

# Managing Digital Platforms in User Organizations: The Interactions Between Digital Options and Digital Debt

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## Abstract

As organizations increasingly use digital platforms to facilitate innovation, researchers are seeking to understand how platforms shape business practices. Although extant literature offers important insights into platform management from a platform-owner perspective, we know little about how organizations manage industry platforms provided by external parties to generate opportunities and overcome challenges in relation to their infrastructure and work processes. As part of larger ecosystems, these digital platforms offer organizations bundles of digital options that they can selectively invest in over time. At the same time, organizations' previous investments in digital infrastructure and work processes produce a legacy of digital debt that conditions how they manage their digital platforms over time. Against this backdrop, we investigate how digital options and digital debt were implicated in a large Scandinavian media organization's management of a news production platform over nearly 17 years. Drawing on extant literature and the findings from this case, we theorize the progression of and interactions between digital options and digital debt during an organization's digital platform management in relation to its infrastructure and work processes. The theory reveals the complex choices that organizations face in such efforts: While they may have to resolve digital debt to make a platform's digital options actionable, hesitancy to plant digital debt may equally well prevent them from realizing otherwise attractive digital options. Similarly, while identified digital options may offer organizations new opportunities to resolve digital debt, eagerness to realize digital options may just as easily lead to unwise planting of digital debt.

**Keywords:** Digital platforms, digital options, digital debt, digital infrastructure, organizational management of industry platforms

## 1. Introduction

Digital platforms such as Google's Android, Apple's iOS, and Facebook are becoming increasingly important for how organizations on the supply or demand side of a range of services establish and renew their digital infrastructure and innovate their business processes and services. In contrast to company-specific platforms, external parties supply these industry digital platforms, which comprise "products, services, or technologies that act as a foundation upon which

external innovators, organized as a business ecosystem, can develop their own complementary products, technologies, or services” (Gawer and Cusumano, 2014: p. 417). Such platforms have therefore received increasing attention in the Information Systems (IS) literature (de Reuver et al., 2017; Eaton et al., 2015; Selander et al., 2013; Sørensen et al., 2015; Tiwana et al., 2010; Tiwana, 2015; Toppenberg et al., 2016; Yoo et al., 2012). Together with studies in related fields, this literature has expanded our understanding of the platform owner’s perspective on key issues related to digital platforms and their transformational and value co-creation consequences, including governance regimes for digital platforms (Wareham et al., 2014); the relationship between governance and architectural choices (Tiwana et al., 2010, Tiwana, 2014); strategies for platform openness (Boudreau, 2010); collaboration between small software vendors and platform owners (Ceccagnoli et al., 2012); the dynamics of mobile platforms (Sørensen et al., 2015); the evolution of mobile platforms such as iOS (Ghazawneh and Henfridsson, 2013); and how platforms as markets can transform economies and business strategies (Parker et al., 2016).

Although the literature theorizes rather extensively about how platform owners attract users and complementors to develop and expand their platform ecosystem, studies on digital platform management from the user-organization perspective are hard to come by. Yet, user organizations are increasingly adopting digital platforms, such as Google ‘apps for work’ and Microsoft’s SharePoint, as central components of their digital infrastructures to support work processes and innovation efforts (Hepsø et al., 2009; Williams and Pollock, 2012). Unlike apps for the Android smartphone, managing external industry platforms in a user organization is complex, expensive, and uncertain. It requires continuous attention not only to developments within the platform ecosystem but also to the organization’s business needs and digital infrastructure. As such, there are compelling reasons for adopting the user organization as the frame of reference to advance our understanding of how context and actors shape the management of external industry platforms. This approach complements the owner-centric perspective that dominates the literature by investigating how user organizations configure and select platform modules (or apps) to fit their needs and digital infrastructure, as well as how they fine-tune governance regimes to balance global standardization and local customization (Constantinides and Barrett, 2014). While we have accumulated significant knowledge regarding strategies and tactics for successfully implementing complex information systems such as enterprise systems (e.g., Boudreau and Robey, 2005; Williams and Pollock, 2012), managing digital platforms presents new challenges and

opportunities as organizations must continuously respond to and leverage an ever-growing and changing set of platform features and complementary products and services, as well as an evolving digital infrastructure with related work processes.

We also note that extant literature has provided largely positive accounts of successful use cases for platforms such as Apple's iOS and Google's Android (de Reuver et al., 2017). These accounts focus on the platforms' generative capabilities grounded in modularized architectures and flexible governance regimes (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013), as well as on how the platforms produce increasing value for the participating actors through positive network effects (Parker et al., 2016). Arguably, an organization's platform management evokes tensions between, on the one hand, the generativity afforded by modularized architectures and flexible governance regimes (Henfridsson and Bygstad, 2013; Yoo et al., 2010; Zittrain, 2008) and, on the other hand, the inertia that platform use produces (Hanseth and Lyytinen, 2010; Star and Ruhleder, 1996). Path dependencies and legacy challenges have been thoroughly examined in studies on the role of an organization's installed base of its digital infrastructure (i.e., deployed systems and related work processes) in influencing, postponing, and sometimes entirely hindering the selection, uptake, and use of digital artifacts (Aanestad and Jensen, 2011; Ciborra et al., 2001; Hanseth and Lyytinen, 2010). Similarly, products, technologies, and services can increase the complexity in organizational platform management to a point that they eventually produce negative cross-side effects, even in successful platform ecosystems (Parker et al., 2016). Theoretically and empirically investigating management of external industrial platforms from a user-organization perspective must therefore account both for the transformative capabilities afforded by digital platforms' generative characteristics (Henfridsson and Bygstad, 2013) and for the inertia and socio-technical complexity that result from an organization's platform use as part of its digital infrastructure over longer time periods (Hanseth and Lyytinen, 2010).

To advance theory on organizational management of digital platforms in relation to digital infrastructures, we draw on concepts and theories related to digital options (Sambamurthy et al., 2003; Sandberg et al., 2014; Svahn et al., 2015) and technical debt (Kruchten et al., 2012; Ramasubbu and Kemerer, 2016; Tom et al., 2013). We use the notion of digital options to focus on the transformative capabilities that digital platform evolution affords a user organization and to explicate whether and how the organization can leverage the investment opportunities available in

the platform ecosystem to further develop its platform use. The digital options concept is particularly helpful in this context, because it underscores that organizations must continuously identify options worthy of exploration, develop options to make them realizable, and selectively realize options to generate new value (Sandberg et al., 2014; Svahn et al., 2015). We also draw on the notion of technical debt to focus on inertia and path dependencies in platform usage and to conceptualize digital debt as a reflection of an organization's cumulative buildup of technical and informational obligations related to the maintenance and evolvability of its platform and infrastructure (Kruchten et al., 2012; Ramasubbu and Kemerer, 2016). Organizational actors continuously plant new digital debt, assess existing digital debt, and selectively invest resources to resolve existing digital debt. Similar to how options and debt are implicated in financial practices, we are interested in understanding how digital options and digital debt dynamically interact, as realizing digital options may reduce or increase an organization's digital debt, and modifying digital debt may facilitate or hinder an organization's realization of digital options. These insights allow us to go beyond simplistic distinctions where options are inherently "good" and debt is inherently "bad." As such, we seek to answer the following research question: *How are digital options and digital debt implicated over time in an organization's management of a digital platform in relation to the organization's digital infrastructure?*

Empirically, we analyze how *Media Company* (pseudonym), a large Scandinavian media organization, used different versions of *News Platform* (pseudonym), which is owned and supported by *Platform Company* (pseudonym) over a nearly 17-year period. We provide a detailed and in-depth account of six episodes in which Media Company adopted, modified, and extended News Platform in two ways: by identifying, developing, and realizing digital options that became available through the platform ecosystem and the digital infrastructure; and by planting, evaluating, and resolving digital debt, which became an intrinsic part of its use of the platform. Based on these empirical insights and extant theory, we theorize the interactions between digital options and digital debt as a contribution to understanding the complex choices organizations face in managing digital platforms. As such, we respond to de Reuver et al.'s (2017) call for advancing theory on the "digitality" of digital platforms and add a user-centric perspective to the literature on control and generativity in digital platform ecosystems (de Reuver et al., 2017; Eaton et al., 2015; Ghazawneh and Henfridsson, 2013).

The remainder of our paper is structured as follows. In Section 2, we review the extant literature on digital platforms. Next, in Section 3, we integrate digital options, digital debt, and their interactions into a framework for understanding how organizations manage digital platforms in relation to their digital infrastructure and work processes. In Section 4, we present our longitudinal study of Media Company's management of the News Platform. Section 5 introduces the empirical context, while Section 6 offers a detailed account of our empirical analyses. In Section 7, we combine insights from the empirical analyses with extant literature to advance theory on how digital options and digital debt are implicated in organizational management of digital platforms. Finally, Section 8 offers our concluding remarks.

## **2. Literature Background**

The literature on platforms is highly multidisciplinary, with studies in economics, engineering, and product innovation (Evans et al., 2006; Gawer, 2009, 2014; Gawer and Cusumano, 2014; Rochet and Tirole, 2003), as well as a growing number of IS studies (de Reuver et al., 2017; Eaton et al., 2015; Ghazawneh and Henfridsson, 2013; Sørensen et al., 2015; Tilson et al., 2013; Tiwana et al., 2010; Toppenberg et al., 2016). As Table 1 summarizes, Gawer (2014) identifies three distinct perspectives in the platforms literature; each makes a different assumption about what a platform is and how it evolves. Gawer argues that platforms have been conceptualized from two dominating perspectives—engineering and economics—and outlines a third perspective that bridges these two perspectives by emphasizing platforms as “evolving organizations or meta-organizations” (ibid: p. 1247). We refer to this perspective as the organizational perspective, which emphasizes the practices involved in platform development and ecosystem management.

A first stream of the digital platforms literature draws on an *engineering* perspective with roots in (physical) product development and software development. These studies conceptualize platforms as technological architectures (Baldwin and Woodard, 2009; Gawer, 2014; Van Schewick, 2012) and typically define platforms as “a set of stable components that supports variety and evolvability in a system by constraining the linkages among the other components” (Baldwin and Woodard, 2009: p. 19). Another basic tenet of this stream is that all platforms have a limited set of core components that are relatively stable, with many more peripheral components that vary widely and are frequently substituted or modified. A well-known example is the Internet, where the Internet Protocol (IP) can be perceived as a stable component that supports a wide variety of changing components through standardized interfaces

(Zittrain, 2008). As such, platforms rely on modularization to manage complexity and ensure evolvability in the design and management of large technical infrastructures (Hanseth and Lyytinen, 2010). The modularization idea builds on Simon's scientific design approach (Simon, 1996) and on Parnas' foundational software engineering principles (Parnas, 1972).

IS scholars have drawn extensively on the engineering platform perspective because it easily relates to software architecture. Tiwana et al. (2010: p. 675) define a platform as “the extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they interoperate” and a module as “an add-on software subsystem that connects to the platform to add functionality to it.” These authors offer a theoretical framework and related research questions grounded in the idea that platform dynamics are reciprocally influenced by the coevolution of platform architecture and governance, as well as by changes in the platform's environment. As such, it is not only the digital platform's functionality that matters, but also the way functionality is modularized and governed to afford flexibility for users and developers across many different contexts. Closely following Baldwin and Woodard (2009), Spagnoletti et al. (2015) conceptualize platforms as consisting of three parts: core, complements, and interfaces. Boudreau (2010) suggests that platforms are technical architectures and investigates different strategies for openness related to them. Thus, the engineering perspective emphasizes that the technical design of platforms matters for their ability to evolve and produce innovation. In more recent research, the engineering perspective's concept of technical design has been elaborated to multiple layers of modular architecture that involve varying arrangements of devices, content, services, and networks (Yoo et al., 2010), underscoring the digital nature of platforms. This conceptual elaboration helps us understand how modular layering creates the generative capacity for numerous recombinant possibilities across layers and new forms of innovation. Drawing on insights from the evolution of digital platforms such as Linux and Wikipedia, Garud et al. (2008) critique the engineering perspective for being better suited for conceptualizing complete and stable systems, and not for taking into account the inherent incompleteness of platforms given that changing system requirements are unavoidable in organizations. As such, a pure engineering perspective cannot fully account for how digital platforms evolve, and it cannot comprehensively capture crucial socio-technical platform characteristics that involve technical architectures, systems, and associated organizational processes and standards (de Reuver et al., 2017).

