambiguous concept. Based on a structured review, we propose a sensitizing conceptualization of socio-technical inertia as a relative force and a mutual constituent of transformation. From a mechanism-based explanation, we derive an analytical multilevel perspective on the conceptualization and explore this lens in a case study. The case company has transformed its socio-technical macro regime through multiple major alterations of its workplace information technology infrastructure. We illustrate how such alterations in local fields of work contingently evoke inertia. Thereby, inertia is manifested not just as resistance to shifts in the socio-technical regime but also by mechanisms of perfunctory change, through which it undermines transformational efforts. Our findings imply the need for a new angle on inertia in future research and support an alternative managerial conception of transformation to the one currently dominating the discourse.

Keywords: socio-technical inertia, digital transformation, workplace, IT infrastructure, case study

1 Introduction

The notion of digital transformation, that is, change in the socio-technical deep structure enabled by emerging information technology (IT), fills today’s business press. The fear of being “disrupted” haunts established organizations (Bonnet et al., 2015). The urgency for organizations to adapt to the dynamics of technological advancements is widely acknowledged. In a global survey (Fujitsu, 2017), 90% of the responding decision makers indicate their ongoing digital transformation initiatives; they have started exploring the strategic potential of embedding emerging IT in their corporations’ core value-generation processes. In search for an “alchemistic solution” (Land, 1996), every new technology trend adopts its own strategy. Why CIOs Still Need a Cloud Strategy is published in Gartner (Pettey, 2016). Planning Your Big Data Strategy can be learned from Forrester (Bennett, 2014). They all promise straightforward solutions to overcome digitalization challenges through new technologies. However, a one-sided perspective on technological idiosyncrasies misses the point that “… when it comes to digital transformation, digital is not the answer. Transformation is” (Westerman, 2018, p. 116, emphasis in original). In other words, transformation does not involve matching individual technologies with discrete business problems or social settings but entails a systemic adaptation of socio-technical arrangements to their environments (Luna-Reyes et al., 2005; Lyytinen and Newman, 2008). Quantitative research suggests that adaptation initiatives—driven and enabled by emerging IT—pose substantial risks. Every sixth to half of those endeavors are claimed to elude managerial control, threatening organizational viability at worst (e.g., Bharadwaj et al., 2009; Flyvbjerg and Budzier, 2011; Goldfinch, 2007).
As Rowe et al. (2017) point out, it seems paradoxical that the same endeavors that seek to ensure competitiveness pose a significant threat to the organizations undertaking them. However, this argumentative angle overlooks or neglects the fact that socio-technical arrangements are not malleable *ad libitum* but intrinsically face inertia (Besson and Rowe, 2012; Rumelt, 1995).

Organizational inertia has long been argued to originate from several factors, such as size and age (Gilbert, 2005; Hannan and Freeman, 1984). Other researchers have emphasized that foundational technological infrastructures may cause inertia (e.g., Fairhurst et al., 1995; Lucas and Olson, 1994). While both perspectives find empirical substantiation, only recently—in the wake of the digital transformation discourse—have scholars started to take inertia along a socio-technical dimension seriously (Rowe et al., 2017; Schmid et al., 2017). Empirical studies suggest that inertia plays a major role in the digital transformation associated with IT (e.g., Mikalef et al., 2018; Rezazade Mehrizi and Rodón Mòdol, 2012). Despite its latent presence in transformation research, the conceptual understanding of the phenomenon remains limited, practically overlooked, and undertheorized (Besson and Rowe, 2012).

In this study, we delineate socio-technical inertia as a research concept and investigate *how inertia emerges and is manifested in digital transformation*. The research objective is to conceptualize and explore inertia in transformation. In this pursuit, we present a case to study how alterations of the overarching socio-technical regime through new workplace IT have unfolded their consequences in the local contexts of work, therein evoking socio-technical inertia. This case, especially with its focus on workplace IT, lends itself as prototypical for a socio-technical perspective (Baxter and Sommerville, 2011; Sawyer and Jarrahi, 2014).

We have structured the remainder of this paper as follows. In Section 2, we review the notions of digital transformation and socio-technical inertia therein, deriving a sensitizing conceptualization and a new analytical lens for the phenomenon. In Section 3, we present our approach to exploring the conceptualization of inertia in a case study of a large-scale socio-technical transformation. In Section 4, we describe and analyze the findings and discuss them further in Section 5. Finally, we conclude with this paper’s anticipated contributions and our outlook on future research.

## 2 Theoretical Foundation and Background

In this section, we outline the theoretical background of our research on *inertia*. To this end, we describe how inertia is a foundational, explanatory concept in theorizing transformation. Based on this notion, we develop a conceptualization of socio-technical inertia and propose an analytical lens for an empirical exploration of the phenomenon.

### 2.1 Digital Transformation: Organizational Deep Structure and Information Technology

Transformation generally denotes *fundamental alterations of the durable, organizational deep structure* (Gersick, 1991, p. 12). While transformation research initially focused on social and managerial aspects of organizations, scholars throughout the 1990s started to move the role of IT to the foreground (e.g., Henderson and Venkatraman, 1990; Scott Morton, 1991). However, along with inquiries into IT trends grew the awareness for the manifold unintended consequences of major, purposeful technology changes. Among other reasons, this realization was due to such endeavors’ constantly high rates of unsatisfactory outcomes (Markus, 2004). Nonetheless, systemic approaches, as propagated by socio-technical thinking, had a difficult stance (Kling and Lamb, 1999; Mumford, 2006), and Information Systems research largely remained fragmented across technology design, implementation, and use (Leonardi and Barley, 2008). While the idea of a dialectic interplay between organizations and IT found broader acceptance, its premise that technology would not only drive transformation but simultaneously constrain it (e.g., Markus and Benjamin, 1997; Orlikowski, 1992) was hardly compatible with the then popular assumption of organizational plasticity (Rumelt, 1995). Today, with digitalization fueling the discourse, the constraining role of IT in change is still frequently overlooked or neglected. In a comprehensive literature review on the theme, Besson and Rowe (2012) show that the quest for a better understanding of the role of IT in transformation has remained a *new frontier*. We agree with their conclusion that a more
systemic, socio-technical approach is needed. Strategists still overly rely on the assumption of plasticity and forget that “… transformation … only takes on meaning if we assume that relative inertia constitutes the normal state of organizational life” (Aldrich and Ruef, 2006, p. 136). Thus, we argue for transformation research to incorporate inertia as a systemic force, particularly along a socio-technical dimension.

