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Cultivating a 'Digital Jungle': Toward a Hybrid Governance Perspective on Infrastructure Evolution

Completed Research Paper

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Abstract

Digital infrastructures (DIs) evolve rather than following planned development trajectories. We know this phenomenon as drift, that is, infrastructures drift from management control. Infrastructure drift has motivated research into infrastructure governance recognizing two governance approaches: top-down and bottom-up. Yet, what happens if an organization engaging in its digital transformation expands its DI following top-down governance while simultaneously introducing elements of bottom-up governance? We study how an industrial manufacturer expanded its DI for collaboration top-down while also giving employees leeway for bottom-up governance. As a result, it found that its digital collaboration infrastructure evolved into – what the informants depicted as – a digital jungle. Theorizing this concept and its emergence, we contribute to research on DIs. Firstly, we provide a framework explaining the manufacturer's DI's evolution into a digital jungle. Secondly, we argue that this concept captures user's perspective on DI evolution signifying the importance for developing a hybrid infrastructure governance perspective.

Keywords: Digital Infrastructure, Infrastructure Governance, Infrastructure Evolution, Digital Jungle

Introduction

In digital transformation initiatives, organizations seek to integrate technologies and new practices to improve organizing around information (Vial 2019; Zammuto et al. 2007). An industry survey found that almost nine out of ten organizations are planning, testing, or implementing digital transformation initiatives (Fujitsu 2018). It reports that one third of the surveyed organizations already reap benefits from their digital transformation. Yet, organizations also face digital transformation barriers such as insufficient skills, lack of a clear vision, and problems to integrate technologies (Bilgeri et al. 2017; Center for Creative Leadership 2018; Svahn et al. 2017). When organizations integrate technologies, their digital infrastructures (DIs) tend to expand, to become complex impeding their effective use and governance (Ciborra and Hanseth 2000; Constantinides and Barrett 2014; Hanseth and Lyytinen 2010; Zimmer and Niemimaa 2019). Thence, organizations' digital transformation intensifies the issues of DI expansion, complexity as well as effective use and governance.

DIs are "the basic information technologies and organizational structures, along with the related services and facilities necessary for an enterprise or industry to function" (Tilson et al. 2010, p. 748). Research inquiring into DI development has shown how DIs tend to evolve rather than to follow set development trajectories. From management perspective, this evolutionary trait of DIs makes them drift from management control and governance (Constantinides and Barrett 2014). The concept of infrastructure drift thus implies that governance of infrastructures should focus on control to avoid such drift. According to Hanseth and Lyytinen (2010), however, successful development of DIs requires balancing contradictory requirements of flexibility and control. These two requirements yield contradictory governance approaches. On the one hand, control relies on top-down governance that builds on the idea that infrastructure development is strictly in the hands of and under the control of management. On the other hand, flexibility requires that employees are able to decide for themselves which tools and technologies to integrate and leverage as part of an infrastructure (i.e., bottom-up governance). Despite management efforts, infrastructures tend to drift away from control as employees tinker and innovate with the infrastructures (Monteiro et al. 2014). Flexibility can also be organizationally relevant as employees are able to choose the technologies according to their preference and that are relevant for their work tasks (Meske 2019). However, as literature on shadow IT shows, allowing employees to fully define and develop their infrastructure engenders managerial problems (Chua et al. 2014; Furstenau et al. 2017). But what happens when an organization engaging in its digital transformation decides to expand its DI for collaboration through its existing top-down governance while simultaneously introducing elements of bottom-up governance?

Answering this research question, we expand the growing body of knowledge on hybrid governance (Brown and Grant 2005; Brown 1999; Constantinides and Barrett 2014) as an eclectic approach to infrastructure governance. More specifically, our ethnographic study yields insights into how a large industrial manufacturing company (henceforth, Firm) responded to felt external pressures by digitalizing its organizing and initiating a transformation toward hybrid governance of its DI for collaboration. Further, we trace this transformation's organizational outcomes. Our research can also be seen as a response to calls to study the intersection of digital transformation and DIs (e.g., Tilson et al., 2010).

Digital transformation and governing digital infrastructure evolution

Organizations engaging in their digital transformation seek to improve organizing through combinations of digital technologies (Vial 2019). They utilize digital technologies to improve their value creation (Chanias et al. 2019; Svahn et al. 2017) as well as internal structures and processes (Andersen and Ross 2016; Dremel et al. 2017; Duerr et al. 2018). For the first, organizations tend to digital technology as an enabler of digital innovations and better customer centricity in their value creation (Andersen and Ross 2016; Hansen and Sia 2015; Karimi and Walter 2015). For the second, they introduce digital technologies to trigger changes to internal structures and processes (Andersen and Ross 2016; Svahn et al. 2017). Doing so, organizations tend to implement not one but a combination of digital technologies. This means, digital transformation is different from an IT-enabled transformations which focus on one single system for gaining efficiency improvements within a particular organizational process (e.g., supply chain management) (Skog 2019; Vial 2019). In a special issue editorial, Constantinides et al.

(2018) have recognizes organizations' move toward infrastructures to operate their business. It leaves organizations with handling implementation and governance of digital technologies not as separate artefacts, but as a combination of artefacts in order to leverage their digital transformation. Tilson et al. (2010) theorize this combination of artefacts as forming one artefact, that is, a DI.