A second stream of research is grounded in an *economic* perspective (Anderson et al., 2013; Eisenmann et al., 2006; Eisenmann et al., 2007; Evans, 2003; Lin et al., 2011; Parker et al., 2016). Compared to the engineering perspective, the economic perspective is less focused on the technical platform itself and more on the business models, strategies, and value creation it affords. In this stream, platforms are seen as multisided markets that enable new forms of interaction between consumers and providers and potentially disrupt traditional markets (de Reuver et al., 2017; Parker et al., 2016). As such, this literature does not emphasize a platform's technical design, but uses concepts such as "platform-mediated networks" that are "comprised of users whose interactions are subject to network effects, along with one or more intermediaries who organize a platform that facilitates users' interactions" (Eisenmann et al., 2007: p. 3). In a recent book, Parker et al. (2016) explore the ways in which platforms, as two-sided markets, are different and can outperform traditional businesses organized as pipelines by enabling multiple network effects (Rochet and Tirole, 2003; Shapiro and Varian, 1998). In relation to platforms and digital technologies in general, network effects or network externalities are concerned with the self-strengthening mechanisms that exponentially increase the value for individual users when a large installed base of users adopt the same solution. According to the economic perspective, multisided platforms have the potential to produce both direct externalities between users on the same side of the platform (same-side effects) and indirect externalities between users on different sides of the platform (cross-side effects) (Parker et al., 2016). Moreover, as Parker et al. (2016) exemplify in the case of the ride-hailing Uber platform, negative same-side and cross-side effects can arise from the imbalance of customers and available vehicle drivers, as well as from the platform ecosystem's increasing complexity. The economic perspective also underscores the role of platform complementors in the form of software modules (apps) and services. Studies in this tradition have examined platforms in relation to various digital phenomena, including consumer-oriented platforms, social media platforms, and sharing economy platforms.

IS researchers have adopted some of the vocabulary on multisided platforms and network effects. Tiwana (2014) referred to same-side network effects and cross-side network effects in two-sided platforms relating to users on one side and app developers (i.e., complementors) on the other side. Ceccagnoli et al. (2012) analyzed the implications of network effects for independent software vendors who joined the large and successful SAP ecosystem. In their study, they found that smaller software vendors could increase their business performance by joining a platform ecosystem.

Song et al. (2017) investigated how cross-side networks from demand (users) to supply (app developers) and supply (app developers) to demand (users) are influenced by the platform owner's governance rules in the case of the Mozilla's Firefox web browser platform. Although not particularly evident in IS research, studies adopting the economic perspective tend to focus on consumers as users and, as pointed out by Gawer (2014), they usually do not consider that organizations can have different and changing roles at different stages of platform evolution. Perhaps a more apt critique of IS platform research adopting the economic perspective is that it tends to deemphasize or overlook the specifics of the technology and its design—a critique that was rendered about two decades ago regarding IS research at large (Orlikowski and Iacono, 2001). Surely, Uber, Facebook, SAP's enterprise system, and Google's Android operating system could all be conceptualized as digital platforms. However, de Reuver et al.'s recent literature review (2017) found that many studies fail to conceptualize the "digitality" of digital platforms, pointing to the opportunity for IS studies to identify and theorize similarities and differences in technical architectures as an important characteristic of these platforms.

We refer to the third perspective on digital platforms as *organizational*. Building on Gawer's (2014) insightful analysis, this perspective does not view platforms as a particular technical architecture or a specific type of market, but emphasizes instead how various actors across a platform ecosystem organize and coordinate practices in order to produce innovation. More than two decades ago, Ciborra (1996) suggested that organizations can be conceptualized as platforms for tinkering and improvising. He suggested that, in turbulent or changing environments, organizations should act upon unpredictability by building a relatively stable platform that would facilitate improvisation in response to changing demands and requirements. In this context, Ciborra (1996) saw digital technology as an enabler for such organizational platforms. Thus, the organizational perspective emphasizes actors' practices in relation to the technical architectures and the markets they establish, consistent with Gawer's (2014: p. 1240) view of technological platforms as "evolving organizations or meta-organizations that: (1) federate and coordinate constitutive agents who can innovate and compete; (2) create value by generating and harnessing economies of scope in supply or/and demand; and (3) entail a modular technological architecture composed of a core and a periphery." Gawer (2014) further argued that agents can be both individuals and firms, hence diverging from the typical economic perspective on digital platforms, which focuses on consumers. Furthermore, Thomas et al. (2014) referred to this platform research as the organizational



capability stream that builds on an understanding of platforms as containers and facilitators of a “collection or specific architecture of resources and capabilities that have been realized and deployed by dynamic capabilities” (p. 6).

IS researchers have begun contributing to this organizational perspective on digital platforms. One recent study examined digital platforms through the lens of boundary resources that comprise the “software tools and regulations facilitating the arms’ length relationships between the involved parties” (Ghazawneh and Henfridsson, 2013: p.176). In contrast to the engineering and economic perspectives, the organizational perspective involves an explicit socio-technical conceptualization of digital platforms as consisting of “technical elements (of software and hardware) and associated organizational processes and standards” (de Reuver et al., 2017: p. 6). Whereas the engineering perspective forefronts platform generativity as the “capacity to produce unanticipated change through unfiltered contributions from broad and varied audiences” (Zittrain, 2008: p. 70) and the economic perspective has similar strong connotations by emphasizing network effects, the organizational perspective takes the position that digital platforms are not unlimitedly generative. To maintain consistency, actors must develop and manage digital platforms by combining modularized and layered platform architectures with appropriate platform governing structures. Hence, as illustrated by Ghazawneh and Henfridsson’s (2013) longitudinal study of Apple’s iPhone software platform, platform owners must balance the tension between generativity and control through what they refer to as *resourcing and securing*. Similarly, Eaton et al. (2015) elaborated how platform-related boundary resources evolve through the actions of heterogeneous and distributed actors in the platform ecosystem. They adopted Pickering’s lens of tuning (1993) furthered by Barrett et al. (2012) to emphasize that changes in boundary resources are not simply driven by platform owners supported by hordes of developers; equally important, such changes result from complex networks of events in which boundary resources “evolve and collide with artifacts within and across multiple organizational and technological contexts” (Eaton et al., 2015: p. 22). Wareham et al. (2014) offered another study from an organizational perspective, emphasizing enterprise systems as digital platforms with modularized technical architectures and as governance mechanisms for managing platform ecosystem tensions.

Although the digital platform literature has progressed to offer complementary perspectives on a complex and emerging phenomenon, it builds on underlying assumptions that can be problematized in two important ways (Alvesson and Sandberg, 2011). First, studies within all three perspectives predominantly adopt an owner-centric view of digital

platforms, albeit with different lenses: engineering perspective studies view platform owners as designers of modularized technological architectures (e.g., Spagnoletti et al., 2015); economic perspective studies view platform owners as developing business models based on multisided markets (Eisenmann et al., 2007; Evans, 2003; Parker et al., 2016); and organizational perspective studies focus on platform owners as implementers of boundary resources that allow them to negotiate an appropriate balance between openness and control (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013). As such, all three literature streams give scant attention to the challenges and opportunities that digital platforms afford user organizations. Without detailed and comprehensive studies of how end users and their organizations develop and use digital platforms provided by external parties, it is difficult to understand how the platform owner's different architectures and governance structures enable or prohibit appropriate platform performance and requisite renewal in the user organization. Further, when adopting a user-centric view, it is important to go beyond traditional IS studies of platforms such as enterprise systems (Howcroft and Light, 2010; Williams and Pollock, 2012), by emphasizing how digital platforms evolve within an organization through a dynamic interaction between the digital infrastructure and the platform ecosystem. It is also important to look at how platforms provide options for evolving and intensifying the generative mechanisms of digital infrastructures (Henfridsson and Bygstad, 2013), as well as how the installed base of technologies and related work processes (Hanseth and Lyytinen, 2010; Aanestad and Jensen, 2011) can inhibit platform management in organizations. Despite the fact that user organizations cannot manage digital platforms in isolation from their digital infrastructure, the literature—with its predominantly owner-centric view on digital platforms—has not addressed the interdependence between digital platforms and infrastructures.

Second, studies on digital platforms have primarily examined successful cases such as Android and iOS (de Reuver et al., 2017), focusing on the options these technologies afford as facilitators of innovation and new business models. They have paid considerable less attention to the challenges that organizations face in managing digital platforms and the business risks they encounter as they manage digital platforms in the context of market dynamics and technological developments in the ecosystems. Shifting the focus to a user-centric perspective may contribute a more nuanced view of how platforms that appear successful within a wider ecosystem are actually experienced by end-user groups within specific organizations. Hence, while extant literature has emphasized digital platform generativity and flexibility, focusing on these platforms in a user-organization context will help us better understand the interactions

between the digital options that the platforms afford as programmable, distributed, self-referential, and editable digital artifacts (Kallinikos et al., 2013) and the digital debt that results from embedding the platforms into the organization's digital infrastructure and associated work processes.

<b>Table 1. Perspectives on Digital Platforms in IS Research</b>		
<b>Perspective</b>	<b>Description</b>	<b>References</b>
<i>Engineering</i>	Digital platforms as <i>technical artifacts</i> with a modular architecture consisting of a stable core component and many changing peripheral components	Boudreau (2010); Spagnoletti et al., (2015); Tiwana et al., (2010); Yoo et al., (2010)
<i>Economic</i>	Digital platforms as <i>markets</i> that disrupt traditional markets and facilitate efficient interactions between consumers and producers	Anderson et al., (2013); Ceccagnoliet et al., (2012); Song et al., (2017); Tiwana (2014)
<i>Organizational</i>	Digital platforms as <i>innovation practices</i> in which actors organize and coordinate innovation enabled by technical mechanisms and social arrangements	Eaton et al., (2015); Ghazawneh and Henfridsson (2013); Thomas et al., (2014)

### 3. Theoretical Framing

We draw on the notions of digital options and digital debt to understand how a user organization can leverage the generative potential and address the legacy challenges involved in managing a digital platform. Specifically, we theorize the progression of and interactions between digital options and digital debt during the ongoing development and use of a digital platform in organizational contexts.