2.2 Inertia and its Socio-technical Dimension

Early organizational sociologists have argued that through their institutionalized structures and practices, organizations are established for stability (e.g., Burns and Stalker, 1961; Stinchcombe, 1965). Based on this premise, theorists have defined inertia as organizations’ ability to sustain reliable and accountable performance in turbulent environments (Hannan and Freeman, 1984, p. 162), considered a favorable characteristic that increases the probability of economic survival (Amburgey et al., 1993; Miller and Friesen, 1980). The rise of malleable IT has given inertia its negative connotation, with the argument that inertia threatens the survival of incumbent firms in the light of the accelerated speed of technological innovation (e.g., Gilbert, 2005; Tripsas, 2009). To date, organizational studies have not come to terms with the phenomenon of inertia itself or its antecedents and consequences. Despite (or perhaps on the grounds of) the lack of conceptual coherence, inertia has found widespread adoption as a term in IS research.

A structured review of the IS literature reveals that inertia, although explicitly or implicitly treated as a core subject in many studies, remains elusive (see the electronic Appendix, incl. a summary of key findings, in http://bit.ly/2QsMuaE). One-third of the publications leave the concept completely undefined or offer only an opaque description. Mostly, inertia is used to describe resistance to change. Especially, studies using a micro- or a macro-level analysis tend to ‘blackbox’ either organizations as collective entities, IT instantiated as material artifact, or both. According to Orlikowski and Iacono’s (2001) artifact typology, all (except one) micro- or macro-level studies employ a tool or a proxy view, treating technology as a static resource or a surrogate measure. Such blackboxing has been argued as problematic in theorizing the role of IT in organizational change (e.g., Bowker et al., 1997; Kallinos, 2002). Conceptualizing inertia from a socio-technical perspective thus requires ‘unboxing.’ Drawing from the work of Besson and Rowe (2012), meso-level studies popularly aspire for this aim and conceptualize inertia as a complex, multidimensional phenomenon, relating it to technology as part of a systemic ensemble, accruing in the dynamic interaction between people and technology (Orlikowski and Iacono, 2001). Over half of the meso-level studies imply, beyond human agency, material agency as a driver of inertia. Nonetheless, they leave unexplained the causal structures through which the latter emerges. Only a few studies (e.g., Orlikowski, 2000; Venters et al., 2014) have attempted to overcome the forced, analytical distinction of inertia as a social and socio-technical phenomenon. Rowe et al. (2017) explain the most recent and mature conceptualization by defining socio-technical inertia as “… the propensity [of an organization] to continue its run on the same path due to the difficulty to change socio-technical systems as quickly as environment changes” (2017, p. 414), proposing that it reflects rigidities in skill allocation, technological architectures, and process configurations. Meso-level studies also leave unexplained how inertia unfolds in socio-technical change.

Because existing theoretical underpinnings hardly substantiate the formal claims about socio-technical inertia, we subsequently develop a sensitizing conceptualization (Blumer, 1954), offering a reference and guidance for studying its empirical instances. We posit inertia as having systemic root causes, originating from the interplay of social entities with technology as material artifacts, as well as from the inherent agency in both (Sarker et al., 2013). Rather than formally separating the dimensions of inertia, we posit it as forming a duality with transformation, being conceptually distinct, not separate but interdependent and mutually enabling constituents of each other (Farjoun, 2010).

2.2.1 A Recursive Model of Socio-technical Inertia

Inertia in its literal, Newtonian sense is inherently relative, which is unveiled along two dimensions: time and space. By referring to trajectories and path dependencies, Rowe et al. (2017) incorporate the relevance of the past in the nature of inertia; Venters et al. (2014) even explain temporal relativity as
contributing to the tension in socio-technical coordination. Furthermore, any reference to an alignment with an *environment* is grounded on the idea of spatial relativity (e.g., Gilbert, 2005; Weick and Quinn, 1999). Consequently, an adequate definition of socio-technical inertia requires incorporating spatial and temporal relativity. Based on this view, we synthesize the definition of socio-technical inertia as *relative unresponsiveness to changes in the organizational environment due to path-dependent, internal consistencies among social and material entities, as well as their dynamic interaction*. This definition allows operationalizing inertia at multiple analytical levels. It explicitly encompasses social and material entities, building on the arguments that suggest both exhibiting and contributing to the emergence of inertia (Orlikowski, 2000; Rowe et al., 2017). By referring to path dependency, it incorporates a temporal dimension. With the articulated unresponsiveness to changes in the environment, the definition incorporates inertia as becoming apparent through contrasting ‘spatial’ *regimes*, that is, contrasting dynamics of change in the external context a unit of analysis with its inner context. Finally, the definition is impartial regarding any favorability of unresponsiveness.

