



Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation

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Abstract Digital technology is increasingly important in achieving business goals, and its pervasive effects have resulted in the radical restructuring of entire industries. Consequently, managers' extensive interest in handling digital innovation is not surprising. Recent research has illustrated how digital technologies give rise to a vast potential for product and service innovation that is difficult to control and predict. Therefore, firms need dynamic tools to support themselves in managing the new types of digital innovation processes that emerge. The nature of these processes forces firms to challenge prior assumptions about their product and service portfolio, their digital environment, and ways of organizing innovation work. In this article, we present a managerial framework that supports firms in this undertaking. The framework, geared at supporting ongoing improvements in digital innovation management, covers five key areas: user experience, value proposition, digital evolution scanning, skills, and improvisation. We also present a diagnostic tool that can be utilized as firms begin the process of implementing the framework. Finally, we conclude with our thoughts on the managerial implications of the framework when going forward in a rapidly changing digital innovation landscape.

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1. The perils and promises of the digital world

Digital technology has become increasingly important as firms seek to achieve their business goals.

However, recent research (e.g., Grover & Kohli, 2012) has highlighted difficulties in evaluating the value generated by digital technology investments. In the 1990s, a first generation of IT applications enabled firms to streamline their internal operations while providing opportunities for process innovation (Lee & Berente, 2012). More recently, digital technology expanded beyond internal dimensions, penetrating firms' product and service offerings (Yoo, Boland, Lytinen, & Majchrzak, 2012).

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Given digital technology's central role in the radical restructuring of a number of industries (e.g., [Evans, Hagiú, & Schmalensee, 2006](#)), managers' extensive interest in handling digital product and service innovation is not surprising. Addressing this interest, we present a framework that both motivates and keeps track of firms' digital innovation efforts.

The unique properties of digital technology enable new types of innovation processes that are particularly rapid and difficult to control and predict ([Henfridsson, Mathiassen, & Svahn, 2014](#); [Yoo et al., 2012](#); [Yoo, Lyytinen, Boland, & Berente, 2010](#)). Therefore, firms need dynamic tools to support them in managing their digital innovation efforts. To this end, our framework identifies five key areas to be measured and evaluated in seeking to manage digital product and service innovation:

- First, digital products and services must not only be efficient to use and easy to learn, but also provide a rich *user experience*. Such user experience can be measured on its levels of usability, aesthetics, and engagement.
- Second, firms need to clearly articulate the *value proposition* of each digital product and service: How do they create value for the users? The quality of such value propositions is assessed on the dynamics of customer segmentation, product and service bundling, and commissions to channel owners.
- Third, *digital evolution scanning* involves gathering intelligence on new devices; digital channels such as web services, mobile operating systems, and social media; and app stores—as well as standards and APIs—in order to identify and exploit opportunities for innovation across emerging use contexts and new user behaviors.
- Fourth, as digital innovation requires new *skills*, firms need to evaluate their mechanisms for supporting continuous learning of the unique properties of digital technologies in order to set up dynamic innovation teams.
- Fifth—and finally—as digital innovation processes are often ignited when organizational members extemporize with digital technology in a learning-by-doing fashion, assessing the available space and time for *improvisation* and the mechanisms for coordinating such efforts is key.

The process of implementing the framework presented in this article involves making informed decisions that cut across three dimensions: the firm's

products, its digital environment, and organizational properties. By obtaining composite measures for each area, the framework enables firms to effectively manage their digital product and service portfolio over time. While implementing the framework enables firms to harness an expanded scope of digital innovation benefits, it should be noted that such an effort requires planning and preparation. Sufficient time must be allocated for the process, and since it involves change throughout the organization, unintended consequences are likely to occur along the way. To support the first step of the implementation process, we present a diagnostic tool that allows organizational members to score their current operations. This enables the firm to get started in evaluating and measuring its digital innovation efforts. The outcome of implementing the framework is a readiness for digital innovation whereby firms continuously adjust their operations in order to harness the benefits of digital innovation.

