

Explicating the market dimension in the study of digital innovation:

A management framework for digital innovation

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Abstract

Digital innovation is gaining momentum among academics and business practitioners. Featuring increasingly cross-industry and multi-actor innovation processes, digital innovation reveals the inherent technology bias in the dominant perspectives on innovation. This study aims to transfer the focus from technology-centred ideas of digital innovation to a more balanced concept in which digital innovation is conceptualised as a combination of multiple needs and solutions linked to various actors and their behaviours. The study builds on a longitudinal case study. The article contributes by providing a partial response to the explicit calls for strategic frameworks that capture the process of digital innovation. Furthermore, the article explicates the market dimension of digital innovation and extends the analysis of the market dimension from a limited view of customer information and user knowledge to further include needs, actions, and behaviours of market actors directly or indirectly using, complementing, or substituting the digital innovation and innovation process.

Introduction

Only a minority of promising new product concepts and technologies achieve commercial success. Since Schumpeter (1934), it has been clear that innovation is a union of technology (used in its general meaning of a solution) and the needs the technology tackles: ‘What may be a startling breakthrough to the engineer, may be completely unremarkable as far as the user of the product is concerned’ (Abernathy and Clark 1985, 4). However, for a long time, academic conceptualisations and managerial tools have largely emphasised the technology dimension at the cost of ignoring the market dimension in the innovation process (see Baregheh, Rowley, and Sambrook 2009; McDermott and O’Connor 2002). This study adopts the recently introduced, more balanced conceptualisations of innovation regarding its market and technology dimension (see Nambisan et al. 2017; von Hippel and von Krogh 2016) for enhancing understanding of the management of digital innovation.

Digital innovation is gaining increasing interest among academics, as well as business practitioners. Furthermore, digital innovation is shaking the idea and model of innovation that is dominant in the extant innovation research (see Nambisan et al. 2017). In the simplest form, digital innovation refers to ‘the carrying out of new combinations of digital and physical components to produce novel products’ (Yoo, Henfridsson, and Lyytinen 2010, 725). In the word’s broadest sense, digital innovation and digitalisation go beyond the mere changes in a technological artefact and further consider the respective socio-technical context regarding the technology and the implications of the use of digital innovation in society (Nambisan et al. 2017). Respectively, digital innovation has been seen as a force for the renewal of the old manufacturing-based business logic (see Lucas and Goh 2009; Vargo and Lusch 2004) by integrating ‘digital materiality’ with traditional product elements (Lyytinen, Yoo, and Boland 2015; Yoo et al. 2012).

Digital innovation reveals the need for a new kind of logic and frameworks for innovation and innovation processes (Grover and Kohli 2013; Nambisan et al. 2017; Nylén and Holmström 2015). Digital innovation catalyses convergence of industries. This manifests in new collaborative arrangements between actors from traditionally separated branches of industry (see Yoo et al. 2012). Consequently, digital innovation comprises an entity that lacks clear boundaries and is in a continuous state of incompleteness and emergence in a multi-actor environment (Lyytinen et al. 2016; Svahn, Mathiassen, and Lindgren 2017). In this context, aside from the technological dimension, the market dimension of innovation is accentuated; that is, it is essential to understand what those needs are and who the actors are that are linked to the solution the innovation provides (Markus and Loebbecke 2013). Examples of digital innovation, such as eBooks, E-textiles etc., can be seen as snapshots in a given time and space that reflect the wider underlying dynamics of digitisation and the respective socio-technical change in society (see Grover and Kohli 2013). As digitisation develops further, these solutions and their elements vanish or integrate with other solutions for novel solutions to arise (Yoo et al. 2012). Consequently, the traditional models of innovation processes that focus on technology and its generation into a state of completeness for launching on the market are in conflict with the new logic of incompleteness and emergence that digital innovation represents (see Grover and Kohli 2013; Lyytinen, Yoo, and Boland 2015; Nylén and Holmström 2015).

The purpose of the article is two-fold. It synthesises a perspective that balances the technological and market dimensions of the digital innovation process and puts forward a management framework for digital innovation.

The article presents two main contributions. First, the article provides a partial response to the explicit calls for novel strategic frameworks that capture the particular nature of digital innovation and its development process (Nambisan et al. 2017; Yoo, Henfridsson, and Lyytinen

2010). Second, the article explicates the market dimension of digital innovation in particular and extends the analysis of the market dimension from a limited view of customer information and user knowledge (see Abrell et al. 2016) to cover the needs, actions, and behaviours of various market actors directly or indirectly using, complementing, or substituting the innovation and innovation process. Thus, the article elaborates the recently proposed ideas for further research on digital innovation as an entity at the cross-roads of markets and technology (see Nambisan et al. 2017) and systemises them into a management framework. The perspective launched in the study sets an integrative perspective to build upon in future research on digital innovation and its management.