From a user perspective, a digital platform is intrinsically related to the organization's digital infrastructure (Hanseth and Lyytinen, 2010; Henfridsson and Bygstad, 2013; Hepsø et al., 2009; Tilson et al., 2010). In the IS literature, the notion of digital (or information) infrastructure is used to conceptualize portfolios of interconnected systems and related components in contrast to stand-alone systems. A digital infrastructure has been defined as "a shared, open (and unbounded), heterogeneous and evolving socio-technical system (which we call installed base) consisting of a set of IT capabilities and their user, operations and design communities" (Hanseth and Lyytinen, 2010: pp. 4-5). Specifically, Hanseth and Lyytinen (2010) conceptualize digital infrastructures as consisting of specific IT resources (e.g., hardware, networking, and communications technologies), platforms, and applications. Hence, because organizations typically invest in multiple digital platforms (Selander et al., 2013), their digital infrastructure typically consists of one or more digital platforms in addition to a portfolio of more traditional information systems that,

together with associated work processes, make up a heterogeneous installed base (Hanseth and Lyytinen, 2010; Aanestad and Jensen, 2011). Given their layered modular architectures and self-referential nature (Yoo et al., 2010), digital platforms can be loosely integrated and use content from other platforms and systems within the organization's digital infrastructure. As such, platforms provide a user organization with numerous digital options that leverage their infrastructure's generative dynamics (Henfridsson and Bygstad, 2013). At the same time, digital platforms are part of an installed base of socio-technical arrangements (Star and Ruhleder, 1996; Aanestad and Jensen, 2011) with accumulated digital debt that make changes costly—as well as organizationally and technologically challenging. As Table 2 summarizes, we next elaborate the notions of digital options and digital debt related to managing digital platforms in organizations.

### **Digital Options**

In the finance literature, an option represents a right to pursue an investment opportunity in the future, providing the option's holder with a preferential advantage in eventually making the investment (Black & Scholes, 1973).

Organizational strategists have appropriated this concept to frame the possibility of an organization engaging in select future actions through incremental resource investments (Bowman & Hurry, 1993; Luehrman, 1998). Options thinking can therefore help managers strategize through a process of generating resource investment choices that stem from current capabilities, future environmental opportunities, and their associated uncertainty (Bowman & Hurry, 1993).

Applying this notion to IT capabilities management, Sambamurthy et al. (2003) suggested that an organization's investments in IT capabilities, together with changes in its technological environment, offer *digital options* for competitive action. As such, digital options thinking can help managers consider IT capability investments without obligation to realize them, develop and bundle options to evaluate alternative investments, and eventually make selective investments in specific IT capabilities (Sandberg et al., 2014). In the context of digital platforms, digital options represent opportunities to invest in new technical and informational features that will increase the platform's value proposition for an organization's work processes. A digital platform offers access to a continuous flow of offerings—that is, apps, products, and services—that are produced by actors in the platform ecosystem or available in the organization's infrastructure; each such offering provides an opportunity for managers to consider whether

adopting the offering would create business gains for the organization. As such, we conceptualize digital platforms as *digital options generators* (Sambamurthy et al., 2003) for managers in organizational contexts.

Drawing on option life-cycle concepts from financial and strategic management theory (Bowman & Hurry, 1993), managers may identify, develop, and realize digital platform options (Sandberg et al., 2014; Svahn et al., 2015) as follows: *identifying* plausible options involves recognizing new technical and informational platform features; *developing* new options involves evaluating and bundling these new features into desirable and feasible competitive actions; and *realizing* the selected options involves implementing the new features into the organization's infrastructure and work processes. In the platforms context, digital options may represent investments in a platform's features to enable interaction with boundary resources, such as integrating the offerings of apps, content, or other technological or informational resources by members in the platform ecosystem (Ghazawneh and Henfridsson, 2013). Such investments in platform features can be directed at all levels of a layered modular architecture (Yoo et al., 2010). As defined by Yoo et al. (2010: p. 728), the "layered modular architecture is a hybrid between a modular architecture and a layered architecture, where the degree by which the layered architecture adds the generativity to the modular architecture forms a continuum." In fact, this inherent generativity of the layered modular architecture of platforms potentially provides an abundance of digital options for organizations. Furthermore, an important characteristic of digital technologies is their self-referential nature, which implies that innovations themselves open further possibilities for innovation (Kallinikos et al., 2013; Yoo et al., 2010). Thus, developing and realizing a digital option related to a digital platform can foster further digital options. For example, in our case, Media Company's external industry platform had APIs for accessing content, which provided numerous digital options for developing new apps. Use of these apps produced new content, which managers in turn identified as digital options that could be further developed and realized. On the flip side, numerous options increase managerial complexity, so organizations run the risk of developing too many options that eventually produce little or no business value. Moreover, the pool of digital options may be greatly expanded as a result of innovation, adoption, and scaling mechanisms in the organization's digital infrastructure (Henfridsson and Bygstad, 2013); this is especially likely when the infrastructure involves several platforms. Still, as Yoo et al. (2010) noted, managing an organization's digital platforms and infrastructure cannot be separated from the wider platform

ecosystems. Hence, a company using Google Docs will be somewhat dependent on how the Google platform ecosystem evolves.

### **Digital Debt**

The technical debt concept has long been used in software engineering; it was first introduced to metaphorically describe how writing “quick and dirty” code meant taking up debt that often had to be paid back later (Cunningham, 1992). Interest in technical debt has recently been intensified as failure to manage it appropriately can adversely affect a software system’s long-term maintainability, evolvability, and quality (Guo et al., 2016; Kruchten et al., 2012; Tom et al., 2013). Although initially closely related to code and software architecture, the technical debt notion has expanded to include lack of testing, missing documentation, and other software development artifacts (Li et al., 2015). Also, technical debt is not inherently bad; taking up some debt may speed up delivery of new features and enable organizations to introduce new services and products to the market earlier than their competition (Tom et al., 2013).

In the IS literature, Ramasubbu and Kemerer applied the concept of technical debt in relation to enterprise systems as “a buildup of software maintenance obligations that need to be addressed in the future” (2016: p. 1487). More generally, Woodward et al. suggested that software maintenance obligations may “be associated with technical redesign, component upgrading, or wholesale replacement of an architecture or layer to implement a desired functionality” (2013: p. 540). Kruchten et al. (2012) broadened the notion further to include both evolvability issues related to technological gaps in software architecture and features and maintainability issues related to the quality of the software code. As such, technical debt is not simply “the result of having made a wrong choice originally, but rather the result of the context’s evolution—the passing of time—so that the choice isn’t quite right in retrospect. Technical debt in this case is due to external events: technological obsolescence, change of environment, rapid commercial success, advent of new and better technologies” (Kruchten et al., 2012: p. 19). Especially in the context of digital platforms, debt’s evolvability dimension is profoundly important as successful platform ecosystems continuously produce new innovations for organizations to invest in—if they are not hindered by existing debt.

Given these insights, we adopt the broader notion of *digital debt* to capture the buildup of technical and informational obligations that affect a platform’s maintenance and evolvability as part of a user organization’s digital infrastructure. These obligations represent risks for relationships between the platform and other parts of the

infrastructure and for the work processes that the platform enables. As such, digital debt represents the inertia and path dependencies that result from an organization's continuous embedding of a digital platform into its digital infrastructure and work processes. Organizations not only maintain and reconfigure software related to their digital platforms, but they also accumulate large amounts of content; more often than not, considerable debt is involved in the way they decide to structure, store, and categorize this information. Such debt associated with informational features can, for instance, result from decisions about how information is structured in databases and on user interfaces and about how users tag and categorize information to support business analytics (Hepsø et al., 2009). In terms of digital platforms' layered architecture (Yoo et al., 2010), technical debt refers to the service, network, and device layers, whereas informational debt refers to the content layer. Consistent with our conceptualization of digital options, we capture the life cycle of practices through which digital debt manifests and evolves during digital platform management, from planting to evaluating and resolving digital debt. *Planting* digital debt involves producing technical and informational obligations that must be addressed during an organization's future platform maintenance and evolution; *evaluating* digital debt involves examining and prioritizing the existing debt; and *resolving* digital debt involves addressing a digital platform obligation to partly or entirely remove existing debt.

The digital debt concept is also related to the concept of the installed base in digital infrastructure studies (Hanseth and Lyytinen, 2010; Aanestad and Jensen, 2011). While an infrastructure's installed base refers to its entire collection of heterogeneous systems and related work processes (Hanseth and Lyytinen, 2010), the notion of digital debt affords a nuanced conceptualization of those installed base components that require considerable maintenance work and reduce evolvability in specific situations. Moreover, consistent with the digital options notion, platform development and use can also plant digital debt in the digital infrastructure as a result of intrinsic interdependencies.

Thus, the implication of digital options and digital debt in organizational platform management is not an expression of dualism in which options are good and debt is bad. Some options may involve complexities and uncertainties that make their development time-consuming and the prospect of realizing them unlikely, while digital debt can be planted strategically to speed up deployment of a new platform version (Tom et al., 2013). As such, digital options and digital debt are interdependent and mutually enabling (Farjoun, 2010) and, while they can constrain each other during organizational management of platforms, they are not necessarily in opposition.

The ongoing interactions between options and debt can comprise different phases of identifying, developing, and realizing digital options, as well as planting, evaluating, and resolving digital debt. Whenever an organization develops and realizes new options—such as by leveraging platform upgrades—new digital debt could be planted to strategically speed up the process, to tactically make it more affordable, or as an unintended consequence of the upgrade itself (Tom et al., 2013). Digital debt may also hinder an organization’s ability to develop and realize digital platform options; it might, for example, make it costly and dependent on expert competence to migrate to a new version. On the other hand, digital debt can enable identification, development, and realization of new digital options.

As such, the ongoing interactions between digital options and digital debt are central to digital platforms’ generativity in organizational contexts as mediated through the platforms’ layered modular architecture. This architecture is highly generative because the same platform components—in terms of their boundary resources and in combination with other platforms and digital infrastructures—can provide different digital options. For example, as our Media Company case study outlines below, the digital platform afforded access to standardized interfaces and protocols that provided new digital options for exchanging multimedia content across different platforms and systems in the digital infrastructure. At the same time, digital options can plant new digital debt as their development and realization can imply strategic debt planting, multiple shortcuts, and unintended debt planting. Precisely because of this generativity, digital platforms can easily be meshed with and interconnected with other platforms and components in a digital infrastructure. In this way, generative platform architectures intensify a dynamic that involves both digital options and digital debt.

**Table 2. Options and Debt Related to Digital Platforms**

<b>Concept</b>	<b>Definition</b>	<b>Examples</b>	<b>Processes</b>
Digital Option	An opportunity to invest in new technical and informational features that will increase the platform’s value proposition for an organization’s work processes  (Sambamurthy et al., 2003; Sandberg et al., 2014; Svahn et al., 2015)	<ul style="list-style-type: none"> <li>• Leverage platform upgrades</li> <li>• Configure platform modules, apps, and data</li> <li>• Develop customized platform features</li> <li>• Loosely integrate with digital infrastructure and other platforms</li> <li>• Redesign platform-enabled work processes</li> <li>• Modify platform governance</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Identify</u>: recognize new technical and informational platform features so they are available for managerial consideration</li> <li>• <u>Develop</u>: evaluate and bundle new technical and informational platform features into competitive actions that are both desirable and feasible</li> <li>• <u>Realize</u>: selectively implement new technical and informational platform features into the organization’s infrastructure and work processes</li> </ul>
Digital Debt	A buildup of technical and informational obligations related to platform	<ul style="list-style-type: none"> <li>• Technical and informational inconsistencies from upgrades</li> </ul>	<ul style="list-style-type: none"> <li>• <u>Plant</u>: produce different types of digital debt representing platform maintenance and evolvability</li> </ul>