We describe the spatial dimension of inertia in two structural realms—social and material. The social realm encompasses human actors with their attitudes and beliefs (Polites and Karahanna, 2012), embedded in their institutionalized social systems of norms, comprising hierarchies, policies, and cultural codes (Powell and DiMaggio, 1991; Scott, 1995). All of these psychological characteristics and social norms, while representing different analytical levels, have been argued to commensurably determine the relative rigidity in this realm (Abdelnour et al., 2017; Barley and Tolbert, 1997). In contrast, the material realm encompasses concrete entities (i.e., IT artifacts) within overarching infrastructures. The relative rigidity of material entities is a design feature that is expressed in the range of potential functionalities, as well as their dynamic adaptability or modularity, that is, malleability or flexibility (Doherty et al., 2006; Leonardi, 2011; Palanisamy, 2005). The relative rigidity is also derived from the *complexity* in this realm, involving the number of material entities in combination, their variety, and the dynamics of interaction. Independent from the artifact design, complexity is claimed to negatively affect responsiveness and to increase rigidity in the material realm (e.g., Bygstad, 2017; Chen et al., 2009; Lucas and Olson, 1994). Each of the two realms can exhibit relative rigidity but not necessarily evoke socio-technical inertia. The basic logic of any socio-technical perspective calls for a complementary third realm of socio-technical action, relating the spatial to the temporal dimension.

The constellation of social and material entities can be described as the *socio-technical regime*, the set of intangible rules governing the *recursive* alignment of entities in a socio-technical arrangement (Cordella and Contini, 2012; Rip, 1995). Through their mutual shaping, the regime evolves along the realm of action, comprising executed socio-technical work practices where entities of the social and the material realms enact their agency on one another (Barley, 1986; Barley and Tolbert, 1997; Leonardi, 2012), thus translating into observable organizational behavior. The practices *recursively* feed back into the social and the material realms, potentially altering the entities within the realms (Orlikowski, 1992, 1996). According to this argument, digital transformation occurs when a *socio-technical regime* perceptibly and consistently changes over time. In contrast, inertia is manifested in the misalignment of social and material entities. In other words, a significant purposeful alteration in one realm is not delegated to the other realm so that inconsistencies accrue in the recursive interaction. Some examples of alterations in the social realm involve individuals learning new skills, adjustments in group policies governing IT use, or a reorganization. Alterations in the material realm can include the introduction of a new IT artifact or the discontinuance of an existing one. Inconsistencies are observed when the functionalities offered by material entities are enacted by social entities for purposes that significantly differ from those for which they have been provided. In this realm of interaction, socio-technical inertia emerges. By relating the instantiations of this basic model to each other, the dynamics of transformation and inertia become apparent. Nonetheless, to unfold its explanatory power, we need an analytical multilevel perspective on the model.

### 2.2.2 An Analytical Multilevel Perspective on Inertia in Transformation

The multifaceted nature of transformation and inertia demands a broad analytical lens. Thus, we propose a multilevel approach, drawing from mechanism-based explanations (Bunge, 1997; Elder-Vass, 2010;
Hedstrøm and Ylikoski, 2010). In the social sciences, mechanisms are analytical tools that reconcile macro-level relations, dynamics, and outcomes with micro-level entities and their actions (Coleman, 1986, 1987). These mechanisms can be differentiated into Types I, II, and III (Coleman, 1986; Hedstrøm and Swedberg, 1998). Type I (situational) mechanisms describe how macro-level events and dynamics affect embedded entities in their local contexts. Type II (action-formation) mechanisms describe how entities adapt to those conditions, either implementing or avoiding change. Type III (transformational) mechanisms describe how, through their actions, micro-level entities generate macro-level outcomes (see Figure 1).

Figure 1. Mechanisms of Transformation and Inertia across Multiple Levels of Analysis (adapted from Coleman, 1986; Hedstrøm and Swedberg, 1998)

In the study of transformation, macro-level dynamics encompass the purposeful, strategic implementation of newly emerging IT to drive deep-structure change with its associated organizational outcomes (see [4] in Figure 1). According to this analytical view, such macro-level outcomes are effects of micro-level dynamics. Those dynamics originate from the (inter)actions of individual entities (see [2] in Figure 1), both social and material. The relationships between the macro and the micro levels are moderated by meso-level dynamics (see [1] and [3] in Figure 1). In digital transformation, the meso level comprises the specific ‘field of work,’ denoting the differentiated yet interdependent collection of individual entities constituting a recognized area of organizational activity (DiMaggio and Powell, 1983; Scott, 1995).

3 Research Design: Exploratory Case Study

We explore our emerging conceptualization of socio-technical inertia in a case study, which employs a well-versed design to inform theorizations of applied phenomena (Benbasat et al., 1987; Eisenhardt, 1989). The methodological steps are detailed subsequently. We orient our approach toward the quality principles formulated by Klein and Myers (1999). Our approach allows us to explore inertia in transformation, while acknowledging that the boundaries between those phenomena and their contexts cannot be drawn clearly (Yin, 1994). The case study subject is the transformation of the socio-technical macro regime in a large corporation. Within the case study, we study, analyze, and compare multiple subcases, called ‘embedded units’ (Miles et al., 2014; Yin, 1994). Accordingly, the unit of analysis in the social realm, at the micro level, comprises collectives of individuals in their specific fields of work. In the material realm, we focus our analysis on workplace IT artifacts as embedded entities in the larger IT infrastructures (Monteiro et al., 2013). Correspondingly, in the realm of socio-technical action, we focus on generic and contingent practices of coordination, collaboration, and communication (Zammuto et al., 2007).

3.1 Site Selection: ABCRail and its Workplace IT Infrastructure

We searched for a research site based on several criteria. It should be a large, for-profit organization that (1) highly depends on IT for its operations, (2) exhibits a strategic commitment to digital transformation, and (3) has implemented multiple, business-critical alterations of its socio-technical regime. ABCRail (anonymized), a western European mobility service provider, possessed the relevant characteristics. The corporation is organized into four divisions (passenger traffic, cargo, infrastructure, and real estate),
headed by a management group that also oversees central functions, such as human resources management, finance, IT, and communications. In its industry, ABCRail faces several trends, such as inter- and multimodal mobility behavior, growing prevalence of ride- and car-sharing services, growing competition of long-distance bus services, and decreasing profit margins in cargo transportation. Furthermore, since the 1990s, Europe has undergone deregulation and privatization in the mobility market. Accordingly, ABCRail anticipates the urgent need to reap the potential economic benefits of digital technologies. Thus, its IT infrastructure has a major stake in its ongoing transformation. However, all technology in ABCRail is traditionally set up and operated according to a high-reliability paradigm (Busby, 2006).