In presenting the framework, this article is structured as follows: In Section 2, we explain the ways in which innovation is cast in a new light due to digital technology, highlighting the key challenges involved when managing digital product and service innovation. These insights are captured by our framework, which is presented in Section 3. Presenting the framework, we describe the elements to be measured and how they can be utilized to motivate and keep track of the firm's digital innovation efforts. In Section 4, we present a diagnostic tool that can be utilized as firms begin the process of implementing the framework. Finally, in Section 5, we conclude by presenting our thoughts on the managerial implications of the framework when going forward in a rapidly changing digital innovation landscape.

2. Digital innovation: What's new?

As information is increasingly digitized and mobile devices accelerate in pervasiveness and processing power, an arena and architecture for innovation is opened up—one in which physical and digital components are combined ([Yoo et al., 2012](#)). Recent research ([Henfridsson et al., 2014](#); [Yoo et al., 2012](#)) has highlighted how the unique properties of digital technology enable new types of innovation processes that are distinctively different from the analog innovation processes of the Industrial Era. In the following sections, we explore the topic of digital innovation in more detail. In doing so, we discuss the challenges in managing digital innovation (2.1.), explore the unique properties of digital innovation processes (2.2.), and contextualize the phenomenon of digital innovation, providing a number of illustrative examples (2.3.).

2.1. Can digital innovation be managed?

Digital technology generates highly complex innovation challenges. We have seen how firms that failed to address them appropriately suffered major consequences (e.g., [Lucas & Goh, 2009](#)). Therefore, the question arises: How can digital innovation be managed? Or, rather, can it be managed at all?

A rich body of management research (e.g., [Evans et al., 2006](#); [Robey & Holmström, 2001](#); [Tushman & Anderson, 1986](#)) has investigated the relationship between technological innovation and radical change. To this end, new technologies can profoundly challenge existing markets. However, the competencies of established firms actually stand in the way of innovating ([Christensen, 1997](#)). Scholars have elaborated on macro-level strategic models that can enable firms to overcome this dilemma. For example, it is argued that firms can learn how to deal with radical and incremental innovation simultaneously by building ambidextrous structures and accumulating dynamic capabilities ([O'Reilly & Tushman, 2008](#)).

While these established strategic models for technological innovation management are useful, recent studies (e.g., [Benner & Tripsas, 2012](#)) utilize new digital technologies, such as digital cameras, as objects of research. Still, the distinct and unique characteristics of *digital* technology tend to fade into the background. To this end, extant research on digital technology and organizations suffers from two limitations:

1. It tends to not fully open up the black box of technology ([Orlikowski & Iacono, 2001](#)). When working toward managing digital innovation, this is an important first step to take; firms that seek to innovate their product and service offerings with digital technology need managers well-versed in the specific nature of digital technology.
2. Research on technological innovation tends to adopt a macro-level perspective on its object of study, often resulting in high-level descriptions of strategic recommendations. To address this gap, we turn attention to the key areas to be addressed when managing digital innovation processes as they unfold in practice.

2.2. Digital innovation processes

While digital innovation is a means for new entrants to leverage digital technology in order to challenge incumbent firms—ultimately causing radical industry-level transformation—it also provides opportunities for incumbent firms to enhance and

expand their product and service portfolios into new domains. However, a key challenge for any firm seeking to manage digital innovation entails understanding the unique properties of digital innovation processes ([Yoo et al., 2010](#)).

When engaging in digital innovation, both incumbents and new entrants face challenges and opportunities that showcase an exceptional complexity. One key aspect of this complexity is the rapid pace of digital innovation processes ([Yoo et al., 2010](#)). Ultimately this rapid pace is enabled by the malleability of digital technologies: the ease at which they can be reconfigured ([Tiwana, Konsynski, & Bush, 2010](#); [Yoo et al., 2010](#)). The rapid pace of digital innovation processes is particularly challenging as firms engage in the design of ‘hybrid’ or ‘smart’ products, via which digital components are embedded in traditional products. An example can be found in the ways in which a major car manufacturer faced complex challenges when embedding GPS systems while separate analog and digital innovation processes unfolded simultaneously at a radically different pace ([Henfridsson et al., 2014](#)).