DIs comprise a combination of technologies that form "shared, unbounded, heterogeneous, open, and evolving sociotechnical systems" (Tilson et al. 2010, p. 748). Therefore, unlike a specific system or an application, DIs cannot be defined by a set of functions or strict boundaries. Rather they are dynamic, longevously and relational (Tilson et al. 2010). Information systems scholars have explored DIs for several decades (Ciborra and Hanseth 2000; Star and Ruhleder 1996). Their research builds on the recognition that the effectiveness of a technology is related to the totality of the socio-technical configuration it is part of (Henfridsson and Bygstad 2013). Simply put, a mobile phone was quite limited in terms of its affordances when situated outside its use practices, high-speed wireless connections, applications, etc. Therefore, researchers have turned to the DI concept to discuss the emergent aspects of the mélange of socio-technical arrangements (Henfridsson and Bygstad 2013). Other key aspects of DIs include an installed-base (i.e., DIs are built upon existing infrastructure), distribution across space and time, complexity, and a shared user-base (Hanseth and Monteiro 1998; Star and Ruhleder 1996).

While a part of the literature has been interested in infrastructures for their instrumental value to innovation (Grisot et al. 2014), remote maintenance and repair (Niemimaa 2016), and digital transformation (Tilson et al. 2010), another part has treated *infrastructures* as its phenomenon of interest studying DIs' evolution. DIs evolve as new technologies become either tighter or looser coupled with other existing technologies (Hanseth and Monteiro 1998). Once an infrastructure has been bootstrapped, it tends to evolve along unforeseeable trajectories (Hanseth and Lyytinen 2010). Sir Tim Berners Lee (or anyone of the Internet pioneers) had unlikely foreseen it as into what it evolved. While the Internet transcends a single organization's control, organizational DIs have shown similar evolutionary tendency due to their inherent generativity (Henfridsson and Bygstad 2013). Research identified that too strict control can hamper DIs' success, while too much leeway creates infrastructure drift (Ciborra and Hanseth 2000; Hanseth and Lyytinen 2010).

Constantinides and Barrett (2014) suggest two governance approaches to DI evolution: top-down and bottom-up. Top-down, organizations seek control over DI evolution. Bottom-up DI evolution emerges from employees' collective actions as organic growth, largely outside management control, expanding DIs to best support their use. In both logics, DIs' complexity grows posing increasing difficulties to their user-base to identify DIs' combinatory affordances for their effective use (Burton-Jones and Volkoff 2017; Zimmer and Niemimaa 2019). An organizations' approach to DI evolution is enclosed in its institutional ideas about technology: following their idea, organizations may seek to control DI evolution or allow it to emerge from grassroot-level (Constantinides and Barrett 2014). Yet, regardless an organization's ideal approach to infrastructure governance, research suggests that top-down and bottom-up governance tend to co-exist (Ciborra and Hanseth 2000; Constantinides and Barrett 2014).

Accordingly, scholars have studied hybrid forms of IS governance, where some parts of organization are kept under strict managerial control and some business units are given control to develop and implement their own IS (Brown 1999). Hybrid governance thus differs from shadow IT (i.e., all ISs which have not received any formal organizational approval (Furstenau et al. 2017; Silic and Back 2014)) in that the development and implementation of IS is done at unit level and with management consent. However, as digital technologies have become more readily available to users and their adoption simpler due to technological advancements such as smart phones and cloud services, organizations have experimented with a different type of hybrid governance than traditionally understood. Research found that shadow-IT systems can become business-managed-IT (Kopper et al. 2018) and that organizations, under the banners of bring-your-own-device, have introduced hybrid elements drawn from top-down and bottom-up governance (French et al. 2014). Such hybrid is not typically based on uneven treatment of departmental units, but rather on sanctioning the adoption and use of technologies on the premise that they comply with organizationally set technological and managerial requirements. Similar developments can be seen more broadly as organizations are experimenting with digital transformation initiatives that further contribute to organizational infrastructures' evolution (Constantinides et al. 2018). Organizations face the challenge of how to

govern their infrastructure development when engaging in their digital transformation (Hanseth and Lyytinen 2010; Tilson et al. 2010). In other words, digital transformation intensifies issues of infrastructure governance and evolution.

We study this issue by looking at the governance and evolution of Firm's DI for collaboration within the context of the company's digital transformation. We conceive a DI for collaboration as an installed base of technologies and applications offering action potentials for collaborative tasks. After outlining the research approach, we show how Firm's interpretation of external pressures yielded introduction of elements of bottom-up governance to a top-down governance. The company introduced these elements to increase flexibility but also to improve digital technologies' relevance for collaboration.

Research approach

Our research is an ethnography of a large, globally operating manufacturing company (Eberle and Maeder 2016; Van Maanen 2011; Myers 1999). Ethnography is an established methodology in information systems science (Myers 1999). Ethnographers immerse themselves in the field for an extended period of time to live with the people they study (Van Maanen 2011). They track and study people, groups or phenomena across different organizational settings and how they (people or groups of people) enact a certain phenomenon (Eberle and Maeder 2016; Van Maanen 2011). Studying the concept of digital jungle and Firm's governance of DI evolution, we take an ethnographic approach.