For an integrated conglomerate such as ABCRail, its infrastructure encompasses a wide range of IT, from sensors on its railway network to productivity tools and transportation management. The core of this infrastructure is the digital workplace. The digital technologies comprise a wide range of multipurpose work technologies (i.e., software and hardware) used for performing unstructured, improvisational knowledge-based work practices, communication, and collaboration, as well as for organizational coordination (Bosch-Sijtsema et al., 2011; White, 2012). ABCRail’s workplace IT infrastructure (Table 1 in the Appendix) is shared across the whole corporation. Enterprise applications for dedicated purposes are not considered part of this infrastructure but are run on its platform (Dery et al., 2017). Therefore, ABCRail heavily invests on transforming the platform that shapes the firm’s overall socio-technical regime. For all these reasons, the case of ABCRail offers a promising, prototypical environment for studying socio-technical inertia in digital transformation.

3.2 Data Collection and Analysis

The collected data included information from semi-structured interviews, informal conversations, and observations (Table 2). The research period started from April 2017 to October 2018. Besides over 20 informal conversations, we recorded, transcribed, and annotated 23 formal interviews (totaling 28.3 h). The interviews were conducted with representatives from different fields of work and from the governing bodies of the transformation. The question guidelines focused on the transformation initiative, as well as individual and collective perceptions of the transformation. We held the interviews in two phases, first, according to a purposive sample, and second, following a stratified sampling strategy (Miles et al., 2014). In the first phase, senior managers, external program managers, and employees (nine interviews) let us leverage their expertise and knowledge to contextualize the dynamics of transformation and inertia, as enacted around past and ongoing alterations in ABCRail’s socio-technical regime. In the second phase, end-user, process management, and technology support representatives (14) were asked about their anticipated consequences of the regime changes for the work practices in their respective fields. Additionally, we gathered data from other sources, such as newspapers, specialist magazines, and websites, as well as internal artifacts, such as protocols, expert reports, infrastructure control reports, strategy documents, meeting presentations, and so on (45 documents). We triangulated our insights from the interviews with these secondary sources.

For the analysis of the interviews and the secondary data, as proposed by Williams and Karahanna (2013), we followed a hybrid approach, combining open and theory-driven template coding (King, 2004; Urquhart et al., 2010). Throughout the analysis, we iteratively reviewed our preliminary findings to inform and extend them and to strengthen our conceptualization. Where necessary, further interviews were conducted to clarify some theoretical notions. An ongoing dialogue with stakeholders at ABCRail served to probe into the alignment of our interpretations with the informants’ perceptions.

4 Case Analysis and Findings: Transformation at ABCRail

In this section, we describe the transformation of the socio-technical macro regime in ABCRail’s workplace IT infrastructure. We then explore its consequences in the vignettes of four fields of work.
4.1 Workplace IT Infrastructure as Driver of Transformation

By evolving its socio-technical macro regime through the development of its workplace IT infrastructure, ABCRail sought to continuously ensure the forward compatibility of its technology platform and optimal productivity in the embedded contexts. Only through proactive development could ABCRail prevent its infrastructure from becoming a bottleneck in its transformation. For that purpose, at the turn of the millennium, ABCRail initiated multiple, large workplace IT-infrastructure programs whose objectives served to evolve its socio-technical macro regime (see Table 3 in the Appendix).

In the first phase, ABCRail made major efforts to standardize its workplace technologies and responsibilities in a coherent, integrated infrastructure. The Standardization of the Office Platform (STOP) program and a new sourcing strategy (RSRC) marked the origin of the company’s actively and centrally managed digital workplace. The increasing popularity of mobile devices toward the end of the previous decade then allowed ABCRail to develop its infrastructure toward a regime of portability. In this second phase, the Mobile Workplace Platform (MOWP) andDigitally Connecting Employees (CONE) were launched to expand the infrastructure and close the ‘digital divide’—the separation between those with and without access to digital information and IT (Dewan and Riggins, 2005). Furthermore, office workers moved from small offices to semi-open physical workspaces (FLEX). Those initiatives jointly set the grounds for more recent initiatives, wherein the infrastructure was developed toward a collaborative regime. Through the Workplace4.0 (WP4.0) program, ABCRail’s workplace IT infrastructure was renewed and extended. The goal was to strengthen collaboration and communication across divisions, driven by enhanced information portability, the enlargement of the firm’s collaboration infrastructure, and substantial investments in user enablement. The program was integrated with other strategic initiatives, such as human resource programs for developing agile leadership, collaboration styles, digital competencies, as well as renewing governance practices in executive teams. The initiative to evolve the regime was offered strategic levers for the ongoing transformation.

The macro-level transformation of ABCRail exhibited acceptable results; emerging workplace technologies found their way into many users’ work practices, as indicated by qualitative and quantitative measures. For example, internal user surveys showed significant growth in user satisfaction with the workplace infrastructure over the three regimes (integrated, portable, and collaborative). The infrastructure component analytics also indicated increasing engagement with the emerging technologies. Nonetheless, it is the nature of IT infrastructures and the changes within them to unfold their consequences in the local contexts of work (Rolland and Monteiro, 2002; Ure et al., 2009). Thus, we complemented the macro-level study of the case organization with a micro-level analysis of the embedded units for the purpose of theoretical replication (Yin, 1994).

