

Digital Innovation

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1 Introduction

Digital technologies contribute to the transformation of large parts of our economy and society. Not only do the five most valuable companies in the world belong to the digital sector¹, also the nature of innovation itself has undergone a digital transformation. The importance of classical product innovations has been reduced in favor of new business models enabled by digital technology platforms. Besides transforming business models, digital innovation also leads to a changing entrepreneurial culture: Digital ventures can grow at a massive rate and scale (Huang et al. 2017) and founders can create temporary monopolies or oligopolies with less external capital (Kurz 2017). Whether this will increase or decrease social welfare, employment rates, and overall quality of life is subject to ongoing debate (cf. Brynjolfsson and McAfee 2013; Davenport and Kirby 2015).

Digital innovation is no longer just the business of software companies. As software is a key differentiating component and an innovation enabler in most products, processes, or services of today, digital innovation is now practiced by an increasing number of companies (Svensson and Taghavianfar 2015; Yoo et al. 2012). For many companies, it is a particular challenge to move away from just regarding IT as a commodity (like Carr framed it in his well-known essay "IT doesn't matter" (Carr, 2003)) or as a machinery to keep the business running. Rather, they have to find a way to align the mandate of providing a stable and predictable IT environment for their current business with the exploration of new opportunities offered by a fast-changing digital and economic environment. For example, the car manufacturer Tesla Inc. uses digital technologies for over-the-air software updates and remote diagnostics to automatically identify issues of the car and schedule service center appointments or send mobile technicians². Besides the digital enrichment of technical components in the car, this digital transformation of car services also means a fundamental shift in the business model of traditional car manufacturing, e.g., in the way garages and related services are offered to the customer.

So, what is "digital innovation" and what is really different about an innovation carried out with and for digital technologies? How can an organization advance its digital innovation capabilities? And how can those digital innovations then be implemented within the IT-department of an organization? The subsequent sections address these questions before we conclude by outlining a path for further research on digital innovation.

¹ As per December 31st 2017, the five biggest companies in the world by market capitalization were: Apple Inc., Alphabet Inc., Microsoft, Amazon.com, and Facebook. See https://en.wikipedia.org/wiki/List_of_public_corporations_by_market_capitalization#2017 (last accessed on August 30th, 2018).

² "The Future of Tesla Service" <https://youtu.be/PBbzOBQmk-0> (last accessed on August 30th, 2018)

2 Understanding Digital Innovations: From Products to Platforms

What is "digital innovation" and what is really different about it? Digital technology has three key characteristics that change the nature of innovations: First, once digitized, information can be stored, transformed, transmitted, and traced by any digital device irrespective of its content (Yoo et al. 2010). Second, digital information is editable through means of re-programming, making digital solutions malleable to changes after deployment by interaction with external systems (Kallinikos et al. 2013). And third, inherently self-referential, digital technology is needed to create digital technology (de Reuver et al., 2016; Yoo et al. 2010). That is, digital technology is both the result of and the basis for developing digital innovations, implying high scalability and low entry barriers and leading to wide participation and democratized innovation (Yoo et al., 2010).

Exhibit 1: Definition: Digital Innovation

Innovating digitally means innovating products, processes, or business models using digital technology platforms as a means or end within and across organizations.

[Fig01]