For collecting data, the principal researcher entered the field from July 2017 until December 2019. He gained access to Firm via a research contract with the company's internal organizational development unit. As part of this contract, the principal researcher observed similar work obligations as his colleagues allowing him to build strong rapport with his peers. Furthermore, he had access to Firm's internal enterprise social media platform allowing him to collect data on digital interactions between employees on Firm's digital transformation (Akemu and Abdelnour 2018; Murthy 2008). Thus, the principal research collected data within three groups of people: firstly, within the internal organizational development unit; secondly, peers he observed and talked with in the field (e.g., peers from Firm's IT or digital unit but also HR or production unit) and thirdly, online communities on Firm's enterprise social media platform.

Methods for data collection were participant observations (Ingold 2014; Van Maanen 2011) and informal interviews which the principal researcher captured in field notes (Emerson et al. 2001). Writing field notes, he kept descriptive notes, analytical notes and memos as different sets of field notes. Moreover, he noted down brief jottings during observations but elaborated these jottings as soon as possible afterwards. By this, he constructed a vast body of field notes on Firm's digital transformation. Further, he collected digital data as archive on Firm's enterprise social media (Akemu and Abdelnour 2018) as well as organizational documents related to Firm's digital transformation initiatives. Based on his observations and field notes, we were able to critically asses the organizational documents and place them within the context of Firm's digital transformation. Digital data as archive allows ethnographers in modern organizational settings to be co-present in online interactions without having to observe the interaction at the time it occurs. Thus, co-presence can be established after the interaction occurred and without the ethnographer physically being in the same place. Further, they are an important data source in modern organizations in which organizing occurs across the physical and virtual space. Hence, digital as archive is an appropriate and powerful data collection strategy for ethnographic research (Akemu and Abdelnour 2018).

Analyzing the collected data, we were broadly interested in organizational transformations implicated by digitalization. However, as we stumbled over a puzzling empirical fact (cf., Ngwenyama and Nielsen 2014), we became preoccupied with the notion of 'digital jungle'. The concept appeared in a post on Firm's enterprise social media discussing the company's DI. We thence commenced empirically pursuing questions as what is organizational members' understanding of digital jungle?; how did the digital jungle emerge?; and what contributed to its emergence? Investigating these questions, we started to conceive the studied phenomena as an organizational infrastructure issue. Thus, we turned to respective literature to connect the phenomena to known concepts in literature on DI evolution and governance. In other words, our data analysis followed an iterative process of back and forth between

studying empirical material and extant literature. Initially, we understood the digital jungle as a fancy term used in the field. Through our analysis, however, we arrived at an understanding conceiving the digital jungle as a reference to a shared experience of Firm's DI. We found the concept emerged as a result of top-down and bottom-up actions as the industrial manufacturer sought to expand its DI to enable new collaboration practices. We present these actions as two narratives. The first captures Firm's top-down infrastructure governance and the second outlines elements of bottom-up infrastructure governance. Combined as one narrative, these actions entailed cultivation of a digital jungle.

Hybrid governance and the cultivation of a digital jungle

Firm is a large industrial manufacturer employing more than 200.000 employees worldwide. These employees work on the same DI for collaboration which Firm's IT unit governs top-down. If employees require access to an information system that is part of this infrastructure, they need to request access from the system administrator or the IT unit (or both). Similarly, if employees intend to purchase a new hard- or software, they need to file a demand request with Firm's IT unit which will then evaluate whether the demand is granted or rejected.

Considering its industry's disruption, Firm's management recognized a need for digital transformation. They comprehended new market entries and technology companies as threatening Firm's incumbent market position. In the presence of external pressures, they thus initialized a program known as FirmGoesDigital to improve the company's organizing by utilizing digital technologies. In particular, FirmGoesDigital focuses on Firm's organizing of intra- and interunit collaboration to nurture digital innovations.

> *New competitors like […] are penetrating our markets. New generations of employees have new requirements of use as employers and as a team. Speed, innovative power and adaptability are becoming increasingly important. If we want to remain successful, we have to change the way we cooperate. – FirmGoesDigital document*

FirmGoesDigital is an organization-wide program that Firm launched in 2016 to drive its digital transformation. For this, Firm inscribed into the program that it intends organizational changes promoting digital expertise and thinking as well as to expand the company's DI for enabling new leadership styles and collaboration. Firm's management positioned FirmGoesDigital as re-aligning the industrial manufacturer's organizing to remain successful in and beyond digitalization. Hence, the program had at its core the idea of utilizing digital technology to facilitate and improve collaboration.