One of the reasons why digital innovation processes are particularly difficult to control and predict is the generativity of digital technology ([Avital & Te'eni, 2009](#); [Yoo et al., 2012](#))—that is, “a technology’s overall capacity to produce unprompted change, driven by large, varied, and uncoordinated audiences” ([Zittrain, 2006](#), p. 1977). When users leverage digital technologies as components or platforms to create new products and services beyond the original design intent ([Yoo et al., 2010](#)), it can result in cascades of innovation, whereby each innovation provides a platform for the next cascade.

Finally, digital technologies constantly evolve toward higher processing capacity and lower cost. As digital technology becomes increasingly ubiquitous and affordable, hindrances are removed for engaging in digital innovation, thus enabling new constellations of actors to generate, develop, and fund novel digital products and services ([Yoo et al., 2010](#)).

When exploring how firms can address the complexities associated with digital innovation, we argue that the characteristics of digital technology need to be put in the foreground ([Orlikowski & Iacono, 2001](#)). These unique properties of digital innovation processes call for firms to challenge established views and assumptions about the role and configuration of their product and service portfolio, their relationships to the digital environment, and how organizational properties are configured to support innovation work. To shed some light on the issues involved, we illustrate in the next section

how digital innovation is manifested in a number of contexts.

2.3. Digital innovation in context

Looking back, the first online shopping websites were often poor translations of printed mail order catalogues. E-commerce has since evolved, expanding the frontiers of digital service innovation. Now, online retailers such as Amazon and Zappos offer more than convenience and cheaper products; by offering recommender systems as well as products at the far end of the long tail, they provide truly novel retail goods consumption. Online digital service innovation investments have also enabled traditional firms such as cab companies and grocery store chains to gain strategic competitive advantage.

A new family of products is currently emerging as digital components are embedded in traditional products such as toothbrushes and heat pumps. Frequently referred to as ‘smart products,’ the embedded digital components enable firms to complement physical goods with online and mobile services that utilize the data generated (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). While the promises of smart products and ‘the Internet of things’ is hotly contested, it is predominantly discussed in the context of home appliances. However, smart products are also emerging in the context of industrial manufacturing equipment. Here, embedded digital capabilities enable real-time monitoring and service forecasting instead of scheduled servicing (Westergren & Holmström, 2012).

The effects of digital innovation are particularly pervasive for firms that engage in information-based products that can be fully digitized. While the mainstream media industry is currently in the midst of such a restructuring process, it seems that the music industry has somewhat stabilized after a transformation that was ignited at the turn of the millennium: record labels had optimized their operations for selling one product—music records/CDs. To this end, pressing sound onto vinyl albums (later CDs) and then distributing copies was an efficient means of delivering music artists’ recorded work to the public from the 1940s onward. In the late 1990s, the emergence of peer-to-peer networks such as Napster and Kazaa confronted the music industry with unexpected challenges (Liebowitz, 2006). When the audience wanted to listen to new music in novel ways, the industry’s somewhat closed approach to innovation was exposed. Although customers were moving in another direction, many major record labels continued to consider their core business the production and sale of music CDs. Historically,

labels controlled their own value chain from end to end: from signing a new artists to distributing his or her music to record stores. Unwillingness to challenge this definition, along with certain insensitivity toward customers’ interest in MP3 files, hampered digital innovation.