The article proceeds as follows. In the second section, the article develops a conceptual framework. The third section reports the methodology, and the fourth section reports the results of the empirical study: a longitudinal account of failure in the digital innovation development process. In the fifth section, a management framework for digital innovation is put forward.

Theoretical background and the research framework

According to the definition, innovation is not something that is made or created; rather it emerges in the interplay between technological processes and market/use processes of adoption and diffusion regarding the technology (Rogers 2003). For a long time, the duality of innovation regarding its technology (the solution in the making) and the market dimension (the potential use and the needs the technology is made for) was largely ignored in the innovation management literature (see e.g. Baregheh, Rowley, and Sambrook 2009; McDermott and O'Connor 2002; Nambisan et al. 2017). Traditional, linear intra-firm innovation models (Gopalakrishnan and Damanpour 1994; Rothwell 1994), as well as the perspectives on collaborative or network innovation (see Dhanaraj and Parkhe 2006), focus one-sidedly on the technology in-the-making ignoring the needs it is made for.

The technology and the market dimension of innovation and their mutual interplay are particularly explicit in the case of digital innovation (Markus and Loebbecke 2013; Yoo et al. 2012). First, as digital innovation comprises digital and non-digital elements representing various industries, the cohesive force putting these elements together to form the innovation lies in the needs of the actors engaged in the innovation (the market dimension) as much as it lies in the compatibility of the technologies (the technology dimension; see Parker et al. 2017). Second, digital technologies are largely connected and fast evolving, and thus, the success of any single digital innovation is linked to market dynamics, generating market needs, as well as substitutes and complements for the focal innovation (Nambisan et al. 2017). Given these elements, we adopt the notion of need-solution coupling as an elementary analytical device. This concept has been elaborated in previous innovation (von Hippel and von Krogh 2016), as well as in digital innovation, research (Nambisan et al. 2017) and seems a particularly suitable conceptualisation for balanced consideration of innovation in terms of the markets and technology.

This study systemises the use of notion of need-solution coupling in linking that with the needs, actions and behaviours of various market actors (see Parker et al. 2017; Svahn, Mathiassen, and Lindgren 2017). The framework in Figure 1 articulates a synthesising approach to digital innovation. The framework defines digital innovation in terms of need-solution couplings and the innovation process with regard to the emergence of the need-solution couplings. The emergence of need-solution couplings is linked to the actions of individual actors and the collective action at the innovation networks and interrelated industries levels.