> *There is no way around digitalization, it is already in full swing in our environment. That is why it is all the more important to promote digital expertise and digital thinking in the company and to expand our digital infrastructure. –FirmGoesDigital document*

> *We need the digital transformation in order to implement the Leadership Principles [Firm's intended leadership style promoted with FirmGoesDigital] successfully. With meaningful technical standards, we can share knowledge and exchange data within seconds. The digital transformation enables new forms of work collaboration in teams which are scattered around the entire world. – Presentation by Firm's digital unit*

To drive utilization of digital technologies, Firm founded a digital unit. This unit had a foundational role in transforming Firm's DI governance. In its FirmGoesDigital program, Firm inscribed that employees' use of digital technologies in and for work practices should be increased. To achieve this, the unit sought to empower Firm's employees to drive the company's digital transformation by giving them leeway to choose the digital technologies they prefer to accomplish their work tasks. This, however, was not a mandate giving employees complete freedom over the technologies they use, but rather maintaining control over the DI, while offering freedom in terms of offering a pool of diverse technologies and providing employees the opportunity to select freely from this set of technologies and to propose additions to the existing DI. As such, the control was still largely in the hands of the digital and IT unit, but rather than dictating which tools to use and where, the units procured and made available a pool of technologies, meant for, especially collaboration. What the digital unit referred to as "tools" (or "digital collaboration tools") were broadly both hard- and software, ranging from small apps to larger systems,

tablets and smartphones. Despite that the digital and IT unit sought to maintain control over the DI, in November 2017, one and a half years after FirmGoesDigital's initiation, the digital unit announced on the enterprise social media that the DI had grown into a *digital jungle.*

Soon after the announcement, the concept got traction among Firm's employees. The concept seemed to provide a common term to give name for some of the joint experiences that both the employees and the digital unit had on the DI. Discussions around digital jungle ensued both in informal discussions and in the enterprise social media, where the employees reflected on their experiences of the Firm's DI as being something elusive. To them, the DI had become overly complex and they found it difficult to identify the digital collaboration tools available or to make sense of for what they could use these tools. Simultaneously, however, there seemed to be a positive connotation to the term, as they also saw potential hiding underneath the complexity for facilitating and improving intra- and interunit collaboration, as echoed in these excerpts:

> *A wide range of tools is available throughout the company, facilitating digital cooperation. Some of them function in a variety of application areas, while others are specialized for one specific use case. So far, just a few people have had a clear overview of all of these tools. But now the teams at [the digital unit] have collaborated with [IT] to shed some light on the darkness of the [Firm] tool jungle. – Post on Firm's enterprise social media by its digital unit*

> *When I first saw the post [on the digital jungle] my impression was wow.. there is a lot of stuff. It was overwhelming, really. I also got confused as many icons [representing a digital technology] appeared multiple times.. it really looked like a thicket. – Employee in an informal interview*

> *Technology is developing at a rapid pace and this is something you need to take care of. We have to manage it on the side. What already exists in the organization? The potential that is hidden behind it but cannot be used because there is no time to take care of it. How can we use it wisely, use it effectively? – Employee in an informal interview*

Reflecting these considerations, we inductively arrived at an understanding and appreciation of the digital jungle as *a shared experience of a digital infrastructure having evolved into an impenetrable technological thicket that stashes its affordances, impairing both its effective use and management, yet, furnishing undiscovered potential*. But how to explain the organizational emergence of this shared experience? Next, we turn to the cultivation of this jungle as two separate – but connected – trajectories of top-down infrastructure governance and elements of bottom-up governance.

Top-down infrastructure governance: Cultivating an infrastructure for collaboration

First, we turn to how Firm's digital unit expanded the industrial manufacturer's DI in a top-down governance approach to realize FirmGoesDigital's intent of providing employees with digital technologies for collaboration. Analyzing the unit's governance approach, we identified three infrastructure evolution dynamics that capture and link the unit's top-down governance in cultivating a DI for collaboration. These are integration of technologies, fragmentation of functionalities and ease of provisioning technologies. Following, we provide excerpts and vignettes from our field notes, informal interviews, documents and digital data reflecting these dynamics.

Integration of technologies

The FirmGoesDigital program formulated the digital units' intent to enable new ways of collaboration by expanding Firm's DI. Thence, Firm integrated digital technologies for collaboration. For this, the industrial manufacturer's digital unit collaborated with its IT unit in expanding its DI. Jointly, the digital and IT unit took a top-down infrastructure governance logic.

> *Our Mission: We are the disruptive transformers aiming to make [Firm] the benchmark digital workplace in the mobility industry by empowering our leaders and employees to ignite digital transformation. – Presentation by Firm's digital unit*

> *We improve opportunities for cooperation by providing several digital tools that enable a closer connectivity and an improved exchange between our employees and support our new culture of open and transparent communication. – Post on Firm's enterprise social media by its digital unit*

In this vein, the digital unit evaluated and suggested to Firm's senior management respective digital technologies. Jointly with Firm's IT unit, it then provisioned the approved technologies expanding Firm's DI. The digital unit positions integrating these technologies as providing employees the 'tools' to engage in new and digital ways of collaboration.

> *Our core task is to make [Firm's] employees fit for digital change - especially where digital cooperation is concerned. To this end, we provide them with the 'tools' they need for everyday life. Or how we like to summarize it: We take care of the right 'mindset, skillset & toolset'. – FirmGoesDigital document*

Among others, we observed Firm integrating digital collaboration tools such as an enterprise social media platform, a team ware and an instant messaging service. Firm's board of management approved these tools in December 2016. Afterwards, the digital and IT unit jointly provisioned this set of digital technologies for collaboration over the course of 2017 and 2018.