While the music industry effectively illustrates an information-based sector that failed to manage digital innovation, other, more firm-specific examples include the bankruptcy of book retailer Borders in 2011 and Kodak’s failure to re-orient its business as digital cameras emerged (Lucas & Goh, 2009). We have, however, also seen how digital innovation can enable established firms to move into new domains. A classic case of such digital portfolio expansion is IBM’s shift in focus from hardware to software and services as PC diffusion accelerated in the early 1990s. In a mainstream media industry context, Nylén, Holmström, and Lyytinen (2014) conducted a case study illustrating how Scandinavia’s largest incumbent publishing firm revitalized its core business by designing digital tablet-based versions of its magazines while somewhat serendipitously becoming an innovator in digital publishing platforms. Another example of such digital portfolio expansion is Apple effectively becoming a music distributor with iTunes. Along with new entrant Spotify, Apple contributed to energizing the business ecosystem in the music industry through digital service innovation. Although the Internet once seemed hopeless as an arena for paid content, Netflix rebutted such notions while invigorating the film and television industries. To this end, Netflix took digital service innovation a step further by not only distributing digital content, but also producing it. Going back to the music industry, additional links in the value chain were eventually reconfigured due to digital innovation; for example, software such as Garageband enables cheaper and highly mobile music production, while free-of-charge alternatives such as Soundcloud illustrate that iTunes and Spotify are not the only gateways.

As firms engage in digital innovation, they face a number of uncertainties. For example, questions arise about what factors govern the adoption of digital products and services. In addition to defining the boundaries between different products and services, firms need to consider how each product and service can generate revenue in different ways through balancing free and premium components. Firms are also challenged to constantly keep up-to-date with how new digital technologies relate to their business and to identify new opportunities for innovation. In organizing their digital innovation efforts, firms need to cultivate and source new skills both internally and externally while coordinating

improvisational efforts in multiple digital innovation projects. While these issues are critical, research has yet to come up with concrete answers. To address this, we now turn to presenting the components of our framework.

3. A managerial framework for digital innovation strategy

In seeking to manage digital product and service innovation, uncertainty occurs across three dimensions: the firm's products, its digital environment, and organizational properties (see Table 1). Therefore, firms need a holistic view of digital innovation when navigating the rapidly changing digital innovation landscape. The framework presented in this article enables firms to gain such a holistic view of digital innovation, helping them to motivate and keep track of their digital innovation efforts. In the

following sections we explore the five key areas included in the framework: user experience (3.1.), value proposition (3.2.), digital evolution scanning (3.3.), skills (3.4.), and improvisation (3.5.). To make the framework applicable, we also detail and explain three key elements.

3.1. User experience

Since the late 1990s, consumer goods and services such as home appliances and air travel have been increasingly purchased via e-commerce websites, which compete on more than just price. Here, website navigation has to be smooth while based on filtering functionalities that allow users to seamlessly navigate massive product databases and arrive at the desired product in a few clicks. Measuring efficient browsing and *usability* is, however, not enough; the customers' experience of interacting with these websites is key. While the user experience design is a

Table 1. The framework

Dimension	Area	Scope	Element
Product	User experience	Digital products and services must offer high levels of usability, possess carefully designed aesthetic properties, and evoke engagement.	Usability
			Aesthetics
			Engagement
	Value proposition	Digital innovation involves an articulated value proposition; i.e., a customer segmentation including strategic pricing and positioning of the product portfolio, dynamic bundling of product units, and carefully negotiated commissions to channel owners.	Segmentation
			Bundling
			Commissions
Environment	Digital evolution scanning	In order to identify opportunities for innovation, firms need to scan their digital environment. This involves gathering information on new digital devices, channels, and associated user behaviors.	Devices*
			Channels**
			Behaviors
Organization	Skills	In order to reap the benefits of digital innovation, firms need to acquire new skills both internally and externally while establishing new digital roles. In doing so, firms should promote continuous learning of the unique properties of digital technologies in order to secure dynamic innovation teams.	Learning
			Roles
			Teams
	Improvisation	The malleability and low cost of digital technologies affords a higher degree of improvisation. As a consequence, managers need to ensure that they provide organizational members with an improvisational space where structure and flexibility is balanced in such a way that the constraints maximize creativity, dedicated time is given, and improvisational efforts are coordinated to deal with overlaps and waste.	Space
			Time
			Coordination

* Hardware such as memory, processors, chips, PCs, smartphones, tablets, etc.