4.2 Contingent Emergence of Socio-technical Inertia in Action Formation

In this section, we describe four fields of work in ABCRail, where the transformation of the socio-technical regime contingently unfolded its effects: IT function (ITF), Project & Program Management (PPM), Point of Service (POS), and the Rail Infrastructure Maintenance (RIM). Employees from ITF were dedicated to developing and maintaining ABCRail’s IT infrastructure (seven informants, ranging from executives to IT architects). Employees from PPM (as part of the infrastructure division) led the rail infrastructure’s development and maintenance projects (three informants, consisting of two project managers and a support staff member). Employees from POS (belonging to the passenger traffic division) served passengers in three clusters: front desks, the back office, and management (five, from all clusters). The RIM employees (as part of the infrastructure division) were skilled workers, organized in expert teams, and responsible for maintaining the railway tracks and the surrounding facilities (three, from different teams, including the support staff).

4.2.1 Vignette – Embedded Unit I: IT Function

The ITF field was characterized by flat hierarchies, a collegial communication style, and flexible collaboration and coordination policies, closely evolving in alignment with the socio-technical macro regime of ABCRail. That is, this field exhibited low relative rigidity in the social realm. With the ITF
employees’ mandate to drive the workplace IT-infrastructure development, new workplace technologies were often available already in the setup and development phase, before the rollout. In other words, this field also exhibited low relative rigidity in the material realm. Furthermore, the majority of the employees proactively engaged with emerging workplace technologies out of personal interest. Accordingly, the interviewees consistently emphasized that the socio-technical practices in their field of work generally corresponded well with the overall regime; as one interviewee summarized: “... we have a ‘bunch’ of people who are skeptical of the new opportunities [that digitalization offers]. They hardly want to change... depending on [where]... you look. Here in the IT function, for example, you can see the transformation happening. But in decentralized divisions, such as [X], we’re definitely not that far yet.” Consequently, a relatively mature evolution of the work practices was found in the ITF field. For example, mobile and remote work, heavy use of digital communication and collaboration platforms, and coordination of work over distributed teams were standard in this field. This was not least due to the major reorganizations that alterations in ABCRail’s macro regime entailed for ITF. First, the responsibilities for the digital workplace were centralized, and then, they were redistributed in a slightly more decentralized way. In the latest phase, they were bundled around IT services. This approach fostered continual alignment among the social realm, the material realm, and socio-technical action in this field, as well as with the evolving macro regime. Thus, with the exception of individual anecdotes, in the ITF employees’ work, inertia relative to the socio-technical macro regime and in comparison to the other embedded units was not found to play a notable role.

4.2.2 Vignette – Embedded Unit II: Project & Program Management
The reliability requirements in rail construction demand strict policies and bureaucratic processes in rail infrastructure development. Therefore, the social realm of PPM was clearly structured, with the employees being diligent about their roles and responsibilities. While mutual acknowledgment of expertise and competence among the PPM employees warranted their respectful style of interaction and leadership, relative rigidities in the social realm were higher in this field compared to ITF. Workplace technologies formed an essential foundation for work in PPM, dominated by coordination and collaboration among experts. Accordingly, digitalization along the evolution of the socio-technical macro regime significantly impacted the work practices in this field; as one informant described it: “It was a milestone when desk phones were turned off, and everybody got a smartphone ... Another important step was, when we got laptops, because we are often travelling [...] Also, mobile PDFs allowed a leap forward—you can now edit them and insert drawings. We were printing, signing, and filing everything until we were like, ‘oh no: one can leave it all in there [digital]’...” Among many of such anecdotes, the employees expressed appreciation for the increasing flexibility of the workplace IT. This also became apparent in some complaints about minor impediments that were perceived as constraining the expected flexibility, such as when mobile devices offered information portability but lacked editing functions due to technological restrictions. Accordingly, the material realm in PPM was not perceived as exhibiting any notable rigidity relative to the macro regime.

While the user population in PPM was heterogeneous (in age and being technology-savvy), the informants consistently reported mature socio-technical practices, including long-tenured senior project managers welcoming regime transitions. This fact was emphasized as not being self-evident as they were socialized with secretaries doing all the paper work; thus newer regimes shifted duties to their side. However, they explained that it would be critical to have oversight, assured only through active and direct communication. Consequently, significant resources were dedicated to the curation of local infrastructure instances, such as collaboration spaces, including business roles solely to ensure that upcoming changes to the infrastructure were closely monitored and anticipated, and their consequences for PPM were proactively assessed. All of these developments allowed the PPM employees to profit significantly from the evolution of the regime and made them perceive the transitions as smooth.

4.2.3 Vignette – Embedded Unit III: Point of Service
The social interactions in the POS field were found to be relatively formal, including many colleagues greeting one another by their surnames (considered an acknowledgment of power distance in German-
speaking Europe), despite repeated official encouragements to give up this tradition. Such norms were also expressed in the employees’ expectations for the management in terms of communication and coordination; as one informant explained it: “It’s the boss who ‘holds the reins.’ Orders are coming in via e-mail.... If something [in the plans] is not working..., he or she will get a counteraction [...] because those things need to be set up properly.... This is what we have the boss ... for. They have to have it under control.” The coordination and information flow in general was found to be strongly top-down. The tasks and the shifts were managed to the minute, and the policies were formulated in granular detail. Accordingly, the POS field exhibited high relative rigidity in the social realm. The workplace IT infrastructure was also central for this field of work. In earlier regimes, dedicated technologies with very narrow ranges of affordances structured the workplace (i.e., dedicated monitors, dedicated keyboards for train schedule requests and ticketing, dedicated printers, etc.). With the evolution of the macro regime, dedicated POS technologies were replaced, and the applications were migrated to run on the generic workplace IT infrastructure. These changes significantly decreased the rigidities in the material realm in POS. However, this increasing flexibility did not translate into the social realm.