> *Board of management decided on our new digital toolbox in December 2016. The toolbox will provide collaboration tools as [Social Media, TeamWare and Messenger]. – Presentation by Firm's digital unit*

Fragmentation of functionalities

Increased introduction of tools engendered fragmentation of functionalities. With the digital unit expanding Firm's DI, the number of digital collaboration tools offering different or similar functionalities surged. These digital collaboration tools include both large-scale information systems (e.g., enterprise social media platform) and small but specified applications (e.g., team ware and project management tools). While the first provide a range of functionalities covering a broad spectrum of use cases, the second provide specific functionalities for a particular use case. Moreover, to accomplish their work, users may require more than one digital collaboration tool as different tools provide the needed functionalities. Thence, fragmentation of functionalities refers to the distributiveness of functionalities required for accomplishing a certain objective across an organization's DI.

> *I'm looking for a tool for managing our new project. I've read that the social intranet [enterprise social media platform] offers features for project management. I've also seen that we've other tools for project management. Which one should I use? I'm familiar with the social intranet and I don't know, if I want to learn about a second tool. – Employee in an informal interview*

The digital unit recognized this pitfall of their DI expansion. On Firm's enterprise social media, they directed a post at Firm's employees. In this post, they advised employees on how to find and select suitable digital technologies for collaboration. One point which the digital unit mentions is to not look for a digital technology suitable for all collaboration purposes. Instead, employees should combine several digital technologies furnishing the required functionalities to achieve a particular collaborative task. In fact, the digital unit emphasizes that, to them, combining specialized tools is a necessity.

> *This is another critical success factor: What is the actual use case of the collaboration? Do I really have to do everything in one tool? What are the strengths of the tool? There is often the desire to find the 'Swiss Army Knife' that can map as many different use cases as possible. Nice in theory but completely against the trend. The Swiss Army Knife doesn't exist, on the contrary: there are more and more specialized tools for special applications. – Post on Firm's enterprise social media by its digital unit*

Ease of provisioning of technologies

Owing much to technological advancements such as cloud-computing, provisioning digital technologies is of relative ease. In some instances, digital collaboration tools are accessible via a web browser and at low costs (Vial 2019). Companies can easily provide these tools to their employees without having to

install them on their employees' devices and without mandatory training. Instead of locally installing new digital technologies for collaboration, they install them on a central server and provision them via the cloud. Hence, ease of provisioning refers to the relative ease in integrating digital technologies for expanding an organization's DI due to technological advancements.

Firm utilized this ease of provisioning by integrating digital collaboration tools centrally and with little training. The digital unit offered trainings comprising webinars or online help guides. Yet, for employees to use these tools, receiving training was not mandatory. Hence, rather than implementing new technologies alongside mandatory or detailed trainings on how to use them, the digital unit merely provisioned technologies. In other words, it made them available. For example, we observed the provisioning of a mobile app called Your Files. Firm provisioned this app overnight. Via its mobile device management, the industrial manufacturer installed the app on its employees' smartphones. Per default configuration, Your Files enabled employees to access files on their personal network drive. Yet, to access files on a department or project network drive, employees had to first configure Your Files. In order to learn configuring Your Files, however, employees had to engage in self-learning or find an expert in their department or within Firm Similarly, we observed Firm provisioning a new tool for agile project management. The digital unit integrated the respective software into an existing cloud solution. It was then accessible via a web browser.

Elements of bottom-up infrastructure governance: Cultivating what is required

After outlining the evolution dynamics of Firm's top-down governance, we turn to the dynamics capturing the elements of bottom-up infrastructure governance which Firm introduced with FirmGoesDigital. These elements encourage employees to cultivate digital technologies to Firm's DI which they (employees) considered required or helpful in accomplishing their work tasks. We found that the entailed cultivation of DI can be explained with three evolution dynamics: empowering employees, ease of accessing and nescience of installed base. Next, we describe these dynamics using excerpts and vignettes from our field data.

Empowering employees

Prior to FirmGoesDigital, Firm's IT unit followed a top-down logic in infrastructure governance. Employees had to request hard- or software from the IT unit which then decided upon approval or denial of these requests. Further, Firm provided certain hard- or software by hierarchy rather than workplace or task requirements. As a consequence, employees required good and convincing arguments and senior management approval to receive such hard- or software. With FirmGoesDigital, Firm changed these practices and switched to incorporating elements of bottom-up infrastructure governance.

> *Compared to two years ago, we've become more flexible and a lot has changed with digitalization. We're more open about the infrastructure to allow business partners technical testing.. the number of requests by business partners jumped.. they're motivated to get rolling on their own but forget to involve IT timely in the process.. – IT manager in an interview*

The elements of bottom-up governance in FirmGoesDigital focus on empowering employees. For this, Firm reduced approval requirements for hard- and software. That is, employees can order certain hard- and software without senior management approval. Similarly, the digital unit altered policies regulating hard- and software distribution. Instead of distributing hard- and software by hierarchy, the new policy formulates that decisions are to be made based on an employees' task requirements.