** Web services and platforms such as social media and app stores

central differentiator and competitive force, Forrester recently reported that 97% of websites had a substandard user experience design (Brokaw, 2012).

In digital innovation, measuring the user experience involves not only usability issues, but also the *aesthetic* properties of digital products and services. Users are affected by beauty and appearance; therefore, these aspects need to be carefully leveraged and aimed at evoking a positive emotional response from the user (Hassenzahl & Tractinsky, 2006; Tractinsky, Cokhavi, Kirschenbaum, & Sharfi, 2006). It can be argued that the consistent aesthetics of Apple's hardware and software under the reign of head designer Jonathan Ive contributed to raising the user experience high above competitors such as PC manufacturers and Microsoft, thereby contributing to Apple's market dominance.

Finally, in our framework, the user experience is measured on the ways the firm's digital products and services evoke *engagement*. When seeking a way to create digital products and services that are engaging, firms need to explore and tap into values that can make the experience of their digital products and services meaningful to users (Diller, Shedroff, & Rhea, 2005). Creating an integrated user experience that evokes engagement is particularly important when moving beyond websites and desktop applications. To this end, the smartphone application Foursquare is a successful example of the role of engagement in the user experience design. While supporting location-based check-ins, Foursquare rewards the user with both virtual badges and titles while showing the user how she is currently doing compared to friends. Through gamification at the intersection of virtual and non-virtual life, Foursquare rewards the user with promotional offers at shops and restaurants in the user's geographic area, thus evoking engagement.

User experience is the first key area that firms need to measure in order to motivate and keep track of their digital innovation efforts. This is done through obtaining a composite measure of the levels of usability, aesthetics, and engagement in firms' digital products and services.

3.2. Value proposition

In the Industrial Era, dominant designs provided a structure that enabled benchmarking and unified pricing. In the digital age, however, firms increasingly innovate on malleable intangibles that can be rapidly reconfigured. Therefore, while digital product categories are fragile and negotiable (Nylén et al., 2014), the ongoing reconfiguration of the firm's business model has been highlighted as critical in a context of digital innovation (e.g., Lucas & Goh, 2009). In this

context, the business model defines the "architecture of the revenue" while addressing the processes of value creation involving the value network around the firm, including suppliers, customers, and third parties (Chesbrough & Rosenbloom, 2002, p. 530).

Indeed, digital innovation has contributed to demolishing several established Industrial Era business models. To this end, digital innovation is associated with a new logic and configuration of revenue streams. In guiding firms in this new logic, however, we need to drill down through the macro-level descriptions, past architectural issues, and consider the very concrete ways in which coherent value propositions are inscribed in digital products and services.

In our framework, the value proposition of digital products and services is evaluated through assessing three elements, beginning with *customer segmentation*. This involves analyzing the customer base in order to make strategic decisions about how to reach different groups of customers with the products and services in the firm's digital portfolio. For example, while most websites were historically free to consume, some firms have recently started to experiment with 'paywalls.' Such decisions are typically based on the assumption that there is a group of customers that are motivated enough to start a paid subscription if it gives them access to additional content. Smartphone and tablet apps, on the other hand, are often based on a 'freemium' model via which users can opt out of ads by paying a fee. Customer segmentation enables firms to start reflecting on the pricing and positioning of their digital products and services.

Having segmented the customer base, firms need to decide how the products and services in their digital portfolio can be differentiated and *bundled*. This includes the specific configuration of the balancing of premium and free and the role of advertising in each of the firm's digital products and services, as well as defining boundaries between them while defining units in each of them. To this end, iTunes challenged the music industry's established bundling model by pricing tracks instead of albums. Therefore, when engaging in digital innovation, firms need to consider how products and services can be bundled in new and innovative ways.