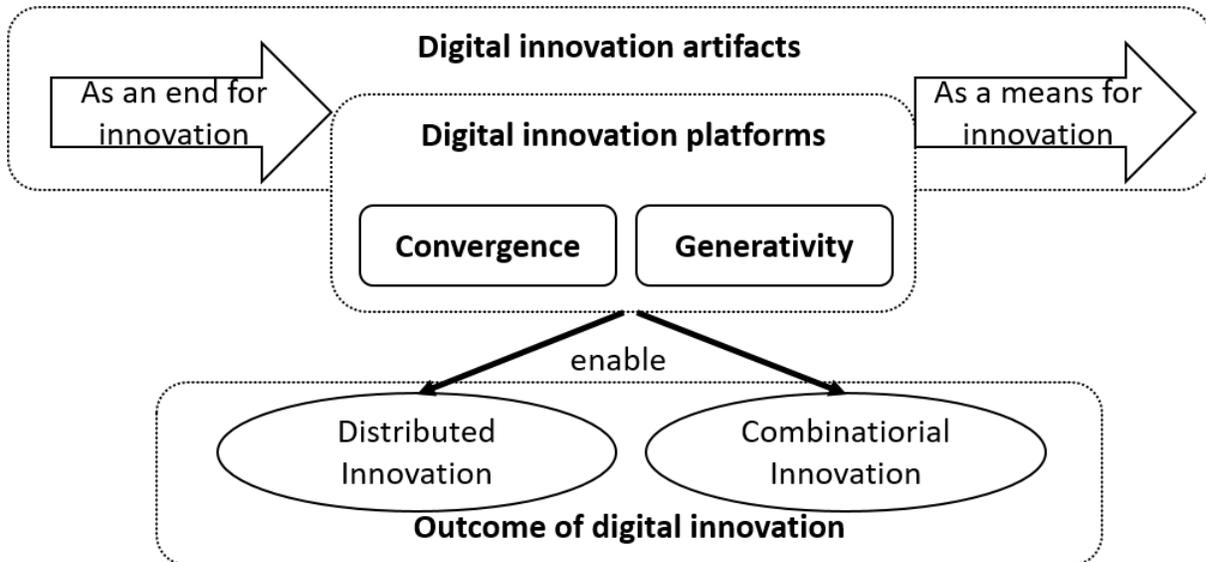


Fig. 1 Characteristics of Digital Innovation (own illustration after Yoo et al., 2012)

Fig. 1 provides an overview of the characteristics of digital innovation and the following sections provide further explanations. The outcomes of digital innovation are characterized by convergence and generativity (Yoo et al. 2012).

Convergence means that the digital technologies combine previously separate components. For instance, the iPhone brought together features of a music player, a video camera, a GPS unit, a web browser, and a traditional phone, among other things.

Generativity points to the fact that digital technologies are inherently dynamic, extensible, and malleable. Sticking to the above example, the iPhone does not only combine different technical features, but it also allows for indefinite expansion by adding features to increase communication or gaming capabilities through its AppStore.

These two characteristics allow digital technology to be both the basis for (“digital technology as a means”) and the result of (“digital technology as an end”) digital innovations. In other words, digital technology enables distributed innovation, combinatorial innovation, and digital technology platforms (Yoo et al. 2012).

Distributed innovation means that digital innovations often result from the collection and (re-)combination of digitally encoded information across organizational boundaries (Lusch and Nambisan 2012; Yoo et al. 2012). Open interfaces enable the creation of digital services by using external digital resources while also granting other collaborators access to digital resources generated in the process. For instance, many popular social media applications, such as Instagram, Facebook, and Snapchat, use smartphone cameras to enable users to take, edit, and share photos. In turn, they offer interfaces for providing user data to advertisers.

Combinatorial innovation means that new digital solutions are often created by combining existing modules with embedded digital capabilities or blending different modules with the same standard. This leads to a wide range of possible combinations of digital technologies, and therefore a wide range of open-ended innovation opportunities enabled by those re-combinable digital technologies.

Moreover, the flexible character of digital technology enables the modular integration of components into *digital technology platforms*. As a result, digital technologies enable firms to innovate by creating digital platforms rather than single products. A digital technology platform is “a building block, providing an essential function to a technological system – which acts as a foundation upon which other firms can develop complementary products, technologies or services” (Gawer 2011, p. 2). For instance, many digital-born companies, such as Facebook, Uber, and Airbnb, provide a digital technology platform with a set of core functionalities that may be extended by complementary contributions from actors outside the organization.

Digital innovations rarely follow traditional logics of governance and coordination but rather emerge from the opportunities available in a digital ecosystem (Um et al. 2013). This results in loosely connected networks. Digital start-ups are born into such networks, meaning that they can develop and grow on a massive scale and in unusual ways (Tumbas et al. 2015), if and when they draw from capabilities offered by others in the ecosystem (Selander et al. 2013). For instance, digital innovation activity differs across platforms depending on the stimulation, facilitation and management of practices (Bresnahan and Greenstein 2014; Tiwana et al. 2010). The comparison between application development platforms for the mobile operating systems iOS (App Store) and Android (Google Play) often serve as an example. Although both platforms have similar technical arrangements, innovation activity differs substantially between them as a result of differing design, architecture and governance arrangements (de Reuver et al. 2016; Gawer

2014). This allows for users to participate in the creation of digital innovations by making it increasingly easy to customize digital platform arrangements to their needs.