	<p>maintenance and evolvability that represent performance risks in an organization's work processes</p> <p>(Guo et al., 2016; Kruchten et al., 2012; Ramasubbu &amp; Kemerer, 2016; Tom et al., 2013)</p>	<ul style="list-style-type: none"> <li>• Upgrades lacking in platform configuration and work process design</li> <li>• Design shortcuts in customization software</li> <li>• Integration gaps or tight coupling with digital infrastructure and other platforms</li> <li>• Ambiguous or deficient platform governance principles</li> </ul>	<p>obligations that need to be addressed in the future</p> <ul style="list-style-type: none"> <li>• <u>Evaluate</u>: examine and prioritize existing digital debt</li> <li>• <u>Resolve</u>: address a digital platform maintenance obligation to partly or entirely remove existing digital debt</li> </ul>
Platform Management	<p>The interactions between digital options and digital debt during an organization's ongoing development and use of a digital platform in relation to the organization's digital infrastructure, where the development and use are shaped by responses to internal and external events</p>	<ul style="list-style-type: none"> <li>• Digital options may increase or decrease an organization's ability to resolve digital platform debt</li> <li>• Digital debt may enable or hinder an organization's ability to realize digital platform options</li> </ul>	<ul style="list-style-type: none"> <li>• An organization may resolve debt to develop digital options</li> <li>• An organization may plant digital debt to realize attractive digital options</li> <li>• An organization may leverage digital options to resolve digital debt</li> </ul>

## 4. Research Design

### Case Study

We seek to advance the theorizing of digital platform management in user organizations based on a longitudinal interpretive case study. An interpretive perspective is appropriate as it aims “at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context” (Walsham 1993, pp. 4-5). Further, to conceptualize the mutual shaping processes of context and digital platforms, we rely on the theoretical framing summarized in Table 2. Although theoretically informed case studies have become an established approach for conducting IS research (Klein and Myers, 1999; Sarker et al., 2013; Tan and Pan, 2011; Walsham, 2006), our approach has some distinctive characteristics: (i) it covers a prolonged period of time (1999–2016); (ii) it involves both historical analysis of past events (Alvesson and Sköldbberg, 2009; Van de Ven and Huber, 1990) and data collected in real-time as the events occurred; and (iii) it involves fieldwork across different geographical sites and multiple stakeholder groups, as recommended for the study of digital platforms (Williams and Pollock, 2012).

The choice of case is of outmost importance for developing new theory (Eisenhardt, 1989). Media Company was selected among several alternatives based on the opportunity to undertake a longitudinal study of digital platform management as part of an organization's digital infrastructure (Yin, 2009). The case was especially attractive because of the business criticality of the News Platform to Media Company, as well as the ways in which the platform was

increasingly embedded into the organization's digital infrastructure and work processes over a prolonged period of time. In comparison with the current platforms literature (de Reuver et al., 2017), in which organizational platform usage is either greatly underrepresented or not at all represented in generic frameworks (e.g., Tiwana et al., 2010), this case is atypical. Arguably, however, in comparison with real-world experiences, this case is likely to be a typical or representative case (Yin, 2009) as many other organizations are increasingly adopting the same or similar platforms. Further, access to multiple sites and different newsrooms afforded the opportunity to interview key stakeholders, including the platform owner, IT consultants, IT operations, IT architects, managers, project participants, and various types of journalists who are the News Platform's primary users. Our level of access to sites, newsrooms, and stakeholders greatly increased the likelihood of gaining rich insights into past and current events relevant to the digital platform's management. As such, the characteristics of the selected case and the granted access positioned this research well for theory development (Eisenhardt, 1989).

### **Data Collection**

We collected data in multiple batches from September 2013 to November 2016. We used different methods and collected data from multiple sources. First, we interviewed a total of 24 different stakeholders. The interviews lasted 30–150 minutes. We interviewed five key stakeholders several times to obtain additional information on past events so we could compare it with information from other sources. We conducted interviews in different settings. We interviewed users (journalists and producers) in their work context, which included private offices, open workspaces, and TV and radio studios. Depending on the setting and the stakeholder's willingness, we recorded the interviews and later transcribed them. In total, we recorded 18 of the 24 interviews. We did not record follow-up interviews, but we did take extensive notes. The interviews were open-ended. We used an interview guide to plan and structure the interview process and to recall key questions. Overall, we drew on the dramaturgical model of interviewing, which emphasizes a physical, social, and cultural interview context in which the researcher is an active participant in the process (Myers and Newman, 2007). As a second data source, we relied on various documents including platform strategies, tender documents, annual business reports, requirements specifications, IT architecture diagrams, and platform user manuals. Further, we accessed additional technical information on the platform owner's Internet sites. This documentation provided a rich historical and technical background and, at times, insights into important sequences of events and

decisions. A third source of data was our own observation of newsroom work, meetings, and workshops. The first author observed in these settings for approximately 125 hours in multiple sessions, which lasted from two hours to three days, from September 2013 to May 2016. He took extensive notes during or immediately after these sessions in which he observed how people used the News Platform in their daily work in various offices and newsrooms. He also observed the introduction of a major new platform version in a local office in 2016. During these sessions, he took photos to visually capture the context in which work occurred. Finally, our fourth source of data was observations of a workshop held especially for the project group implementing versions 4 and 5 of the News Platform. The workshop gave us a detailed overview of specific events and how those events influenced platform management in various newsrooms and geographical sites; offered different stakeholders' interpretations of past events and use of the digital platform in various contexts; and reflected on the News Platform's long history in Media Company. The entire workshop lasted seven hours. We recorded it and later shared a comprehensive presentation with key stakeholders. Their feedback provided additional data that made us question some of our initial views on the platform and its consequences—following the principle of interaction between researchers and subjects (Klein and Myers, 1999).

<b>Table 3. Overview of Interviews</b>		
<i>Geographical sites</i>	<i>Number of stakeholders</i>	<i>Stakeholder groups</i>
HQ office	10 (stakeholders 1–10)	Managers IT operations IT consultants IT architects Journalists Producers Project participants
Southern Office	7 (stakeholders 11–17)	Managers Journalists Producers Project participants
Northern Office	3 (stakeholders 18–20)	IT architects Journalists
Western Office	4 (stakeholders 20–24)	Managers Platform company IT consultants Journalists

**Table 4. Excerpts from Case Study Protocol**

<i>Activity</i>	<i>Site and setting</i>	<i>Time period</i>
Observed initial project workshop for implementing a new platform	External offices including external consultants and project participants	October 2013
Analyzed various documents and held informal meetings	Informal meetings with project manager at HQ office; discussion of documents and issues	October/November 2014
Conducted first round of interviews and observations	Interviews at the HQ office, demonstration of features, and observation of platform use	February–April 2014
Observed a project workshop	External offices including project participants; onsite interviews	March 2014
Conducted second round of interviews and observations	Interviews at the Southern office; observations of platform use	October 2014
Conducted third round of interviews and observations	Interviews at the HQ office; observations of platform use in a newsroom	November/December 2014
Conducted fourth round of interviews	Interviews at the Northern office	December 2014
Observed full-day workshop with project participants	Workshop at the HQ office included a retrospective of the platform and focused on the project to acquire a new platform	January 2015
Presented findings and analysis for key stakeholders	Presented key documented findings and analysis of workshop and interviews at HQ office	April 2015
Conducted follow-up interviews and held informal meetings	Interviews at the HQ office	May 2015
Conducted fifth round of interviews and observations	Interviews at the HQ and Western offices; observed use of new platform version in a newsroom	April 2016
Held follow-up meetings with key stakeholders	Meeting at HQ to get an update on the organizational-wide implementation of the new version of the News Platform	November 2016

## **Data Analysis**

We analyzed data iteratively, alternating with data collection activities. This process followed Pan and Tan's (2011) approach, using a framing circle followed by an augmenting circle. During the framing circle, we conducted the first round of interviews, document collection, and participant observation, followed by initial analyses in three steps. First, we coded the data using descriptive codes (Miles and Huberman 1995) and a computer-based tool for qualitative analysis (hyperResearch). This gave us an overview of the events and challenges involved in Media Company's management of the News Platform over nearly 17 years. Second, we used temporal bracketing as described by Langley (1999) to structure the different stages in which the organization responded to critical events that challenged its current use of the platform. Specifically, we used Newman and Robey's (1992) framework to identify encounters or triggering events that challenged Media Company's use of the News Platform, and episodes in which the organization responded

to those challenges through digital options and digital debt practices. We initially identified 11 episodes and later filtered out 4 that did not relate directly to the News Platform. We then merged 2 episodes that had strongly connected events. Third, we analyzed how digital options and digital debt were implicated in each of the resulting 6 platform management episodes. In the augmenting circle (Pan and Tan 2011), we collected additional data during 2015 and early 2016 (Table 5) to complement our initial analyses. Because we collected data in this phase at additional sites, newsrooms, and offices with different stakeholders, we used a theoretical sampling strategy (Corbin and Strauss, 1998) to validate previous findings and provide further evidence that could help us develop a detailed account of the different dimensions of our analytical framing. In this way, our research followed the principle of suspicion and the principle of multiple interpretations (Klein and Myers 1999).

In parallel with these empirical material analyses, we developed and refined the theoretical framing in Table 2 to support a rigorous and comprehensive account of Media Company's management of the News Platform. Our initial analyses of data and our review of extant literature revealed attractive opportunities to contribute to digital platform theory by drawing on the digital options concept (Sambamurthy et al., 2003; Sandberg et al., 2015) and the digital debt concept, which we developed based on the literature on technical debt (Kruchten et al., 2012; Ramasubbu and Kemerer, 2016; Tom et al., 2013). This framing helped us analyze how each episode in Media Company's News Platform management was triggered by internal and external events and how the organization responded in terms of digital options and digital debt. Throughout, our analyses were guided by Klein and Myers' (1999) interpretation principles. These principles helped us establish plausible interpretations of the different episodes. We focused particularly on the fundamental principle of the hermeneutic circle and the principle of contextualization to relate specific instances of digital options and digital debt to Media Company's News Platform management.

## **5. Case Description**

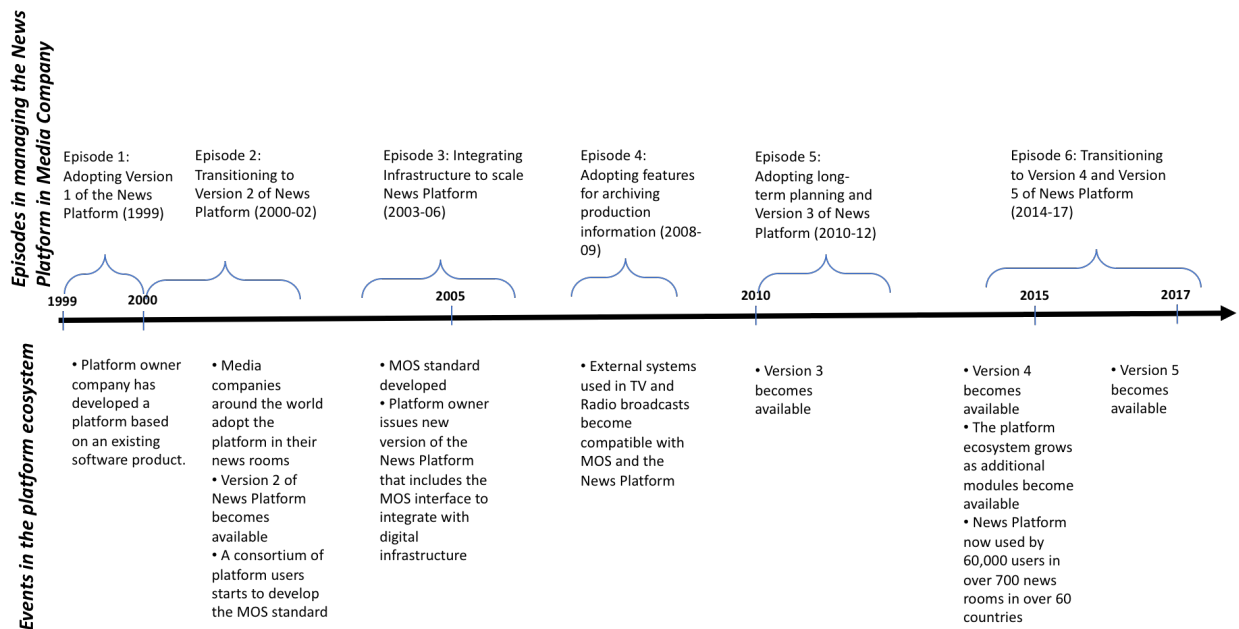
Media Company is located in Scandinavia and has more than 3,500 employees at more than 50 geographical sites. Given the on-going digitalization of content and new delivery platforms, actors such as Netflix and HBO Nordic are transforming the media business by streaming popular series and movies that are accessible on multiple devices and platforms. This is resulting in significant changes in media habits as users move from linear to non-linear TV; the

implication is that viewers are more selective in what they consume, when they consume it, and which media platform they prefer (such as mobile, PC or TV, digital radio, podcasts, or web). Hence, Media Company needed to transform its way of working from being media-platform specific to developing a capability for working and delivering content across different platforms. A crucial part of this involved the implementation of the News Platform, a new digital platform to support planning, production, and execution of broadcast programs on TV and radio, as well as the publication of content on the organization's websites.