In transitioning through the different regimes, the managers hierarchically oversaw the changes in the IT infrastructure to meticulously translate the artifact use into the contexts of their fields. As one manager expressed it: “[The] question is, how do we hand over the workplace ... artifacts to our employees? .... One of the first steps we take is ... to write guidelines, to specify instructions on how to exactly work with the new infrastructure.” Accordingly, long-tenured and younger employees alike emphasized how changes in the macro regime episodically punctuated their daily work practices. When new artifacts were rolled out, they preserved work practices to the possible degree, seeking minimally revised ‘protocols’ to apply until the next perceivably forced change. Such changes were repeatedly described as “losses.” However, the employees made little use of any autonomy for innovating practices. For example, smartphones available since half a decade ago barely found innovative applications in this field of work. Multiple employees described in detail how they and their colleagues used mobile phones only for making calls when no desk phone was available, as well as for purposes that no other technology offered (e.g., mobile app for lost-and-found items), to the degree of active avoidance. This included shying away from using familiar mobile communication channels for work purposes. Socio-technical work practices in this field accordingly evolved slower than in other fields and in a more punctuated way. This was observed despite the low relative rigidities in the material realm. Therefore, relative to the macro regime and other fields of work, inertia was found to be higher in the POS field.

4.2.4 Vignette – Embedded Unit IV: Rail Infrastructure Maintenance

Work in the RIM field was structured by the reliability requirements of rail maintenance work (including hazards and work health and safety standards) and the substantial efforts for its coordination. This set of functions was comparable to that of PPM, yet the hierarchies were expressed more strongly through professional seniority, knowledge, and company tenure. The workers also experienced a more granular organization of their tasks, as one informant explained: “... it’s all authorization and state of order. We work with order states, but orders are driven ... corporate-wide top-down. You can trace [the] status to the branch, the team, down to the individual.” Those relative rigidities in the social realm were reinforced through rigidities in the material realm. Similar to other fields of work, the evolution of the macro regime enabled increasing harmonization of technologies in RIM as well. However, contrary to the fields where the workplace IT infrastructure accounted for most of the technology, the new artifacts introduced to RIM had to continuously ensure backward compatibility with the legacies in the material realm. Specifically, physical technologies and their integrated electronic circuits had significantly longer life cycles, smaller ranges of affordances, and less malleability than the workplace IT that integrated with them. Those rigidities heavily constrained the workplace IT use, as one employee explained: “[RIM workers] are often in the field and ... are on the road with their cars. They have control points in little shacks along the rail tracks [...] So, somebody is sitting there, recording problems, and fixing them. Meaning, they obviously have to be wherever there’s an issue.” Moreover, the embeddedness in this environment shaped the socio-technical practices in the workplace IT.
The emerging digital workplace IT was adopted in RIM, if at all, more slowly compared to other fields. The innovations in the practices, if at all, came from the improvisational practices of those individuals who reactively experimented with new artifacts. Nonetheless, the scaling of promising practices often faced resistance, as it was difficult to convince others of the benefits. One employee traced this issue to the attitude of skilled workers: “I find that we still block ourselves because teams and individuals guard their little ‘gardens’ [...]. We’re all little ‘gardeners’ .... It’s a power game […]. It might not be good for the transformation of ABCRail, but in our field, it is currently just like that; ‘every craftsman wants their own screwdriver’.” This matter resulted in a relatively low degree of digitalization in RIM’s socio-technical work practices. Multiple informants illustrated how collaborative digital spaces, such as the Content and Document Management System (CDM) at its introduction, were actively circumvented instead of being used to share documents. Therefore, some information remained unavailable for other social entities, prohibiting benefit realization from CDM. The negative consequences of such behavior were aggravated since an open data policy had been introduced in the governance of the workplace IT infrastructure at ABCRail. Other prevalently described examples referred to handwritten reports that were later typed into computers by someone else or to manuals and procedures that were consistently carried around in dozens of physical folders. In this field as well, many smartphones remained unused at rollout, completely locked away by managers or individuals or exchanged with old mobile phones. Consequently, relative to their counterparts in the other fields, the employees in RIM perceived the evolution of the socio-technical regime as punctuating their work practices in a particularly strong manner. Similar to their colleagues in the POS field, the employees in RIM perceived the changes as occurring in episodic phases at the artifact rollout. Likewise, replicating established practices on new artifacts was popular in RIM. However, in this field, it was mostly left to each individual to cope with the alterations in the macro regime, which fostered resistance. Additionally, we found that the employees became innovative in developing practices to avoid some of the newly introduced artifacts. Overall, relative to the macro regime and compared to the other fields we studied, socio-technical inertia in the RIM field was found to be the highest.

5 Discussion: Socio-technical Inertia in Transformation

In this section, we discuss three major findings. The first reveals how we find the changes in the socio-technical macro regime as locally evoking inertia. The second shows how inertia, beyond resistance, is expressed as a perfunctory, path-dependent change. Finally, the third finding indicates how the simultaneity of the deep-structure change and inertia in large organizations increases the tensions between local practices and the macro regime.

5.1 Material Agency in the Emergence of Inertia

The case study illustrates how material entities, through their inherent agency, do not just drive transformation at the macro level but also contribute to the emergence of local inertia. Such inertia unfolds through two types of mechanisms. Through Type I mechanisms, contingent rigidities in the material realm of the fields of work constrain the flexibility of social and material entities in action formation. In Type II mechanisms, logics engrained in material artifacts shape work practices that persist over multiple generations of technology. Our case exploration offers illustrative examples.