When it comes to developing digital innovations, the resulting solutions often embody characteristics of products and services simultaneously, thus they are often described as service innovations or product-service systems (Matzner et al. 2018). For instance, the Service-Dominant logic perspective (in short S-D logic), originating from the marketing discipline, reconceptualizes service as the application of specialized knowledge through a process of value co-creation in a network of providers, customers, beneficiaries, and other actors (Vargo and Lusch 2004). This notion of service also entails that service innovation is a networked collaborative process of co-creating value enabled by complex socio-technical systems with recombinable digital resources (Barrett et al. 2015). For instance, the vast opportunities for analytics and automation, enabled by a combination of big data, robotic process automation, machine learning, and human intelligence, significantly extends the creative leeway for service design. This digital transformation of service innovation gives rise to new fields of study, such as service systems engineering, defined as the systematic design and development of service systems (Böhmann et al. 2014). Again, a fundamental characteristic of service is that it is constituted in people's everyday practice (Barrett et al. 2015).

3 Organizing Digital Innovation: From Processes to Practices

How can an organization advance its digital innovation capabilities? Traditionally, innovation has often been described as a discrete, linear, and sequential innovation process with clearly ordered, differentiated, and consecutive phases. For instance, Tidd and Bessant (2011) divide the innovation process into *search*, *select*, *implement*, and *capture*. Chesbrough (2003) differentiates between *research* and *development*. Desouza's (2011) innovation process consists of *idea generation*, *advocacy & screening*, *experimentation*, *commercialization*, and *diffusion & implementation*. And Fichman et al. (2014) distinguish between *discovery*, *development*, *diffusion*, and *impact*.

The purpose of such innovation processes is essentially to coordinate the activities of individual agents and to organize these activities reasonably well according to given, recurring circumstances (Tidd and Bessant 2011). Such innovation processes are also necessary conditions for digital innovations, but they alone are not sufficient for advancing the digital innovation capabilities of an organization: Digital innovation capabilities are enhanced if organizations support combinatorial and distributed innovations. For this goal, companies also need to understand and support the "practices" (cf. Tuomi 2002) of those who actively develop digital innovations. In the context of digital innovation, we refer to this as "Digital Innovation Practices".

Exhibit 2: Definition: Digital Innovation Practice

In line with recent conceptualizations, we understand *digital innovation practices* as a routinized and interdependent set of goal-oriented, digital technology-mediated, and social interactive activities in the context of digital innovation.

Practices are carried out by humans who skillfully and purposefully conduct activities using their brains, bodies, and material objects to satisfy their needs and intentions (Kaptelinin and Nardi, 2009). In fact,

practices constitute human sociality and being human means first and foremost to carry out practices as a 'doer' within a social context (Nicolini 2012, pp. 105–118).

Digital innovation practices are often carried out inside the boundaries of an organization by inventive and entrepreneurial employees, hence called *intrapreneurs* (Desouza 2011, p. 5). Intrapreneurship is a form of direct participation in which the employee takes the initiative to generate, develop, and implement ideas for innovative solutions (Høyrup et al. 2012; Kesting and Ulhøi 2010). Within every employee lies an innovative potential, which organizations seek to foster and facilitate (Hargadon and Bechky, 2006; Kristiansen and Bloch-Poulsen 2010). Self-organizing networks of employees are a crucial driver for the development of digital innovations, and ever more companies facilitate the collection of ideas from all parts of the organization (Chesbrough 2003; Desouza 2011; Neyer et al. 2009).

Supporting these intrapreneurs and other self-organizing employees from a practice perspective means organizations have to provide a) instruments that allow them to keep up with the increasingly networked and connected character of innovation and support distributed innovations, and b) appropriate artifacts that make it possible to create and communicate innovative ideas and support combinatorial innovations. The following case vignette highlights fundamental aspects of digital innovation practices and the paragraphs below place these aspects in the context of recent literature. We use a pseudonym as the company wishes to remain anonymous.

Case Vignette: BITS' transformation to digital innovation

BITS is the largest privately held banking software provider in Switzerland. For more than two decades, the business model of BITS has been the development, distribution, and operation of its proprietary core banking system. After the executive board became increasingly concerned that the life cycle of this product might peak at some point, BITS took steps to develop various new solutions in the areas of mobile banking, outsourcing, financial services, and consulting.