Media Company first adopted the News Platform in 1999 across all offices. Although News Platform adoption and use varied across sites, the platform was centrally governed by the Headquarters' IT Department, which coordinated upgrades, specific configurations, bug fixes, and integration issues with the digital infrastructure. All offices used the same arrangement of platform features, including interfaces with other systems; the same version of the platform core; and the same set of customized modules and configurations. The News Platform is a generic software platform owned and supported by Platform Company, and it is currently used by approximately 60,000 users across more than 700 newsrooms in 60 countries around the world. It consists of a platform core with standardized features for planning, coordinating, and executing news productions. The platform offers a set of standardized APIs for integrating with other components and systems in a digital infrastructure. It is also possible to configure standard modules and develop new modules.

The News Platform is a more specialized digital platform than that typically reported on in IS literature (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013). It is an industry-specific, multisided digital platform within the ecology of media and software companies, which both use and further develop the platform. However, the US-based Platform Company has outsourced much of the platform's actual software development to an organization located in the West Indies, and third-party developers and various standards organizations also contribute to evolving the platform further. Platform Company organizes annual meetings in which ideas and prototypes of new features are announced and discussed, thereby working closely with major customers on evolving the platform. Over the years, Media Company has been directly involved in evolving the platform ecosystem further in at least two ways. First, it has produced local add-ons in terms of apps. Second, it has indirectly participated in developing the platform core, as Platform Company has piggybacked on experiences and modifications in Media Company. Platform Company also acts as a consultant

supporting organizational implementation and configuration, as well as developing customized modules for customer organizations. However, as a general rule, Platform Company advises customers to use the standardized features and undertake only minor configuration changes.



**Figure 1.** Timeline of Case Episodes and Platform Ecosystem Events

## 6. Results

Using our theoretical framing (Table 2) to analyze News Platform management in Media Company from 1999 to 2017, we identified six episodes in which critical events challenged the organization’s use of the platform as part of its digital infrastructure, triggering digital options and digital debt. In the following, we offer a detailed account of these analyses as summarized in Table 5.

<b>Table 5. Management of the News Platform in Media Company</b>			
<b>Episodes</b>	<b>Triggering events</b>	<b>Digital options</b>	<b>Digital debt</b>
<b>1. Adopting Version 1 of News Platform (1999)</b>	Legacy platform not expected to cope with the Year 2000 switch, a crisis that required immediate action	<b>Identifying options:</b> Managers identified various software packages, in-house development opportunities, and platforms for newsrooms.	<b>Planting debt:</b> The project created shortcuts by adopting a ‘default’ platform without selection, development, and adaptation of apps and modules from the ecosystem.

		<p><b>Developing options:</b> Consultants helped Media Company develop requirements specification and tender documentation. During the tender process, they developed four different options.</p> <p><b>Realizing options:</b> Media Company invested in News Platform, implemented the standard Version 1 organization-wide, and established a comprehensive training program for newsrooms.</p>	<p><b>Evaluating debt:</b> Initial platform use forced the project leaders to assess and provide strategies for resolving existing digital debt related to legacy platforms and news production information.</p> <p><b>Resolving debt:</b> The project developed a gateway to connect to legacy information before replacing the legacy platform.</p>
<p><b>2. Transitioning to Version 2 of News Platform (2000–02)</b></p>	<p>Standardized platform features not well aligned with newsroom work processes</p> <p>Version 2 of News Platform available</p>	<p><b>Identifying options:</b> Media Company negotiated with Platform Company to evolve implementation of News Platform.</p> <p><b>Developing options:</b> Media Company experimented with apps for smartphones for news notification and increased standardization of work processes across regions and newsrooms. Platform Company offered Version 2 of News Platform.</p> <p><b>Realizing options:</b> Media Company upgraded and reconfigured Version 2 of News Platform and defined new common work processes in relation to Version 2.</p>	<p><b>Planting debt:</b> Media Company created shortcuts and planted debt by increasing customization of the user interface and repurposing the “commercial break” feature for the Norwegian news context. Unused platform features remained dormant.</p> <p><b>Evaluating debt:</b> Media Company analyzed and addressed technical and informational inconsistencies from the legacy platform and the implementation of a standard platform configuration.</p> <p><b>Resolving debt:</b> Media Company replaced Version 1 of News Platform and its related design shortcuts.</p>
<p><b>3. Integrating infrastructure to scale News Platform (2003–06)</b></p>	<p>Work inefficiencies due to lack of integration between News Platform and other systems</p> <p>News Platform compatible with new MOS industry standard for media content exchange</p>	<p><b>Identifying options:</b> Media Company collaborated with Platform Company to improve platform integration with other IT systems for TV and radio production.</p> <p><b>Developing options:</b> Media Company participated in industry consortium to influence development of MOS standard. Platform Company made News Platform MOS compatible.</p> <p><b>Digital options realized:</b> Media Company utilized News Platform’s MOS capabilities to integrate with Omnibus system.</p>	<p><b>Planting debt:</b> Media Company planted digital debt by customizing apps to directly access information stored in News Platform.</p> <p><b>Evaluating debt:</b> Media Company identified and analyzed duplicate information across different systems.</p> <p><b>Resolving debt:</b> Media Company resolved duplicate information across News Platform and Omnibus system.</p>
<p><b>4. Adopting features for archiving production information (2008–09)</b></p>	<p>Inconsistent archiving and problematic news production research</p>	<p><b>Identifying options:</b> Media Company explored various opportunistic practices to archive news information.</p> <p><b>Developing options:</b> In-house developer experimented with readily available platform resources for application development and information storage.</p> <p><b>Digital options realized:</b> Media Company added Thomas module to the platform and defined efficient work processes for archiving and researching news production.</p>	<p><b>Planting debt:</b> Media Company planted digital debt by establishing tight coupling between Thomas module and News Platform and by aligning work processes with these design shortcuts.</p> <p><b>Evaluating debt:</b> Media Company recognized implications of planting digital debt related to use of Thomas module.</p>
<p><b>5. Adopting long-term planning and Version 3 of News Platform (2010–12)</b></p>	<p>Pressure from user groups to provide features for long-term planning</p>	<p><b>Identifying options:</b> Media Company negotiated with Platform Company and identified apps to support long-term planning of TV programs. However, these features would not be available before Version 4 of News Platform.</p> <p><b>Developing options:</b> Newsrooms experimented with different artifacts,</p>	<p><b>Planting debt:</b> Media Company implemented fragmented information about long-term news production across different platforms and work processes.</p> <p><b>Evaluating debt:</b> Media Company recognized that upgrading to Version 4 of News Platform involved risks and potential debt.</p>



		screens, software tools, and work routines for long-term planning. <b>Realizing options:</b> Media Company implemented apps from Google and Microsoft platforms for long-term planning and upgraded to Version 3 of News Platform.	<b>Resolving debt:</b> To facilitate upgrading to Version 4 of News Platform, Media Company turned to Version 3 to resolve some of the existing debt.
<b>6. Transitioning to Version 4 and Version 5 of News Platform (2014–17)</b>	<b>Contract with</b> Platform Company expired  Platform Company offers two new versions (4 and 5) of News Platform	<b>Identifying options:</b> Media Company explored different platforms on the market and the possibility of developing its own solution. <b>Developing options:</b> Consultant developed specifications and initiated tender process. Media Company interacted with multiple platform providers; selected Platform Company based on quality and price; negotiated contract for versions 4 and 5 of News Platform and experimented with new features. <b>Realizing options:</b> In collaboration with Platform Company, Media Company engaged in user training, definition of work processes, and bug fixing. Adopting incremental implementation across offices and newsrooms, Media Company first implemented Version 4 and then Version 5 of News Platform.	<b>Planting debt:</b> Media Company implemented Version 4 of News Platform as a temporary solution to reduce the risk of implementing Version 5. <b>Evaluating debt:</b> Media Company identified and assessed risks of migrating information from Version 4 to a new database in Version 5. <b>Resolving debt:</b> Media Company replaced Version 4 of News Platform with Version 5 in some offices and newsrooms.

**Episode 1: Adopting Version 1 of News Platform (1999).** In the 1990s, Media Company used a platform to support news production across the entire organization. However, with year 2000 rapidly approaching, the vendor could not guarantee that this platform would work properly after the end of the millennium. At the same time, the platform was deeply entrenched in the organization’s existing infrastructure and the work processes of journalists and producers. The platform was extremely configurable for end users, and journalists had over the years made countless adjustments to the standard configuration. Consequently, the platform had many different local configurations and its built-in flexibility had opened the way for many shortcuts and local adaptations, which planted considerable digital debt over time:

*The legacy platform was very configurable. Two of us travelled to London to participate in a course to learn how to write scripts to configure different features.... The platform had some incredible shortcuts that there are many stories about, and the platform included most of the features that we have today—including a calendar system. (Stakeholder 2, project participant)*

At this critical juncture, Media Company hired external consultants to identify alternative solutions and initiate a comprehensive formal tender process in 1999. As such, digital options were developed through a comprehensive and time-consuming process, with requirements specification based on workshops with users as well as inspirational visits

to other media companies. Media Company developed three options comprising different standard platforms for news production and one option based on in-house software development. These activities, which occurred in close collaboration with consultants who had specific competence and knowledge about the platforms, substantially increased the available digital options. Developing these digital options were highly dependent on specific competences and contextual issues such as time, cost, and other resource considerations that influenced stakeholders' deliberations on the options. After a long-drawn process, Media Company decided to realize Version 1 of the News Platform.

During this episode, Media Company also planted, evaluated, and resolved digital debt. The legacy platform had a considerable amount of digital debt attached to it, especially in terms of information about radio and TV programs and contributors. Through its News Platform implementation project, Media Company evaluated this debt, but resolving it turned out to be problematic. Hence, the IT-department developed a gateway for transferring digital content from the legacy platform to the new News Platform. This fix also accommodated the fact that it was considered "impossible" to switch all users from the old to the new platform at the same time:

*[We] did not move all users in one operation. We had to maintain access to the archiving system, and we had to be able to send messages from one platform to another, to search across the two platforms, and to move news cases from one to another. This was relatively complex and we had to set up a small mediating system in order to make it work. We would not have survived without it. (Stakeholder 10, IT department)*

By temporarily resolving substantial digital debt through this gateway, Media Company made it possible to implement the News Platform organization-wide in its standard configuration. Additionally, it mobilized Platform Company to provide requisite first-hand insights, training, and support to help implement the News Platform across the organization. However, by implementing the News Platform's standard configuration without appropriately aligning with journalist and producer work processes, Media Company also planted significant new digital debt. This move resulted in a need for comprehensive training programs:

*[We] were running out of time. We did double shifts delivering a training program everywhere. The plan was not of this earth—but we made it. But, the old platform had an internal hierarchical structure that made it hard to switch to the new platform. In the new platform there are a lot of folders, which gives you access to the*

*different servers—for example the main news program has its server—and you need to know where to navigate. (Stakeholder 2, project participant)*

Media Company was indeed under pressure to implement the News Platform in due time before year 2000, which led to planting additional digital debt through several shortcuts in configuring the platform and a decision to not transfer important pieces of information from the legacy platform, which resided on PCs and file servers.