Several examples of Type I mechanisms through which material agency contributed to inertia were found in the case. For example, when dedicated configuration devices for rail switches in RIM were replaced by mobile devices, their use was constrained by legacy technologies that did not afford remote configuration. Furthermore, inertia emerged from material agency as the logic of technology became ingrained in socio-technical practices along the Type II mechanisms of action formation. Despite changes in those technologies as they become more flexible over several generations or the introduction of complementary technologies that would multiply the existing technologies’ range of functionalities, socio-technical practices do not necessarily evolve. For example, more than five years after their rollout at ABCRail, smartphones were often used like traditional office phones. It shows that the broad range of functionalities for alternative means of communication are often not implemented despite offering
efficiency and effectiveness. Existing research suggests that this issue originates from the habituation of socio-technical practices and preferences that are shaped by technology affordances (e.g., Polites and Karahanna, 2012, 2013). The case of ABCRail suggests that such habituation, as the Type II mechanism, also applies to group behavior.

5.2 Resistance and Momentum as Faces of Inertia

The analysis of the embedded fields indicates that socio-technical inertia has multiple faces, exhibited through Type II mechanisms. The most prominent and best documented form of inertia in socio-technical change is resistance—active efforts to preserve any status quo (e.g., Kim and Kankanhalli, 2009; Lapointe and Rivard, 2005). Inertia is also expressed as a perfunctory change. We call this momentum, corresponding to a similar phenomenon described at an organizational level (Kelly and Amburgey, 1991; Miller and Friesen, 1980). Such change superficially complies with transformational objectives. However, a closer evaluation reveals that it undermines such objectives because changes might lead to an alignment with the external context. For example, resistance was expressed when some employees locked away newly distributed smartphones. Beyond that, inertia may unfold as a perfunctory change in two ways. First, as described in Section 5.1, existing practices can be replicated on new artifacts. We found several examples of replication mechanisms: i) handwritten reports that were digitally recorded as devices in the portability regime yet still printed for analogue processing and archiving, ii) smartphones used as ordinary telephones, and iii) CDM used as personal file storage. Second, social entities can adapt work practices to new socio-technical regimes for working around newly introduced artifacts. We observed instances of workarounds when a new CDM was introduced and individuals or whole teams started to innovate information handling procedures, including printing and rescanning documents, to circumvent the new system. Type II mechanisms like those became apparent by relating multiple instances of socio-technical practices to one another (see Figure 3 in the Appendix for a proposed formalization). Replication and workaround as mechanisms of momentum, while perfunctorily appearing as changes, ultimately preserve the status quo, thus constraining the realization of transformational macro-level outcomes. With relatively low degrees of change, such mechanisms foster a potential misalignment between entities within their local socio-technical arrangement and the overarching macro regime, especially because they may progress over multiple generations of technologies.

5.3 Simultaneity of Transformational Change and Inertia

As changes in the socio-technical macro regime and the shared workplace IT infrastructure were implemented contingently in the fields of work, the dynamics of deep-structure change and inertia simultaneously accrued at ABCRail (Type III mechanisms). Such contingencies were made apparent through an analytical multilevel perspective. The transformational dynamics at ABCRail were mobilized and unfolded through central decisions on workplace IT-infrastructure developments. In the ITF field, the representatives tended to familiarize themselves with emerging digital technologies early on. Once new technologies were rolled out, they were quickly adopted, and work practices, such as communication, coordination, and collaboration, were continuously adjusted. Those circumstances drove the transformation in the ITF field that exhibited a malleable social environment relative to the other fields. However, an examination of other local enactments of those changes revealed mechanisms that simultaneously contributed to the emergence of socio-technical inertia. The most contrasting embedded unit was the RIM field, where newly introduced workplace IT artifacts had to be integrated with electronic legacy software and hardware, constraining the flexibility of the new artifacts. In combination with social rigidities (i.e., hierarchies, strict responsibility allocation, and detailed policies guiding work practices), this led to considerable socio-technical inertia in implementing the evolving workplace IT infrastructure. Other fields at ABCRail, such as PPM and POS, exhibited dynamics between those two extremes (see Figure 2).

If research and management refrains from blackboxing organizations and digital technologies in strategizing transformational change, there is no need to implicitly or explicitly describe transformation and inertia as mutually exclusive organizational phenomena. Farjoun (2010) argues that this holds true for
organizational change and stability in general. Our case furthermore shows that inertia may lead to increasing heterogeneity in local socio-technical arrangements among different fields of work. This poses a major managerial challenge, as growing heterogeneity impedes strategic alignment and thus potentially future alterations to the macro regime (Ciborra and Hanseth, 1998).

Figure 2. Socio-technical Inertia in the Transformation of ABCRail

6 Conclusions

This study sheds light on socio-technical inertia and its role in transformation. We propose conceptualizing the former as a spatially and temporally relative characteristic, emerging from both social and material agency. With our case study, we have illustrated how a multilevel perspective on the phenomenon unveils explanatory mechanisms for its emergence.

This study’s findings have implications for research and practice. As socio-technical inertia can be exhibited in the guise of a momentum, researchers should exercise caution in assessing outcomes of transformation endeavors. Only by relating macro-level efforts to micro-level dynamics can effective deep-structure change become apparent and be differentiated from perfunctory change. Mistaking the latter for deep-structure change bears the risk of understating the complexity inherent in large-scale socio-technical transformations. For practice, our findings imply that inertia is an integral part of transformation that cannot be overcome but only counterbalanced. It might be tempting to describe the two as mutually exclusive phenomena so as to provide the grounds for deterministic narratives, as well as legitimize decisions in uncertain undertakings of socio-technical change (Hoefer and Green, 2016). However, it bears the risk of systematically underestimating chance and overestimating determinism in strategic choice (De Rond and Thietart, 2007). Thus, we emphasize the need for a more balanced view on transformation. Strategists might well emphasize the sense of urgency for change but should concurrently invest heavily on enabling social entities to cope with increasing tensions emerging from differences in the pace of evolution of local work practices and socio-technical macro regimes.