> *All employees get empowered to actively participate and shape our digital transformation. – FirmGoesDigital Strategy Document*

> *Until now, many people had to click many checkboxes before you could get an IT device approved for their daily work. In addition, new device classes such as smartphones or tablets were issued to employees based on hierarchy - not business requirements. In addition, some locations defined their own product portfolio and their own rules for ordering hardware and software. The new process addresses these shortcomings: A maximum of two people will be involved in approving your IT order.*

> *Low-value consumables and basic equipment such as mice, keyboards, chargers, adapters or bags do not require approval at all. – FirmGoesDigital post on Firm's enterprise social media*

The digital unit also opened Firm's internal IT shop. Firm's IT shop is an internal system similar to a web shop. It lists all hard- and software that is available within Firm Before FirmGoesDigital, only IT admins had access to Firm's IT shop and employees had to put their order via their responsible IT admin. Yet, the digital unit changed the policies regulating access to Firm's IT shop. It opened Firm's IT shop for employees to look for and order both hard- and software themselves.

> *This [self-service ordering on IT shop] is really great. I was able to download a different browser, the same I use on my private device and it loads the websites faster.. and is more stable than [the default browser] – Employee in an informal interview*

Ease of accessing

Cloud computing and other technological advancements enable ease of provisioning. Similarly, these advancements ease accessing digital technologies for collaboration. This means, employees can easily access digital collaboration tools and other applications via a web browser. In addition, compared to laptops and desktop-pcs, Firm's device management of smartphones is less constrained allowing employees to install apps to their smartphones which are available on their devices' operating system's official application store but not necessarily part of Firm's DI.

For example, we observed Firm's internal organizational development unit engage in its digital transformation. The unit was looking for a tool to create interactive slide shows. They favored two alternatives which they had seen used by different departments. Yet, Firm did not provide neither of the alternatives within its DI. Given the ease of access to these alternatives, which are both accessible via the cloud, the unit conducted a trial period concluding to purchase a license for one of the alternatives. We then observed how the use of the purchased solution spread within the unit. Consequently, they required to purchase further licenses.

In order to purchase further licenses, the unit contacted Firm's IT unit. The latter was at first eager to support the unit's request but eventually had to deny it for: *"The issue with [this alternative] is that [Firm] data leaves the company to be processed and stored outside. A few months ago, the [alternative] was found to be unsecure and consequently, is no longer being procured." (Email from Firm's IT unit).* Instead, Firm's IT unit suggested another interactive slideshow tool available within the industrial manufacturer's DI which the organizational development unit agreed to test.

Thence, ease of accessing refers to the relative ease by which users can access digital technologies both within and without their organization's DI. In other words, ease of accessing expands the infrastructure that users consider accessible beyond the boundaries that a company has defined for its organizational infrastructure. It enables users to access and thus, integrate digital technologies into their workflow.

Nescience of installed base

Firm's employees seem nescient (i.e., lack awareness or knowledge) of Firm's installed base; the digital technologies which Firm provisions within its DI. When inquiring for digital technologies facilitating their work, they tend to turn to digital collaboration tools which they know rather than screening for, identifying and evaluating the tools provisioned within Firm's installed base. This engendered that employees integrated digital collaboration tools that were well-known to them rather than integrating their *pendant* available within Firm's installed base. Further, as employees observed other employees using a tool, its use spread, that is, other employees noticed this tool and considered it part of Firm's installed base.

Illustrating, FirmGoesDigital integrated TeamSuite a cloud-based team ware. We observed a human resources department establishing a similar team ware which was also cloud-based (i.e., ease of access) offering similar features as TeamSuite. Asking the department's manager why they did not select TeamSuite, the manager responded: *"I wasn't aware that [Firm] offers an internal solution. My employees suggested to use this platform to better connect between our different teams. They said it was*

a well-known platform and free to use. I only told them which channels.. like topics.. they should create for colleagues to connect."

Similarly, we observed Firm's organizational development unit's interactive slideshow tool becoming part of Firm's installed base. Employees started using the tool and kept using it despite Firm's IT unit declaring it a security risk. For its continued use, an increasing number of employees considered it part of Firm's installed base. Eventually, Firm's IT and digital unit integrated the tool into the industrial manufacturer's installed base.

> *I was looking for an app that allows you to run real-time questionnaires during a presentation or an event or so.. I remembered a colleague using one the other day. When I asked him, he told me he used [application's name]. I then started wondering as I thought this one was prohibited [within Firm]. After a quick search on [Firm's enterprise social media platform], I found that many people use it and discuss this openly. – Employee in an informal interview*

> *Global IT Shop Go Live. On the 9th of September [application's name] was pushed centrally to all IT Shop sites. – Post on the interactive slideshow tool on Firm's enterprise social media by its digital unit*

Thus, nescience of installed base refers to users' lack of awareness about their organization's installed base. It engenders that users integrate further digital technologies entailing bottom-up expansion of their organization's DI.

Discussion

Taking an ethnographic approach, we study the evolution of an industrial manufacturer's DI for collaboration into a 'digital jungle' focusing on the role of its infrastructure governance. Within this focus, we posed the question of *what happens when an organization decides to expand its DI for collaboration through its existing top-down governance while simultaneously introducing elements of bottom-up governance*? Observing such a scenario at Firm, our findings suggest that it entailed two cultivation trajectories which jointly engendered the DI's evolution into a digital jungle. Firstly, Firm's digital units' top-down governance cultivating a DI for collaboration. Secondly, Firm's employees leveraging elements of bottom-up governance to access and integrate digital technologies they considered useful for completing their work. If we consider these trajectories independently, both the digital unit and Firm's employees, from their perspectives, purposefully cultivated the DI. They expanded the DI with technologies they considered required and helpful to change organizing of collaboration. Yet, we observed a shared experience of the infrastructure having become a 'digital jungle'. An experience which can be explained, if the two trajectories are not seen as separate but interconnected.