While they initially provided a standard software solution to be installed at their clients' premises, BITS more recently started re-positioning their offering as a digital technology platform. Technically, this meant that other software companies could integrate their software with the BITS banking core and with other third-party software. Economically, this meant a new business model allowing BITS to leverage superior earnings as the software became a network product. But it also meant that they had to start sharing their platform with traditional competitors.

Along with the shifting business model, a shifting innovation culture became necessary. BITS has positioned itself as Swiss innovation leader and has been investing large parts of their earnings on innovation for years. While in the early years it appeared natural that the founders drove innovation, they now rather wanted to reap the innovative potential of their own employees. This required them to identify and support their most creative and entrepreneurial employees.

In their effort to establish an entrepreneurial culture (from managing to practicing digital innovation), BITS started organizing exhibitions where employees could present early concepts and prototypes of innovation and they implemented a phase-based innovation process. Concretely this meant using the malleability of software to create convincing innovation artifacts, most prominently prototypes (Ciriello et al. 2017) and PowerPoint (Ciriello et al. 2015). These innovation artifacts were then simultaneously applied to further develop the innovative idea, to build up a supportive community and to persuade key persons in the BITS management and in the BITS user community. While these approaches naturally evolved in the BITS culture over time, the awareness of those practices offered novel opportunities to support them, e.g., offering tools that made

informal innovation activities transparent to them and to gently transition them into the official development process (Ciriello et al. 2016). Those insights also prevented them from taking management measures that would unintentionally kill innovation practices.

The networked character of digital innovation means that organizations can be seen as an interconnected web of people, practices, tools, and other resources working together towards creating digital solutions (Ciriello, 2017). For instance, so-called promoters are employees who actively and intensively support the innovation process by providing certain resources, such as specialized knowledge, organizational influence, communication skills, and networking competencies, to overcome barriers, such as administrative hurdles, or lack of resources (Fichter 2009). And so-called catalysts are employees who play a passive role in innovation processes by supporting, facilitating, and promoting the innovativeness of their colleagues (Tortoriello et al. 2014). In a digital innovation context, providing employees with adequate spaces for social networking is often done in form of so-called *idea* hubs. Idea hubs can be understood as a nexus of collective creativity, where different kinds of employees collectively generate, refine, or extend innovation-ideas online or offline (Ciriello and Richter 2015). Such idea hubs are the focal point of collective creativity, where a connected group of employees bind ideas together to generate team level synergies. They are important for enabling employees to share ideas in digital spaces (such as enterprise social media platforms or office web applications), physical spaces (such as facilities for formal meetings and informal discussions), as well as in a combination of digital and physical spaces connected through Internet of Things technologies (Ng and Wakenshaw 2017).

Organizations can also provide employees with appropriate artifacts to create and communicate their ideas. Such *digital innovation artifacts* refer to any underspecified representation of an envisaged new digital solution (Ciriello et al. 2017). A fundamental characteristic of such artifacts is that they can manifest as abstract idea or concept and are therefore often emergent, unfinished, and partial. As such, digital innovation artifacts can be an important tool to facilitate individual work in crafting a first idea (in a combinatorial manner), as well as group communication, collaboration, and decision-making during the design of digital solutions (Badinelli et al. 2012).

4 Implementing Digital Innovations: From Exploitation to Exploration

While the prior section depicted how the development of digital innovations is best understood from an organizational perspective, this section switches the focus to the implementation of digital innovations. *How can an organization integrate digital innovations in their day-to-day IT business activities?* Here, organizations typically face a tension between exploitation (i.e., running and incrementally improving the existing business to ensure current viability) and exploration (i.e., radically innovating in new business areas to ensure future viability) (March 1991). Gartner proposes a bimodal IT management approach³ in the face of such tensions. Rather than being predictable, focusing on improvement and renovation in more well-understood areas, management approaches for digital innovation are exploratory and focus on experimentation.

³ <https://www.gartner.com/it-glossary/bimodal/> (last accessed on August 30th, 2018).

In the face of such tensions, how are digital innovations then actually implemented? Implementation teams typically include business representatives, user representatives, domain specialists of the addressed domain, external specialists, and increasingly frequently also researchers from universities. These inter-disciplinary teams usually do not only follow an agile software development process, but also systematically engage in exploration as part of their innovation practices. Literature distinguishes between three types of such practices:

1. Teams explore the potential of new technologies by applying them to proof-of-concept and proof-of-value prototypes (Nunamaker et al. 2015). In doing so, they try to identify promising use cases for emerging technologies.