Our proposed novel lens offers the first step toward operationalizing socio-technical inertia in transformation. On those grounds, we encourage future research to work toward more substantive theorizations. Exploring a recursive model of inertia in other industries (e.g., financial services or insurance) that exhibit high degrees of digitalization would be insightful. However, as Rumelt notes, “… there can be no simple theory of inertia as its causes are multiple and varied” (1995, p. 101). Therefore, we caution that scholars in social studies face a fundamental challenge known from physics; inertia cannot be measured directly. The sciences help themselves by measuring physical mass. A corresponding measure in socio-technical studies has yet to be found. Until then, there is barely a way around approximating organizational inertia and related mechanisms by retroductively explaining them from the effects of transformational dynamics in socio-technical systems.
References


7 Appendix

<table>
<thead>
<tr>
<th>Artifact Components of Workplace IT-Infrastructure</th>
<th>Description</th>
<th>Regime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal computer (PC)</td>
<td>Laptops or workstations of employees</td>
<td>X X X</td>
</tr>
<tr>
<td>Operating System (OS)</td>
<td>Operating System running on personal computer</td>
<td>X X X</td>
</tr>
<tr>
<td>Terminal Server (TS)</td>
<td>Server OS for login with thin clients or used by employees working across multiple workstations</td>
<td>X X X</td>
</tr>
<tr>
<td>Office Application Suite (OAS), client-side (incl. mobile)</td>
<td>Compresses software, running on OS or mobile, for text editing, spreadsheet calculation, presentations, database management</td>
<td>X X X</td>
</tr>
<tr>
<td>E-Mail Inbox &amp; Server</td>
<td>The e-mail inbox is integrated in the OAS,</td>
<td>X X X</td>
</tr>
<tr>
<td>Mobile device</td>
<td>Smartphones and tablet devices</td>
<td>X X</td>
</tr>
<tr>
<td>Office Application Suite, cloud-based</td>
<td>In addition to the OAS running on PC and mobile devices, a cloud-based version of the OAS was made available in the . This allows for web-based work with applications.</td>
<td>X X</td>
</tr>
<tr>
<td>Content &amp; Document Management System (CDMS)</td>
<td>Enterprise content &amp; document management platform, integrates into the corporate intranet, used for collaboration and communication; accessible through all devices</td>
<td>X X</td>
</tr>
<tr>
<td>Personal file storage (PFS), client-side &amp; cloud-based</td>
<td>Storage for all types of files, synched across all devices</td>
<td>X</td>
</tr>
<tr>
<td>Team Collaboration Space (TCS)</td>
<td>TCS connects OAS functionalities for collaboration purposes and offers mailboxes, calendars, file storage, notebooks, and task planning for groups</td>
<td>X</td>
</tr>
<tr>
<td>Team Collaboration Platform (TCP)</td>
<td>Closed group communication platform, including messaging, calling, file sharing, virtual meeting etc.</td>
<td>X</td>
</tr>
<tr>
<td>Enterprise Social Network (ESN)</td>
<td>Platform allowing 1:1, 1:n, and n:n chats, offering spaces for loose collaboration, information sharing, and group feeds</td>
<td>X</td>
</tr>
</tbody>
</table>

Note. Made avail. in Regime: I = Integration; P = Portability; C = Collaboration.

Table 1. Components of the Workplace IT Infrastructure at ABCRail

<table>
<thead>
<tr>
<th>Type of Data</th>
<th>Nature and Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal interviews</td>
<td>23 conversations (28.3h, ø74min), collected between 04.2017 and 10.2018; recorded, transcribed, and annotated; protocol focused on the transformation initiative of ABCRail, the nature of work in the different fields as well as individual and collective perceptions of the transformation</td>
</tr>
<tr>
<td>Informal conversations</td>
<td>20 pages of fieldnotes</td>
</tr>
<tr>
<td>Meeting observations</td>
<td>Two meetings: steering committee meeting of infrastructure development program, preparation of executive board presentation by program lead and head of IT workplace; five pg. of fieldnotes</td>
</tr>
<tr>
<td>Secondary data: documents</td>
<td>45 documents such as newspapers, specialist magazines, and internal documents such as protocols, expert reports, infrastructure control reports, user surveys, strategy documents, meeting presentations, etc.</td>
</tr>
</tbody>
</table>

Table 2. Data Sources
Year | R. | Prog. | Primary Objectives | Major Outcomes
--- | --- | --- | --- | ---
2004 | I | STOP | • Centrally managed workplace  
• Standardization of infrastructure across company | Standardization of office platform across the whole company
2007 | I | RSRC | • Streamline workplace technology portfolio  
• Concentrate on fewer but large outsourcing partners  
• Solve pervasive workplace IT-performance issues | Harmonization of sourcing strategy and infrastructure component providers
2011 | P | MOWP | • Upgrade and extension of infrastructure  
• Assure forward compatibility (mobile trend)  
• Accessibility through mobile devices | Upgrade of basic workplace infrastructure and establishment of mobile workplace platform
2015 | P | CONE & FLEX | • Assure electronic information flow  
• From ‘closed-by-default’ to ‘open-by-default’ information storage policy  
• Enable new ways of working  
• Increase intra-org. collaboration | Closing digital divide through connecting employees with devices and infrastructure access; flexibilization of physical office workspaces
2017 | C | WP4.0 | • Upgrade and extension of infrastructure  
• Foster decentralized work practice innovation  
• Enable (inter-org.) collaboration  
• Drive cultural transformation  
• Make workplace attractive for younger generations | Introduction of the next generation workplace IT-infrastructure with “social” platforms for collaboration and communication

Note. R = Regime; I = Integration; P = Portability; C = Collaboration.

Table 3. Infrastructure Programs along Socio-technical Workplace Regime Evolution

![Relative Degree of Innovation in Work Practices](image1)

Figure 3. Faces of Socio-technical Inertia as relative Force in Transformational Change: Resistance and Momentum