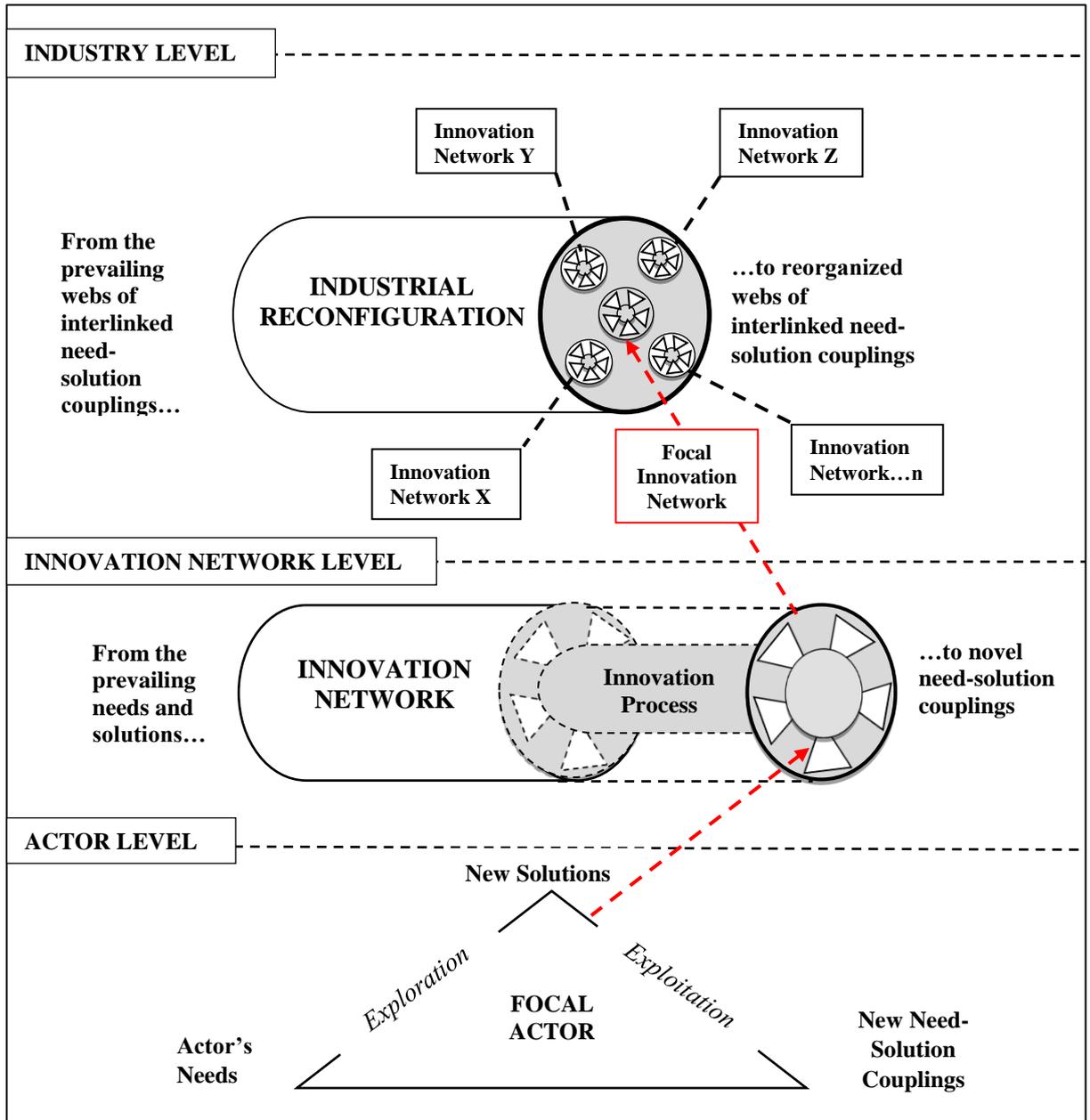


Figure 1. The digital innovation process as a coupling of needs and solutions.

The actor, innovation network and industry levels bring different perspectives on the innovation process. The triangle at the actor level (at the bottom of the framework) displays how an actor *explores* and *exploits* solutions to meet their needs (see von Hippel and von Krogh 2016). In this instrumental meaning to couple with the need, the solution is located at the top of a single triangle.

The central panel of the framework describes the innovation process in terms of the innovation network. At the network level, the innovation process is a common platform that links together the actors and their attempts for need-solution coupling. The framework employs the concept of the innovation network to refer to those actors that participate in the innovation process (see e.g. Dhanaraj and Parkhe 2006). The interaction in the network is motivated by the actor's purposes to employ the innovation and innovation process as a solution to meet their needs (Nambisan et al. 2017; Svahn, Mathiassen, and Lindgren 2017; Parker et al. 2017; von Hippel and von Krogh 2016).

The upper part of the framework depicts the *reconfiguration of an industry* as a passage of time. The industry level is the broadest level of analysis in the framework, and compared to the innovation network level, the focus rises from interlinked need-solution couplings to webs of interlinked need-solution couplings that consider various actors within related industries. The idea of the reconfiguration of an industry builds on and synthesises terms, such as industry architecture (e.g., Kashan and Mohannak, 2016), business community (Markus and Loebbecke 2013), and service ecosystem (e.g., Vargo and Akaka 2012), to refer to dynamics that contextualise digital innovation. In the framework, the reconfiguration of an industry is an outcome of the focal innovation network, as well as various other innovation networks ranging from X, Y, Z to ...n. The other innovation networks produce substitutes and complements and thus affect the success and failure of the focal innovation (see Grover and Kohli 2013; Markus and Loebbecke 2013).

To summarise, the framework describes the innovation process as the coupling of needs and solutions with regard to the actor-, innovation network-, and interrelated industries-level dynamics. Thus, the framework builds on an inherently emergent idea of digital innovation that is well reflected in the recent writings on digital innovation (see

Nambisan et al. 2017; Svahn, Mathiassen, and Lindgren 2017) according to which the interplay between the technological and market dimensions is open-ended and shaped by multi-level contextual properties and behaviours of various market actors.

Research method

The research design of the study follows an abductive theory-building approach where knowledge is produced as a result of the continuous interplay between theory and empirical observations (Dubois and Gadde 2002). The theoretical framework (Figure 1) provided a general starting point that enabled rich inductive insights and empirically driven concepts to emerge from the data (Coviello and Joseph 2012). Particularly, the research framework directed the focus on exploring the needs of the variant actors as well as solutions that link with them. Thus, our focus was set on identifying the needs and solutions regarding the M-ad solution as well as needs and solutions regarding complements and substitutes for the M-ad solution. We implemented the theoretical framework in a longitudinal case study (Yin 2013) that comprised two stages. The first stage featured a three-year living lab study (2003-2005) that covered the actual innovation process for digital innovation, and the second stage in 2016 featured a subsequent evaluation of the process and its implications, as well as consideration of the failure with regard to developing substitutes and complementary products/services that took place after the process. This is why the focal case represents a failure: The M-ad solution was too early in the market, and later on, the other media solutions for such advertising superseded it. These case study analysis facilitated us to theorize the management framework for digital innovation (Figure 3).