In contrast to traditional product licensing models, firms engaging in digital innovation are faced with *commissions* of channel owners. For example, the Apple Store and Google Play both take a 30% commission on sales, while e-commerce storefront services vary in their commissions. Therefore, firms need to consider how the commission of channel owners can be negotiated. Value proposition, dealing with how value is created and

captured in each digital product and service, is thus the second key area to assess for firms that seek to achieve successful digital innovation management.

3.3. Digital evolution scanning

The nature of digital technology implies that it evolves in a 'recombinant' or 'combinatorial' manner. This refers to the ways in which hardware circuits and lines of code are configured to interact in new ways. In other words, digital technology seems to evolve out of itself, starting with a few simple hardware and software components, combined in several rounds over time into more and more sophisticated and integrated ones, forming systems of increasing complexity (Arthur, 2009).

During the last decade we have seen how this evolutionary process is constantly speeding up. This is not only manifested in ever-shorter release cycles of digital devices, but also in the explosion of social media and communication services and applications. This calls for revisiting established notions of strategic environmental technology scanning (e.g., van Wyk, 1997). Indeed, firms need to monitor these developments in order to ensure compatibility by implementing timely upgrades of their digital products and services. However, this scanning moves beyond compatibility concerns when firms seek to harness the full scope of digital innovation.

Digital evolution scanning involves identifying new opportunities for innovation. As digital innovation emerges in these acts of recombination, firms need to continuously consider how they can be active participants. That is, how can they exploit these opportunities and generate an aggregated value through creating digital products and services that utilize existing components?

In doing so, firms need to keep up-to-date with and analyze the progress of digital technology and associated usage patterns. This is done through gathering intelligence on which new hardware devices are on their way to market, including components such as memory, processors, and chips, and devices such as PCs, smartphones, and tablets. While the former can enable embedding digital capabilities into traditional analog products, the increased processing capabilities of mobile devices is continuously allowing resource-demanding services and content such as films, video games, and advanced editing to be done on the same device. Firms need to expect this evolution to continue and assess how it relates to their business.

Furthermore, digital technology has enabled a re-invention of sales and distribution channels. Firms

can now position and integrate their products and services with an abundance of mobile operating systems, social media sites, and app stores. Facebook is currently a key actor for many firms that utilize the platform to a varying degree, ranging from small businesses that push information out to their customers, to large players like Skype and Spotify that instead utilize Facebook to pull new customers in through formalized Facebook partnerships materialized in integrated user accounts. Finally, digital evolution scanning involves observing new user behaviors. To this end, new markets can emerge as users sometimes unexpectedly adopt a digital technology into a new use context.

As noted, the ways in which devices, channels, and behaviors co-evolve is highly complex. Rather than try to reduce this complexity, firms should instead seek to harness it (Axelrod & Cohen, 2000). This is done through digital evolution scanning, whereby firms can identify and exploit the structural holes (Burt, 1992) in which opportunities for combinatorial digital innovation reside. Digital evolution scanning is thus the third key area that firms need to address in order to validate that they have the mechanisms in place for identifying opportunities for innovation that emerge in their digital environment.

3.4. Skills

The rapid pace of digital innovation processes suggests that current forms of organizing innovation work need to be transformed. As noted by Christensen (1997), the core competencies of incumbent firms can actually stand in the way of innovating when entering new markets. This is also a challenge in digital innovation, but as production of quality products and content remains key, digital innovation requires new skills without making all existing skills obsolete. Three main elements should be measured when evaluating the firm's digital innovation skills.