Overall, during this episode, Media Company identified, developed, and realized several options related to its implementation of the News Platform. Importantly, this investment provided Media Company with APIs to develop customized apps and modules, and with direct access to important new competencies in Platform Company. Media Company's introduction of Version 1 of the News Platform also implicated digital debt associated with the legacy platform, and managers, consultants, and developers spent considerable effort evaluating and resolving existing digital debt. However, these digital debt-related activities did not resolve all digital debt; rather, implementing the News Platform's standard configuration led to planting of new digital debt.

**Episode 2: Transitioning to Version 2 of News Platform (2000–02).** As it became clear that the standardized platform features were ill-aligned with newsroom work processes, demands increased for customization of the platform across newsrooms. Media Company started to analyze and address technical and informational inconsistencies from the legacy platform and from its initial implementation of the standard platform configuration. At the same time, new digital options became available through an upgraded News Platform Version 2 with additional features. However, Media Company dismissed several features and decided to adapt others:

*We tried to use a feature that gave users a notification on their mobile to use when they were offline [journalists sometimes leave the office to do interviewing and reporting in the field], but it never took off. These features are still available, but not used. There are many features that we are not using. They are developed for commercial TV stations—a comprehensive module for American elections, for instance, and the “commercial break” line. This particular feature we use for a different purpose than initially intended. (Stakeholder 10, IT department)*

Hence, although Media Company identified and developed new digital options, not all options were realized and instead remained dormant on the platform. These dormant features and modules represented new digital debt; this was especially true of the notification feature for mobile devices, which was slightly customized but not really used by Media Company. This situation also underscored how Media Company needed to keep up with the wider platform ecosystem's ongoing evolution, which was occurring at a speed largely outside its control. As such, it had to invest considerable efforts in developing options that were not readily realizable—and that sometimes turned out not to be relevant for Media Company, as in the case of the mobile notification feature.

Newsrooms also planted new digital debt by repurposing some of Version 2's generic apps and features. Platform Company develops its platform software for many different media companies all over the world. Because most countries allow advertising and commercials during radio and TV productions, the News Platform comes with an out-of-the-box feature (thick blue lines on the screen) that highlights a free space for commercial breaks in the middle of a program. However, due to Norwegian legislation, Media Company did not have commercials, making this feature—if not directly problematic—initially perceived as a bit cumbersome and as adding to the frustration with the platform's user interface. To address this, users repurposed the feature to structure program components into larger chunks, making timing during program execution easier:

*This is very important, and you can add a blue line here [pointing at the screen] to make sure that the timing is correct. So if I write 27 minutes here, then it is 14:30, then I put it [the blue line] in there, and then we are on 14:40. Then I still lack some minutes, but I know that this program will take its time. (Stakeholder 12, newsroom manager)*

This demonstrates how users tried to resolve some digital debt by repurposing platform features that were not well aligned with work process requirements. However, in doing so, they planted another form of digital debt by, in this case, linking information other than commercial breaks to the “blue line.”

During this episode, some minimal customizations—particularly regarding navigation on the platform user interface—improved the overall efficiency of work processes across newsrooms. However, because the project had to be kept within budgets, different kinds of digital debt were planted through additional shortcuts and accumulated maintenance work that was postponed for the future. As such, both Episode 1's first out-of-the-box implementation and

Episode 2's customizing strategy introduced digital debt. To resolve some of this debt, Media Company realized some of the digital options made available through Version 2 and transformed its governance regime to better control how the platform integrated with its digital infrastructure and work processes across the organization.

**Episode 3: Integrating Infrastructure to Scale News Platform (2003–06).** Over time, journalists across many newsrooms experienced serious limitations with the News Platform. In particular, it did not work well with the installed base of the digital infrastructure and related work processes for producing and executing radio and TV programs with the required graphics, video and audio clips, metadata, and texts. For journalists, this resulted in a range of extra work tasks—often requiring them to register the same or similar sets of information in several systems. For example, newsrooms that produced radio programs had to first register information regarding a program in the “Radio Platform” and then in the News Platform. This introduced a new type of digital debt related to maintenance of duplicate information across different systems. Further, in the early 2000s, the number of related—but not integrated—and partly overlapping systems was growing. Consequently, Media Company suffered from several sources of digital debt that made evaluating and resolving debt gradually more complex. For example, the digital option of developing software to integrate the Radio Platform with the News Platform involved considerable work to identify and evaluate digital debt and organize maintenance work to resolve it. For strategic reasons—specifically, to maintain control of the News Platform at Media Company— Platform Company argued that this customization was an unnecessarily complex fix that involved considerable risk.

To address this situation, Media Company joined an industry consortium to develop a new standard for information exchange between various media software systems and equipment. This resulted in a new protocol called the *Media Object Server Communication Protocol* (MOS), and Platform Company decided to support MOS in its News Platform. MOS made it easy for users to communicate with media servers so that, for instance, a video clip could be directly linked and played through the platform without using different systems. Collaborating with other platform users and Platform Company, new options were identified for improving newsroom work processes and potentially resolving accumulated digital debt. In 2003, Media Company leveraged MOS capabilities to integrate a video server management system called *Omnibus* with the News Platform infrastructure. The integration allowed journalists to access video clips

through the News Platform, and thus made their work much more efficient while at the same time increasing the scope of what they could do. As such, Media Company was able to transform current newsroom work processes and roles based on the News Platform's interface capabilities and MOS standard features. Realizing these digital options was dependent on specific competencies and the infrastructural context in which the digital options were developed and realized.

In the following years (2003–06), Media Company integrated a wide array of systems with the News Platform using the MOS standard. These integrations made news production coordination easier, with less inaccuracy due to spelling errors and misunderstandings. As a result, there was less micro-coordination between the control room and the desk manager during broadcasts. As one stakeholder told us:

*Before, you had to do everything manually in Columbus [a different system for executing TV programs]. We had to, before executing the program, develop headlines that were put together and transferred to the platform [News Platform]. Nowadays it is much easier, you can rearrange the headlines within the platform and then the Mozart system [the new system for executing TV programs] automatically adjusts. That's a concrete example of the change. (Stakeholder 13, photographer and producer)*

In similar ways, many users reported that they now did less-specialized tasks and, in some contexts, the work process required fewer people to be directly involved. For example, a photographer could now undertake journalistic work, editing and broadcast production. Importantly, by realizing this digital option, the News Platform became integrated with other systems in the organization's digital infrastructure. Also, the News Platform became increasingly embedded into work processes across newsrooms. While these efforts made more digital options available, they also increased complexity and thus the potential for planting new digital debt. One example was the development of several smaller apps that realized new digital options, but did so through shortcuts to access the News Platform storage directly based on app-specific requirements. These shortcuts reduced the platform's modularity, as access to the platform's resources by external resources (such as apps) was supposed to be through the standardized interfaces.

During Episode 3, Media Company developed new digital options on the basis of the MOS standard. These options made it possible to integrate the fragmented portfolio of systems that journalists and producers used in news production. However, change activities in terms of software development did not effectively resolve current digital debt,

as information had accumulated in several systems over many years without proper maintenance. As such, integrating the News Platform with other systems in the infrastructure could not be isolated from historically accumulated maintenance issues that had to be evaluated and resolved.

**Episode 4: Adopting Features for Archiving Production Information (2008–09).** With all the integration efforts between 2003 and 2006 and an increasing focus on cross-publishing across different media channels (radio, TV, and Internet), Media Company faced pressure to maintain a consistent and updated archive that would make news content more accessible across individual journalists, newsrooms, and geographical sites. When a radio or TV broadcast was done, journalists and producers were expected to archive all metadata for the particular broadcast (location, participants, date, content, and so on) in the common Program Bank system, which communicated with the archiving system associated with the infrastructure. Initially, this was often a very long and cumbersome process and, given high levels of work pressure, users did not always follow the routines. They sometimes forgot to archive the metadata; when they did remember, they often did it partially or incorrectly. Over the years, this situation accumulated significant informational debt.

Thomas, an in-house engineer who worked in one of the remote region offices, identified and analyzed this digital debt and began developing a piece of software in Visual Basic in his spare time. Realizing the digital option of accessing news production data directly from the News Platform, he developed a customized module that automatically extracted metadata information from the platform and then transferred it to the Program Bank and the archiving system. This module saved journalists and producers hours of work, as they now had only to check and correct the metadata before transferring it to the Program Bank. A producer described the process as follows:

*[[I] use the module called the “Thomas module” as it was developed by Thomas. The program transfers supra-information, intros, and all metadata describing who made video clips, produced them, and everything else. All these metadata are then [automatically] connected to the actual video clip aired and all related clips. They are then transferred to something called “Program Bank” and then to the big archive. (Stakeholder 9, producer)*

Over time, this customized module became so popular that the IT department decided to give Thomas the time and resources to develop an updated, more professional version. The customized “Thomas module” was made official.

While adding this customized module improved the metadata tagging of content across the organization, it also increased platform and systems coupling by introducing the need to update the Thomas module whenever the News Platform or the Program Bank were updated. Customizing practices such as these, plant digital debt that requires regular maintenance work in response to even small modifications in the News Platform (and, in this case, in the Program Bank).

Hence, in Episode 4, Media Company developed and realized digital options through customizations (software development on top of the platform) that made work much simpler for journalists and producers, but also produced new digital debt. While increasing the efficiency and accuracy in the work process for archiving TV program data, the Thomas module was a local fix that created barriers to migrating to different solutions for the metadata and archiving problem. It is important to note that the digital options made available through the MOS standard and realized in Episode 3 opened up these change activities, which, in turn, planted additional digital debt.

**Episode 5: Adopting Long-term Planning and Version 3 of News Platform (2010–12).** During 2010–2012, Media Company's use of the News Platform spread to Internet publishing and alternative types of news productions for radio and TV, a development reinforced by the organization's adoption of Version 3 of the platform. Adopting Version 3 resolved some of the existing digital debt and was a necessary step to later transition to Version 4. Moreover, broadening the News Platform's use triggered new user needs. One of the most pressing issues was the need for a feature to plan news production across a week or multiple weeks—rather than just one day at a time, as in the current version. Because Media Company's strategy was still to use the features provided in the standard platform rather than developing a customized module for news planning, it approached Platform Company and asked for a long-term planning feature to be added to the platform core. While Platform Company agreed to implement such a feature, it would be included in Version 4 of the News Platform and not in the current Version 3. However, Media Company's contract with Platform Company was coming to an end due to national procurement legislation, so it could not implement Version 4 during this period. Thus, although options for long-term planning were identified, they were not realizable because of contractual and cost considerations.