2. Teams explore user needs by applying methods or frameworks like Design Thinking (Brown 2008; Dolata and Schwabe 2016). In an iterative process they understand user needs, quickly develop prototypes and evaluate them with users. In recent years, the initially vague Design Thinking approach has matured into an engineering method applied by major companies such as SAP and IBM, and special "flavors" of Design Thinking make it applicable to diverse areas beyond classical product development, such as service innovation (Brown and Wyatt 2010; Plattner et al. 2009).

3. Teams explore the economic viability of innovative ideas by linking them with novel business model patterns (Osterwalder and Pigneur 2010) and testing them in pilot studies. While existing management approaches focus primarily on *what* activities take place in digital innovation, it is subject to ongoing scholarly discourse *how* these activities should be supported (Ciriello et al. 2017). This opens up opportunities for design science scholars to develop prescription-driven knowledge, which can be used by professionals to design solutions for management problems (van Aken 2004) in the context of digital innovation.

5 Taking Digital Innovation Further

Digital innovation is a multi-faceted phenomenon that offers desirable insights for cross-disciplinary research. In this article, we bring together perspectives from innovation management, digital innovation, and practice theory. We argue that the three perspectives complement each other well, and we outline a path for understanding and improving the management and practice of innovation in the digital age. We consider it promising to study all the above introduced characteristics of digital innovation. Figure 2 provides an overview of promising research areas within digital innovation, and the following paragraph provide corresponding research questions and further explanations.

[Fig02]

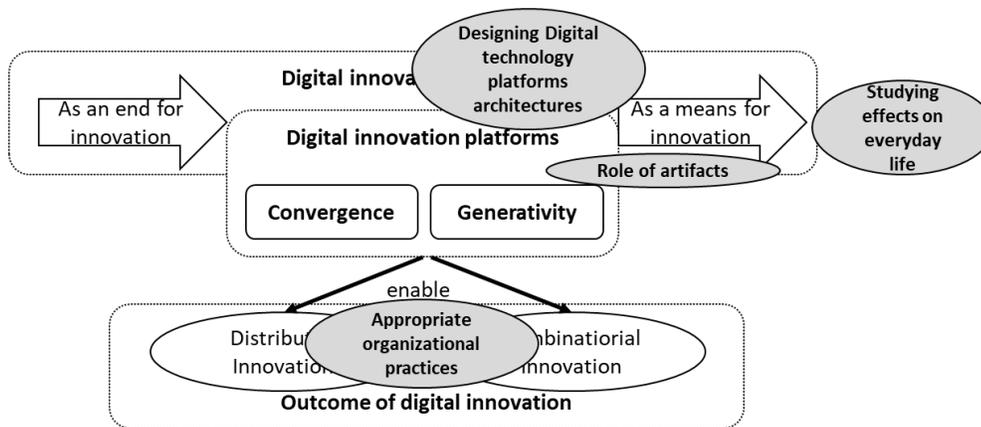


Fig. 2 Further research field for digital innovation

When it comes to innovation practices, it is important to better understand the twofold role of digital *artifacts as means and end*. How are these artifacts part of innovation practices and how are they the product of these practices? Relating to some specific earlier mentioned practices, it is relevant to further study how digital artifacts can support social networking and interaction in digital innovation practices and how employees use digital artifacts to communicate ideas. Specifically, how do artifacts support storytelling, persuasion, decision-making, and knowledge transfer within organizations? How do digital artifacts enable and constrain innovation practices?

When it comes to *designing digital technology platform architectures*, De Reuver et al. (2016) call for further research on understanding the architecture of digital platforms and how they should be designed. Furthermore, they call for a more precise definition of concepts and rigorous in-depth studies on *their transformative power and effect on everyday life*. As we are trying to understand the innovation platform established in the last decade, blockchain technologies are challenging our comprehension developed so far (Beck, 2018). What does digital scarcity (Miscione et al. 2017) mean for digital innovations? Are there mechanisms for generativity of transactions and rights? What does decentralized control mean for platforms? What is the role of generativity and convergence in these digital technologies? What are appropriate organizational practices to create digital innovations and how can organizations enable the emergence of digital innovations stemming from their employees' creativity?

When it comes to different *appropriate organizational practices*, it would be interesting to study how different constellations of people, places, and time stimulate collective creativity. What different kinds of social influence exist in organizations and what is the effect of digital artifacts on social interactions? At which times and in which places do people communicate ideas?

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