First, Industrial Era firms should seek to leverage and translate skills obtained from developing analog products. Measuring this key area involves taking stock of the ways in which learning is supported and promoted throughout the organization. Digital innovation involves continuous learning whereby new digital technologies are explored in order to create an understanding of their unique properties. This can involve establishing conditions for retraining and incentives for existing staff to acquire digital skills. To this end, it is critical to acknowledge organizational members' spontaneous digital innovation initiatives throughout the firm. Therefore, firms should be alert and identify organizational

Table 2. Diagnostic tool

		Do not agree	Partially agree	Agree	Score	Diagnosis (low scores)
User experience						
Usability	Our digital products & services are easy to learn & interact with.	1	2	3	0	The user experience of the products and services included in the firm's current product portfolio needs to be redesigned.
Aesthetics	They have articulated aesthetic properties that evoke a positive emotional response.	1	2	3	0	
Engagement	They are created to offer our customers meaningful experiences.	1	2	3	0	
Composite measure:					0	
Value proposition						
Segmentation	We have analyzed our customer base and divided it into multiple segments.	1	2	3	0	The firm's digital profits can be boosted through reconfiguring the value proposition inscribed in the firm's products and services.
Bundling	The components of our digital product and service portfolio are differentiated and the boundaries and relationships between them are clearly specified.	1	2	3	0	
Commissions	We continuously evaluate and negotiate our relationships with channel owners.	1	2	3	0	
Composite measure:					0	
Digital evolution scanning						
Devices	We carefully follow which new hardware components & devices are under development.	1	2	3	0	The firm needs to develop digital evolution scanning mechanisms.
Channels	We track the evolution of digital distribution channels (e.g., software platforms, operating systems, & web services).	1	2	3	0	
Behaviors	We pay attention to emerging user behaviors across contexts and markets.	1	2	3	0	
Composite measure:					0	
Skills						
Learning	We promote continuous learning of the unique properties of digital technologies.	1	2	3	0	The firm needs to acquire new skills internally and externally while promoting continuous learning.
Roles	The balance between overall digital skills & specialized digital roles is adequate.	1	2	3	0	

Table 2 (Continued)

		Do not agree	Partially agree	Agree	Score	Diagnosis (low scores)
Teams	We can assemble teams with the right combination of skills for each digital project.	1	2	3	0	
Composite measure:					0	
Improvisation						
Space	We try to organize work in a way that structure and flexibility are balanced.	1	2	3	0	The firm needs to adjust its routines and structures to support improvisation .
Time	We dedicate time for improvisational efforts in each profession.	1	2	3	0	
Coordination	We have mechanisms in place to coordinate improvisational efforts.	1	2	3	0	
Composite measure:					0	

members that are drifting from their established *roles* toward improvising with digital technologies. Such talent is important to pick up in order to secure the appropriate skillsets for future projects, ultimately achieving sustainable digital innovation management.

While new roles can emerge from within the organization, firms may necessarily recruit externally for specialized digital roles that complement existing roles. In combining such roles, it is a key challenge for managers to assess the current status of organizational members' skills, ensuring that they can be fruitfully assembled in dynamic innovation *teams* with the right combination of skills for each project. Therefore, firms need to carefully consider the balance between carrying out digital innovation projects in-house and engaging specialized external consultants.

While managers may prioritize involving leading consultants to achieve supreme digital service designs in individual projects, developing in-house skills ensures the agility needed to handle the rapid pace of digital innovation processes. In large firms, this could involve sourcing and combining resources and skills from multiple countries and divisions within the firm. Guided by the composite measure on this fourth key area, managers can organize their digital innovation teams to address the rapid unfolding of digital innovation processes.

3.5. Improvisation

In the Industrial Era, product development was a slow and costly procedure. Trained organizational members in formal engineering and designer roles exclusively handled this activity. In contrast, digital

technologies are ubiquitous in contemporary firms. We argue that by promoting improvisation throughout the organization rather than trying to impose a central control on all digital innovation processes, contemporary firms can harness complexity through combinatorial innovation.

Research on organizational improvisation (e.g., Weick, 1998) has explored notions of structure and arrangements in jazz music, via which improvisation involves composing and performing at the same time. In this context, improvisation is defined as "the conception of action as it unfolds" (Cunha, Cunha, & Kamoche, 1999, p. 302). Although it often emerges as a consequence of formal plans not playing out, managers can intentionally employ improvisation as a deliberate strategy (Pavlou & El Sawy, 2010).