Accordingly, local newsrooms improvised multiple ways of practicing long-term planning. Many newsrooms developed and realized the option of using Google Docs, Google Calendar, Microsoft Outlook, or some combination of these apps from the Google and Microsoft 365 ecosystems. Some newsrooms also experimented with combining the use of other artifacts, such as physical whiteboards, with the digital platform to manage planning information. For example, a newsroom producing a popular radio-program on culture had a whiteboard with key planning information next to the PC screen running the News Platform. In this way, the team could do long-term planning on the whiteboard and access and update information on the platform accordingly. Thus, the News Platform was used in combination with physical artifacts, as well as the more generic platforms from Google and Microsoft, to significantly expand the available digital options in its infrastructure.

As a result, in Episode 5, digital debt in terms of fragmenting information across different physical artifacts and multiple digital platforms was introduced, while also developing new options, such as providing Google calendars and Google Docs as apps on journalists' and producers' smartphones. As such, the episode revealed how the status of the News Platform in terms of digital debt and digital options changed dramatically without any technical modifications to the platform itself.

**Episode 6: Transitioning to Versions 4 and 5 of News Platform (2014–17).** In 2014, when the contract with Platform Company expired, Media Company was forced to undertake a new tender process and select a vendor to deliver a digital platform for news production. The company explored different platforms available on the market, as well as the possibility of developing its own system. It also visited other TV and radio broadcasters and international media companies to learn about their experiences with different vendors and in-house systems. In addition, Media Company hired a consultant to develop specifications and initiate the tender process, which involved demonstrations and negotiations with multiple platform providers.

However, at this point, the News Platform was deeply embedded in the organization's digital infrastructure, in newsroom work processes, and in IT department competencies. This increasing entrenchment of the News Platform meant that a transition to a different platform would be complex because of the significant interdependencies between the platform and the infrastructure. One stakeholder described the situation as follows:

*[But] as more systems get integrated, the amount of configuration increases. And as long as more and more systems are integrated with [News Platform], there are more systems you have to take into the account when doing the actual configuring. (Stakeholder 2, project participant)*

Obviously, with three major systems and approximately 20 smaller modules and applications integrated with the News Platform, considerable digital debt had accumulated, along with major associated maintenance obligations—expressed as “the amount of configuration” by Stakeholder 2 above. This digital debt was not simply limited to the technical integration between platforms and systems—it also involved how the different systems and the News Platform entangled within the work processes of journalists and producers. As a result, Media Company again selected Platform Company based on quality and price and negotiated a new contract in late 2015 with a renewed Version 4 and another Version 5 in development. Version 5 had a completely new architecture and a new user interface, and it made available new digital options for news production.

To upgrade from Version 3, Media Company had to first implement Version 4 so that Version 5 would work properly. As such, in Episode 6, Media Company was severely challenged to keep up with developments in the News Platform ecosystem. The organization adopted a staged implementation strategy, starting in one of its regional offices in February 2016. Based on the experiences at the regional office, Media Company continued with the implementations in four other offices, concluding these implementations by the summer of 2016. This implementation strategy leveraged the layered modularized architecture of versions 4 and 5, which made it possible to transition to the new front end—including Version 5’s new features and the completely renewed user interface—while at the same time running on the back-end databases and servers used in Version 4.

Eventually, the implementation of Version 5 resolved some of the digital debt that had been building up over the previous decade. Moreover, Version 5 offered new digital options that allowed Media Company to implement new work processes for “case handling” specific important news happenings such as the Olympic Games or recent developments in international politics such as Brexit or the US election. These new work processes helped the different newsrooms and media channels work in a more integrated and coordinated manner. Version 5 also provided options for better developing customized modules. Media Company realized several of these options; for example, it developed

a customized module and reconfigured the platform to accommodate the use of different Sámi languages in Nordic countries and Russia.

Episode 6 also involved digital debt in terms of software bugs that Platform Company had planted in Version 5 of the News Platform. Media Company needed these bugs to be resolved, which prolonged the transition process. On two occasions, this digital debt was so serious that the transition to Version 5 across Media Company had to be put on hold. Because Platform Company was eager to put the new version to use, it made shortcuts and introduced additional software bugs that planted new maintenance obligations. In contrast to consumer-oriented platforms such as Google's Android on mobile phones, where platform features and apps are automatically updated, updating News Platform involved tedious and complex maintenance work to resolve the digital debt planted through hasty software development fixes. Hence, while upgrading the News Platform made new digital options available, it also involved dealing with digital debt that was planted as part of the upgrading efforts. As of 2017, Media Company was still challenged by digital debt stemming from both the platform core and the way in which news production information was managed through the digital infrastructure.

## **7. Discussion**

The purpose of this study is to advance theory on the management of digital platforms as part of a user organization's digital infrastructure. Our work complements the current literature's focus on how digital platform owners may attract users and complementors to develop and expand their platform; the generative capabilities afforded by digital platforms through layered modular architectures and flexible governance regimes (Eaton et al., 2015; Ghazawneh and Henfridsson, 2013); and the positive network effects of digital platforms (Parker et al., 2016). We advance understanding on how organizations manage their external industry platforms by honing in on the ongoing progression of and interactions between digital options, or the opportunities and flexibilities afforded through the organization's infrastructure and the platform ecosystem (Yoo et al., 2010; Zittrain 2008), and digital debt, or the inertia and path dependencies produced by the development and use of the platform (Hanseth and Lyytinen, 2010; Star and Ruhleder, 1996).

As a process theory contribution (Markus and Robey, 1988; Van de Ven, 2007), we advance a theoretical framework of how digital options (Sambamurthy et al., 2003; Sandberg et al., 2014) and digital debt (c.f., Kruchten et al., 2012; Ramasubbu and Kemerer, 2016; Tom et al., 2013) are implicated in digital platform management in relation to an organization's infrastructure and work processes (Table 2). The framework focuses on how digital options and digital debt dynamically interact as digital platforms are continuously developed and used in organizational contexts. As such, the framework is premised on the need to challenge and go beyond a simplistic dualism between good options and bad debt to reveal the complex decisions managers face. These decisions are complicated by the fact that realizing digital options can reduce or increase the organization's digital debt, and modifying digital debt can facilitate or hinder the organization's realization of digital options.

To uncover the framework's detailed workings and support further theorizing on the role of digital options and digital debt in digital platform management, we offer a longitudinal study of Media Company's management of the News Platform covering a period of nearly 17 years (Table 5). Our detailed account of six episodes reveals how digital options created opportunities for Media Company to adapt and evolve the platform by integrating digital resources from within and outside the platform ecosystem using external standards (such as MOS), generic platforms (such as Google Docs and Microsoft 365), and other systems within Media Company's digital infrastructure. Likewise, our study offers insights into digital debt, which created inertia by accumulating maintenance obligations and reducing the evolvability of the platform. For example, the digital debt planted in episodes 3 and 4 in relation to app customization and locally designed apps increased the complexity and cost of implementing a new platform version in Episode 6. In the following, we draw on these empirical insights (summarized in Table 6) and on extant literature to advance theory about a user organization's management of a digital platform in relation to its infrastructure and work processes.

<b>Table 6. Managing Digital Options and Digital Debt at Media Company</b>	
<b>Observation</b>	<b>Episode</b>
<i>Digital options:</i>	
1. New platform versions afforded opportunity to develop and realize digital options	1, 2, 4, 5, 6
2. Systems and infrastructure provided digital options for developing and using the platform	3, 5
3. Developing and realizing digital options depended on context and available competencies	1, 2, 5, 6
4. Actors and competencies from the wider ecosystem helped develop and realize digital options	1, 2, 3, 4

<i>Digital debt:</i>	
1. Resolving digital debt introduced new digital debt	2, 4
2. Planting of or failure to resolve technical debt led to new informational debt	2, 3, 5
3. Planting of digital debt reduced platform and infrastructure evolvability and generativity	2, 4, 6
4. Evaluating and resolving digital debt were complicated by different types and sources of debt across the organization's infrastructure	1, 3, 6
<i>Interactions of digital options and digital debt:</i>	
1. Developing digital options provided new ways of resolving digital debt	1, 2, 3, 4, 6
2. Realizing digital options intentionally and unintentionally planted digital debt	1, 2, 4, 5, 6
3. Developing and realizing digital options led to unwise planting of digital debt	1, 3
4. Resolving digital debt facilitated developing and realizing digital options	1, 6

### **Digital Options: Leveraging Ecosystem and Infrastructure Generativity**

Extant literature emphasizes how platform owners can promote platform generativity through governance mechanisms that balance the need for control and flexibility by effectively securing and resourcing appropriate boundary resources (Bodreau, 2010; Eaton et al., 2015; Ghazawneh and Henfridsson, 2013; Wareham et al., 2014). Wareham et al. (2014) emphasize how such generativity may be boosted through the wider ecosystem based on the finding that “although it is possible to cultivate generativity within the boundaries of a single firm, generative potentials substantially increased in a looser arrangement of heterogeneous actors” (p. 1198). As a complement to these predominantly owner-centric perspectives, we offer a user-centric perspective on how Media Company leveraged and managed the generativity that was made available through the News Platform ecosystem and its own digital infrastructure. Although the News Platform served as a digital options generator (Sambamurthy et al., 2003), the features and boundary resources it afforded were not directly applicable to help Media Company develop and use the platform in its organizational context. IT managers, designers, consultants, and end-user groups had to spend time and resources developing and selectively realizing various digital options made available through the News Platform and through related systems in the organization's digital infrastructure. As Table 6 summarizes, these digital option dynamics reveal how Media Company analyzed and contextualized the generic News Media platform's features and resources to its advantage. The dynamics suggest that digital options are not to be construed as merely embedded in a platform and ready to be realized by all users, but rather as requiring an ongoing assessment of the relation between the digital platform and the digital infrastructure in which it is embedded. This assessment requires user organizations to engage in a process of mindful

management that is generally viewed as critical for the effective appropriation of IT into an organizational context (Swanson and Ramiller, 2004).

Here, our specific insights and observations include the following. First, new platform versions gave Media Company the opportunity to develop and realize a constant flow of features and boundary resources (episodes 1, 2, 4, 5, and 6). However, the company had to selectively develop these options to make them credible in its organizational context, and it subsequently realized only some of these options. Hence, although new features and boundary resources were accessible to Media Company through the platform ecosystem, they were not necessarily directly usable. Available digital options had to be developed for use in the organization's context—a process that entailed trying out and testing features and boundary resources, reconfiguring them to mesh with complementary technological and organizational resources, and embedding them into the digital infrastructure and work processes of geographically distributed newsrooms. In Episode 4, for example, Media Company identified various ways of overcoming inconsistencies in the archiving of news productions, experimented with available platform resources to develop a new application for archiving and researching productions, and eventually realized this option by making the application available for all newsrooms. Similarly, in Episode 2, Media Company invested resources in identifying and developing a digital option that would give journalists mobile notifications related to their news productions. However, this application never took off. Although the application remained available on the platform, it was dismissed for practical use. As this example shows, Media Company had to invest considerable effort in continuous attempts to develop the platform's digital options without necessarily knowing whether the option would eventually be realized and translated into improved work processes. Second, other systems within Media Company's digital infrastructure provided additional digital options for evolving the platform further (episodes 3 and 5). For example, in Episode 5, Media Company drew on Google Docs and Microsoft 365 to develop support for long-term planning of its news production. This concurs with Selander et al.'s (2013) finding that most platform users are likely to use several different platforms and ecosystems. Third, Media Company's efforts to develop and realize digital options depended on context and available competencies (episodes 1, 2, 5, and 6), confirming that digital infrastructures in organizations are heterogeneous and built on an installed base of socio-technical arrangements (Aanestad and Jensen, 2011; Hanseth and Lyytinen, 2010; Hepsø et al., 2009; Star and Ruhleder, 1996). Fourth, Media Company increased its option span by drawing on industry

consortiums and the complementary skills of consultants with expert knowledge on the platform's boundary resources and architectural design to configure and upgrade it, develop customized software, and redesign work processes (episodes 1, 2, 3, and 4).