'Cultivating a digital jungle'; the title of this study bears an oxymoron. To cultivate refers to the purposeful preparation of land and growth of plants to yield crop. A jungle is a dense thicket, a confused mass or jumble of vegetation; the outcome of organic growth. Thence, how can an organization cultivate a jungle? Purposefully? Should an organization not cultivate a beautiful garden? Our findings suggest that in Firm's case, two units were central to cultivating its DI. The first unit was its digital unit. The second unit were its employees; the users of its DI. Firm's digital transformation program (i.e., FirmGoesDigital) seems to be key in understanding these cultivation trajectories. In its program, Firm inscribed a switch from top-down infrastructure governance to incorporating elements of a bottom-up approach (Constantinides and Barrett 2014). The digital unit should expand its DI top-down integrating digital technologies for collaboration. Simultaneously, it should empower employees to choose the technologies they required for their work. This engendered that Firm's digital unit cultivated its DI with technologies for collaboration while its employees cultivated technologies they saw as facilitating their work. These two trajectories entailed a shared experience of Firm's DI having become a digital jungle. Put differently, while employees (i.e., users) interpreted Firm's intent as a move toward a hybrid governance perspective, its digital unit kept a top-down perspective. Analyzing these cultivation trajectories, we found six evolution dynamics which explain Firm's infrastructure evolution into a DI experienced as a digital jungle. These evolution dynamics are (1) integration of technologies; (2) ease of provisioning of technologies; (3) fragmentation of functionalities; (4) nescience of installed base; (5)

ease of accessing and (6) empowering users. Forming a framework (see Figure 1), these dynamics contribute to our understanding of DI evolution as an organization transforms from a top-down approach toward a hybrid approach (Hanseth and Lyytinen 2010; Tilson et al. 2010).

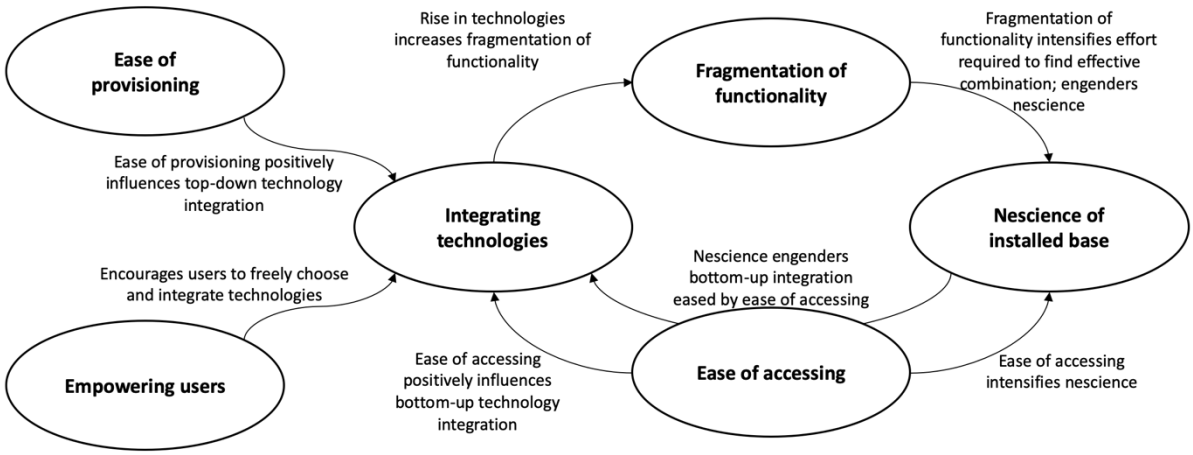

Figure 1: Framework explaining cultivation of a digital infrastructure jungle

Integrating digital technologies (1), Firm expanded its infrastructure to enable changes and improve collaboration practices. Our findings suggest, that integration of technologies was positively influenced by the (2) ease of provisioning such technologies. Ease of provisioning refers to both ease of technical integration due to technological advancements (e.g., cloud computing) and reduced amount of training offered alongside integration. The infrastructure expansion, entails increasing (3) fragmentation of functionalities. Instead of one technology offering the functionalities for a certain task, users may be required to combine several technologies or choose between a set of technologies offering similar functionalities. This intensifies users' search efforts for a technology (or a combination of technologies) to complete a certain task. Since users identify, test and integrate digital technologies into their work alongside their actual work, they struggle to keep pace with the infrastructure expansion entailing their (4) nescience of the installed. This nescience is intensified by the (5) ease of accessing which refers to the relatively little effort required to access digital technologies both within and without the installed base. We observed users integrating technologies which they knew, and which were easy to access via a web browser rather than investing effort into searching for a respective technology within Firm's installed base. Ease of accessing also allowed users to circumvent IT approval rendering bottom-up integration easier (Chua et al. 2014). Lastly, our findings suggest that users (i.e., Firm's employees) interpreted their (6) empowerment as truly choosing any technology without confinements to Firm's installed base. We observed them being determined and encouraged by Firm's digital transformation initiative to drive and push infrastructure expansions themselves and thus, to integrate technologies they knew and had access to regardless of whether these technologies were legitimately integrated into Firm's DI. Thus, while Firm's digital unit indeed inscribed a notion of user empowerment into its infrastructure governance, users' interpretation of this notion seems to have pushed its original meaning of choosing any technology available within Firm's installed base. This is not to say that organizations should not empower their users. On the contrary, studies on infrastructure governance and evolution have shown the importance of flexibility as well as bottom-up infrastructure development (Constantinides and Barrett 2014; Hanseth and Lyytinen 2010). However, it signifies the importance of not only empowering users to choose freely from a pre-defined pool of technologies but to already involve them when making the selection for this pool. Jointly, the six evolution dynamics explain a DI's evolution into a state experienced as a digital jungle. In other words, the digital jungle – as a metaphorical concept – captures a shared experience of a DI.