In the digital realm, improvisation is often an act of reconfiguration. To this end, the malleability of digital technologies affords a higher degree of improvisation than their analog counterparts. Improvisation involves risk taking, and in the context of digital innovation, the low cost of digital technology also means a lower cost of failure. Therefore, managers need to ensure that they provide organizational members with an improvisational *space* in which structure and flexibility is balanced in such a way that the constraints maximize creativity while evoking generativity (Avital & Te'eni, 2009; Yoo et al., 2012).

Allocating *time* for improvisation is key; we have recently seen how Google allocates 20% of employees' working hours to individually initiated projects and 'skunkworks.' In digital innovation, improvisational efforts typically occur across different units, levels, and divisions of the firm. Therefore, it is

critical for firms to establish mechanisms for capturing the successful outcomes of such efforts. Meanwhile, in order to deal with overlaps and waste, *coordination* is a key measure.

Digital innovation requires an organizational culture that allows for improvisation—and, thereby, also failures—throughout the firm. Improvisation is thus the final key area to be assessed by firms that seek to achieve sustainable digital innovation management.

4. Implementing the framework

We developed a diagnostic tool that supports firms in taking the first step of implementing the framework (see Table 2). Based on the framework, the tool consists of 15 Likert-style questions. Here, organizational members are asked to score the firm's current operations by assigning a value on a scale of 1–3 for three questions in each key area. For each area, participants are asked to calculate and fill out the composite score.

After the forms have been collected, a workshop facilitator should calculate the total average scores. When discussing the five overall average composite scores that have been produced at this point, we encourage firms to first focus on the lowest scores. These are the areas in which the firm currently underperforms, thus hampering the overall output of its digital innovation efforts. The brief diagnosis in the far-right column articulates what needs to be improved. We encourage firms to use this brief diagnosis as a foundation when running a series of workshops investigating how they can establish routinized data-capturing mechanisms and start to transform their digital innovation practices in those areas.

5. Concluding thoughts

Aspiring to bring technology to the center, we presented a framework (Table 1) informed by recent research exploring the unique properties of digital innovation processes (e.g., Henfridsson et al., 2014; Lee & Berente, 2012). We then illustrated and discussed the elements to be measured in each area and detailed the first step of the implementation process, which includes using the proffered diagnostic tool (Table 2). When successfully implemented, the framework enables firms to continuously adjust their operations in order to optimize digital innovation efforts. It should be noted, however, that because each firm is unique, the ways in which each measure is operationalized and deployed may differ substantially. Tailoring the framework involves deciding whether to utilize quantitative or qualitative

measures; the framework provides the space for each firm to define this. Indeed, digital technology opens up multiple ways of capturing data. For example, in the product dimension, firms can negotiate with customers to share their data in order to gain insight regarding usage and purchasing patterns. In terms of the environment, firms need to investigate how they can capture or 'scrape' web data from technology blogs and similar venues to obtain intelligence on developments in digital technology that complements their existing business intelligence practices.

As shown in our framework, many factors influence firms' digital innovation efforts. While factors such as political policies and regulations were always important in a context of innovation, this is also the case in digital innovation. Our framework, however, focused on the new key areas to be prioritized due to the unique properties of digital technology. Another limitation of the framework is that it does not cover internal process innovation enabled by digital technology. Although it falls outside the scope of this article, we call for more research into how digital process and product innovation are related and can be integrated in firms.

While being able to deal with the rapid change associated with digital innovation processes is key in contemporary firms, this is clearly still uncharted territory for many companies. This fact underlines the importance for all firms to have in place appropriate tools for managing digital innovation. Given the lack of such tools, our framework should be a welcome contribution. Although our framework is informed by recent research and industry developments, we hope to inspire additional managerial accounts as well as further scholarly study in this exciting domain. As noted, industry accounts of digital innovation typically include failures to adapt. Therefore, we encourage successful examples to be documented, involving both new entrants' and incumbent firms' experiences of managing digital innovation.

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