Collectively, the concept of a user organization's digital options injects a novel theoretical perspective into the critical role of how a platform's options need to be developed and realized in the context of the user organization and its digital infrastructure. This perspective informs how a user organization must mitigate against failing to develop options that otherwise would positively impact same-side and cross-side network effects (Parker et al., 2016). Hence, based on our interpretation of the empirical findings and consideration of the extant literature, we suggest the following:

***Proposition 1:*** *An organization will more likely benefit from and sustain its digital platform if it mindfully leverages the generativity that the organization's digital infrastructure and the platform ecosystem afford by iteratively developing and realizing digital options as integral parts of its organizational and technological context. To be effective, this process must include leveraging related digital resources from the digital infrastructure and engaging competencies of actors in the platform ecosystem.*

### **Digital Debt: Managing Maintenance and Evolvability Obligations**

As a second tenet of our theorizing, we advanced the idea that digital debt is a key to understanding digital platform management in relation to an organization's infrastructure and work processes. In doing so, we extended the technical debt notion (Kruchten et al., 2012; Ramasubbu and Kemerer, 2016) to include the informational dimension of digital platform usage; developed a life cycle of how organizations may plant, evaluate, and resolve digital debt; and emphasized that digital debt involves maintenance obligations as well as evolvability obligations (Kruchten et al., 2012) as a reflection of digital platform generativity. Our findings show that digital platforms in organizations typically involve planting digital debt that can lead to inertia and path dependencies in the maintenance and evolvability of the platform and the digital infrastructure as a whole. This debt planting may include (i) the planting of technical debt by creating shortcuts during platform configuration and related software and infrastructure development, and (ii) the planting of informational debt by embedding digital platform features into digital infrastructures and work processes in ways that produce inconsistencies and gaps.

As Table 6 shows, we uncovered four different forms of digital debt dynamics based on our empirical findings of how Media Company managed the News Platform. First, we observed how resolving digital debt sometimes introduced new debt (episodes 2 and 4). This underscores the complexities in managing a digital platform in an organizational context. Particularly, as organizations resolve debt associated with specific technical features or boundary resources (e.g., resolving debt by adopting a new version), they may need to assume new debt associated with other features and boundary resources (e.g., shortcuts in the new version's configuration). Second, we observed how planting of or failure to resolve technical debt related to the service, network, and device layers (Yoo et al., 2010) could lead to planting informational debt on the content layer (episodes 2, 3, and 5); for example, in our case, failure to resolve technical debt from Episode 1 led to more informational debt in Episode 2. As the platform was used over time, more content regarding TV and radio programs were uploaded and structured according to the existing information, which was ill-structured due to technical debt. Third, at a more general level, digital debt reduced platform generativity through accumulation of maintenance obligations and reduced the evolvability of the platform and the digital infrastructure as a whole (episodes 2, 4, and 5). In Episode 2, for example, lack of integration of the News Platform with other systems led to accumulation of digital debt, which in turn reduced the platform's overall evolvability. Similarly, in Episode 4, platform evolvability deteriorated due to the planting of new debt through tight coupling of the Thomas module and the core platform. Again, these findings underscore how overall generativity in a platform ecosystem may lead to different outcomes in user organizations as features and resources are appropriated into the infrastructure and work processes of specific organizations, contributing to a contextual understanding of platforms as called for by Reuver et al. (2017). Fourth, our analysis revealed that planting different types of digital debt from different sources over time made their evaluation and resolution in the organization increasingly complex (episodes 1, 3, and 6). This reinforces how digital debt can accumulate and become increasingly complex if not attended to on an ongoing basis.

By emphasizing the dynamics of technical and informational debt, we contribute to the understanding of “digitality”—an important yet under-theorized aspect of digital platforms (de Reuver et al., 2017; Kallinikos et al., 2013). Similar to the emphasis on infrastructural data practices in relation to social media platforms (Alaimo and Kallinikos, 2017), our findings surface the critical role of a user organization's management of digital debt related to technical as well as informational aspects of the platform. We also add to past work in arguing that a platform owner's evolution of



a digital platform requires a focus on the interdependencies between the platform architecture layers. Hence, we suggest the following:

***Proposition 2:*** *An organization will more likely benefit from and sustain its digital platform if it ensures the maintainability and evolvability of the platform in relation to the digital infrastructure by iteratively evaluating and resolving digital debt that was planted through the ongoing platform development and use. To be effective, the process must surface the dynamics of technical and informational debt across the layers of the platform and the digital infrastructure in which it is embedded.*

### **Interactions Between Options and Debt: Managing Platforms in Relation to Digital Infrastructures**

Our analysis of Media Company's management of the News Platform revealed important interactions between digital options and digital debt (Table 6) as evidence of the complex dynamics—and sometimes opposing forces—that influence digital platform management in relation to an organization's digital infrastructure and work processes. Consistent with past research, the News Platform afforded Media Company with (1) generative capacity through its layered, modularized architecture (Baldwin and Woodward, 2009; Yoo et al., 2010; Yoo et al., 2012); (2) complementary solutions and services through network externalities from hundreds of newsrooms all over the world (Parker et al., 2016); and (3) open platform governance and boundary resources that boosted the platform's generative capacity (Ghazawneh and Henfridsson, 2013; Zittrain, 2008). Providing nuance to these general characteristics, our research suggests that flexibility or rigidity in an organization's management of its digital platform is the result of ongoing handling of digital options and digital debt. While the IS literature previously has treated the concepts of options and debt separately (Ramasubbu and Kemerer, 2016; Sandberg et al., 2015), our approach demonstrates how the combination of these concepts can reveal important insights into how flexibility and inertia are implicated in managing platforms.

Specifically, our findings revealed four insights into how events related to digital options and debt dynamically interact and therefore must be considered together to understand their roles in platform management. First, Media Company's practice of developing digital options provided new ways of resolving digital debt (episodes 1–4 and 6), as in Episode 2, when the organization resolved digital debt planted in Episode 1 by leveraging options afforded by Version 2 of the News Platform. Second, by realizing digital options, the organization sometimes intentionally and unintentionally

planted new debt (episodes 1, 2, 4, 5, and 6). This was particularly common when actors implemented shortcuts in configuring and contextualizing new features and apps. At a more strategic level, we observed several examples of how Media Company intentionally planted new debt in order to realize digital options. This was the case when it introduced new versions of the News Platform in episodes 1 and 6. Actually, hesitancy to plant new debt in those examples would have threatened the upgrade and introduction of the new versions, reinforcing the claim by Tom et al. (2013) that it is counterproductive to strive for zero digital debt because it leads to blindness toward developing and realizing digital options. Third, we observed how developing and realizing digital options can lead to unwise planting of digital debt (episodes 1 and 3). Perhaps the most notable instance of counterproductive interdependence between realizing options and inadvertently planting significant debt was when Media Company rushed to implement Version 1 of the platform without much consideration of current work processes and user needs. Fourth, initiatives to resolve digital debt facilitated the development and realization of digital options. For example, in Episode 6, resolving the digital debt associated with Version 4 of the News Platform facilitated the implementation of Version 5, which offered access to new digital options.

These insights into how practices related to digital options and digital debt dynamically interact contribute to the emergent organizational perspective on platform management (Table 1). By revealing the nuanced ways in which options and debt progressed and interacted during Media Company's News Platform management, we add to Ghazawneh and Henfridsson's (2013) notion of securing and resourcing boundary resources and to Eton et al.'s (2015) notion of distributed platform tuning. In summary, then, we draw on our empirical findings and extant literature to suggest the following about the dynamic interaction and the sometimes opposing forces involved in managing digital platforms in relation to an organization's infrastructure and work processes:

***Proposition 3:*** *While an organization may have to resolve digital debt to make digital options provided by its digital platform and digital infrastructure actionable, hesitancy to plant digital debt may equally well prevent it from realizing otherwise attractive digital options.*

***Proposition 4:*** *While digital options provided by an organization's digital platform and digital infrastructure may offer new opportunities to resolve digital debt, eagerness to realize digital options may equally well lead to unwise planting of digital debt.*

## 8. Concluding Remarks

Our research advances a user-centric perspective on managing digital platforms, thereby elaborating on the predominantly owner-centric perspective. In contrast to the vast majority of digital platforms literature, which adopts either a technical or an economic perspective, we adopt an organizational perspective to uncover how digital options and digital debt are implicated in managing external industry platforms over time. By advancing a process theory of managing digital platforms at user organizations, we reveal why the assessment of digital options and digital debt requires contextualization with respect to the organization's digital infrastructure. We also surface how the progression of activities related to identifying, developing, and realizing digital options intertwines with the progression of activities related to planting, evaluating, and resolving digital debt. These dynamics involve significant tensions in which the accrual of digital debt may constrain the development and realization of identified digital options, and in which realizing digital options may increase digital debt due to the idiosyncratic changes needed to contextualize platform features to the user organization. Hence, by adopting an organizational perspective on platforms, we add to previous insights on platform evolution (e.g., Gawer, 2014), distributed tuning (Eaton et al., 2015), and issues of balancing control and generativity (Ghazawneh and Henfridsson, 2013) by empirically illustrating and theoretically articulating how these dynamics influence a user organization's management of its digital platform. Consequently, even successful and highly generative platforms that balance stability and evolvability (Wareham et al., 2014) in a cost-effective manner are not directly generative in all organizational and technological contexts. Even when planted strategically, digital options must be identified, developed, and realized, and digital debt must be evaluated and appropriately resolved.

Although our research design is constrained to the News Platform's particular characteristics and to the context of Media Company, a rich interpretive case study spanning nearly 17 years allowed us to generate theoretical insights into how a user organization manages digital platforms in relation to its digital infrastructure and work processes. We therefore offer the following recommendations. First, user organizations should appreciate the variety of option- and debt-related activities that they can pursue to effectively manage a digital platform in changing organizational and technological contexts. These activities must encompass a context-sensitive approach to managing digital options and digital debt, particularly with respect to the organization's digital infrastructure and related work processes. They also call for a mindful approach that rejects the simplistic notion of options as good and debt as bad and instead brings to

the fore the interdependencies of how they progress because of their mutually constitutive nature. Given these interdependencies, organizations will likely need to change their IT governance regimes in response to new demands for platform-enabled innovation. This will require moving toward governance regimes that balance centralization and decentralization of decision-making related to platform-associated options and debt. As evidenced at Media Company, decentralized regimes facilitated local innovation by developing and realizing options to extend the platform's core features (e.g., through options to integrate with complementary software). However, over longer periods of time, breaking away from the inertia resulting from uncoordinated choices required more centralized governance. This, in turn, afforded the requisite mobilization of stakeholders within and outside the user organization to mindfully evaluate debt practices and accumulation that could add maintenance costs and constrain the platform's evolvability. Hence, a user organization must emphasize different governance regimes at different stages in managing a digital platform. Second, organizations should carefully consider whether to rely on a single digital platform to support their business or instead leverage several partly incompatible and even competing platforms. Based on our research and in concurrence with Selander et al. (2013), it is possible that an organization like Media Company would be better off investing in multiple, loosely coupled platforms in a working infrastructure rather than customizing a single platform to fulfill a variety of needs across the organization. Instead of spending resources on customizing a single digital platform and launching large-scale integration projects, organizations could instead focus on developing smaller components and scripts to loosely integrate digital platforms and IT capabilities in their digital infrastructures. In sum, a user organization's digital platform management in relation to its digital infrastructure and work processes requires a mindful approach to the interactions between digital options and digital debt that leverages the generativity afforded by the digital infrastructure and platform ecosystem.

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