The digital jungle is an emic concept. Firm's digital unit introduced the notion of a digital jungle in a post on the company's enterprise social media. Investigating its meaning, we found that the concept acts as a sensitizing device, a signifier for Firm's employees shared experience of its DI for collaboration (Walsham 2006). They experience Firm's DI as a dense thicket of digital technologies and express difficulties in finding the technologies they require and in comprehending the installed base. We

observed that employees turn to technologies which are well-known creating shadow-IT or business-managed IT systems causing the infrastructure to drift from the digital unit's control (Chua et al. 2014; Ciborra and Hanseth 2000; Kopper et al. 2018). Yet, unlike infrastructure drift, which stresses that an infrastructure drifts from management control, the digital jungle concept encapsulates users' (in this case employees') struggle to comprehend what an infrastructure offers. In other words, the concept signifies that the infrastructure drifts from users' comprehension and thus, use. It thus extends the top-down governance issue addressed by infrastructure drift (Ciborra and Hanseth 2000; Hanseth and Lyytinen 2010) as it captures the drift from users' comprehension and use. As such, it signifies the importance of developing a hybrid infrastructure governance approach. Hence, the digital jungle concept contributes to our understanding of DI governance and evolution in the context of organizations' digital transformation (Henfridsson and Bygstad 2013; Øvrelid and Bygstad 2019; Tilson et al. 2010).

Conclusion

In this research, we have elaborated on the emic concept of 'digital jungle' that captures *a shared experience of a digital infrastructure having evolved into an impenetrable technological thicket that stashes its affordances, impairing both its effective use and management, yet, furnishing undiscovered potential*. At Firm, we observed how this concept for a shared experience provides actors with a vocabulary to problematize infrastructure evolution, governance and use. We thus conceive it as a sensitizing concept facilitate organizations in demystifying their infrastructure's evolution (Walsham 2006). For theory, it adds to the discourse on DI evolution and governance (Constantinides and Barrett 2014; Henfridsson and Bygstad 2013; Tilson et al. 2010). Instead of conceiving infrastructure drift as a matter of control, that is, infrastructure development drifting away from management control, it problematizes evolving infrastructures as also drifting from users' comprehension and thus, use. Hence, it signifies the importance of acknowledging that infrastructure governance is – or requires – a hybrid perspective involving both management and users (Constantinides and Barrett 2014; Henfridsson and Bygstad 2013).

The framework conceptualizes evolution dynamics cultivating a digital jungle. We presented these dynamics as two evolutionary trajectories. The first trajectory grounded in Firm's top-down logic; the second in its employees' response to elements of a bottom-up logic. Combining these trajectories, the framework explains Firm's DI expansion entailing the outcome of a 'digital jungle'. Hence, it contributes to DI evolution capturing intertwined processes of top-down and bottom-up cultivation enabled by technological advancements easing both provision and accessing of digital technologies. Thus, our findings rattle our conception of cultivating infrastructures toward an envisioned target picture as an either/or matter of management and control or organic growth (Constantinides and Barrett 2014). They indicate that both trajectories followed a notion of purposeful cultivation and pose the question of how organizations can involve their users in infrastructure governance to avoid cultivating a jungle; but a beautiful garden instead. For theory, the framework provides an explanation for cultivating a digital jungle. For practice, it presents a starting point for identifying the evolution dynamics that a hybrid governance perspective on DI evolution should address.

Since we took an ethnographic approach, we acknowledge limitations on our conceptualizations as originating from observations within a single organization and on a DI for collaboration. Yet, through our iterative analysis, we gained confidence on the veracity and truthfulness of the issues' framing (Klein and Myers 1999). Further, we do not claim that our framework can explain every instance of DI evolution in the context of digital transformation but that it contributes to our theoretical understanding of such evolution by providing a theoretical abstraction of our observations (Lee and Baskerville 2003; Sarker et al. 2013). We suggest for further research to test and develop our framework in additional sites. Lastly, as an emic concept, the digital jungle may be quite particular to our research site. Providing a theoretical abstraction of this concept (Lee and Baskerville 2003), however, we call for future studies to build on this abstraction expanding the digital jungle concept through research at other sites. Acknowledging these limitations, our study hence provides two contributions. First, the digital jungle as a sensitizing device for users' perspective on infrastructure evolution and as signaling the importance of a hybrid approach to infrastructure governance (Walsham 2006). Second, the framework explaining the cultivation of such a jungle as actions grounded in two distinct logics of infrastructure governance.

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