The living lab study explored here focused on developing and testing a novel mobile advertising (M-ad) solution. Mobile advertising as a general concept is about tailoring advertising messages that are sent to and presented on identified mobile devices through a

wireless network (see e.g. Kim and Jun 2008). M-ad solution refers here to the specific system designed for sending mobile advertisements (M-ads), i.e., short message service (SMS) or multimedia messaging service (MMS) messages, to local consumers who had signed up to receive them. Three living lab experiments were organised during the summers of 2003, 2004, and 2005 in a Scandinavian city with a population of approximately 120,000. The experiments were organised as a large academic cross-disciplinary research project. In this practice-oriented development of an M-ad solution, the university research group (URG) set up the innovation network and became the coordinator (in other words, the hub actor). The other key actors were local retailers that would become M-advertisers and technological companies, including device manufacturers, operators, and technology providers (e.g., software companies).

The basic idea of the living lab research was that the new M-ad solution would be used by local retailers and would involve M-ads that were sent to the mobile phones or PDAs of interested consumers. If the consumers did not have a suitable device, they could borrow it from the research project, which made sure that anyone interested could participate in receiving the M-ads. The M-ad solution was continually developed based on feedback from technological companies, customers (i.e., retailers) and consumers, and the URG experience and usage statistics. A total of 69 local retailers utilised the M-ad solution during the three experiments. The retailers created 184 individual M-ads, which were collectively sent 12,190 times to consumers during the second and third trials. The first field trial was excluded from the statistics, as the system employed at the time did not store this information.

The data were gathered through thematic interviews (Arksey and Knight 1999), recorded personal observations, and e-mail exchanges. The first set of interviews was conducted with 11 potential M-advertisers (see Table 1), that is, local retailers that were

members of the City Center Association, to gather information on their thoughts and expectations for the new M-ad solution.

Table 1. List of interviews with potential users of M-advertising

| Line of retail / organisation | Duration | Interviewee(s) position | Time period of the interview |
|-----------------------------------------|-----------------|--------------------------------|-------------------------------------|
| Fish Shop | 40 min. | CEO | Before 1st FE |
| Restaurant and Program Services Company | 25 min. | CEO | Before 1st FE |
| Clothing Store I | 35 min. | Shop manager | Before 1st FE |
| Cafe and Pub | 25 min. | Restaurant manager | Before 1st FE |
| Deaconesses' Institution | 25 min. | Property manager | Before 1st FE |
| Spa and Restaurant | 20 min. | CEO | Before 1st FE |
| Bank | 25 min. | Property manager | Before 1st FE |
| Consulting Firm | 25 min. | CEO | Before 1st FE |
| Insurance Company | 30 min. | Regional director | Before 1st FE |
| Restaurant A | 30 min. | Restaurant manager | Before 1st FE |
| Restaurant B | 30 min. | Restaurant manager | Before 1st FE |

The second set of 55 interviews was conducted with 43 selected retailers (some were interviewed two or three times) who employed the new M-ad solution and became M-advertisers during the field experiments (see Table 2). The interviewees were selected to include a diverse set of retailers (e.g., in terms of their activeness/inactiveness during the experiments, their fields of business, and size) to obtain multifaceted data on their perceptions of the M-ad solution usage situations, purposes, and benefits.

Table 2. List of interviewed retailers

| Line of retailing / organisation | Interviewee(s) position | Time period of the interview |
|----------------------------------|---------------------------------|------------------------------------------------------------------|
| Advertising Agency 1 | Assistant | After 2 nd Field Experiment (FE) |
| Advertising Agency 2 | Owner | After 2 nd FE |
| Advertising Agency 3 | CEO | After 2 nd FE |
| Advertising Agency 4 | Copywriter and Graphic designer | After 2 nd FE |
| Advertising Agency 5 | Owner | After 2 nd FE |
| Advertising Agency 6 | Art Director and Director | After 2 nd FE |
| Advertising Agency 7 | Owner | After 2 nd FE |
| Advertising Agency 8 | Managing director | After 2 nd FE |
| Art Museum | Press officer and Assistant | After 2 nd FE |
| Bakery | Office manager | After 1 st FE |
| Book Store 1 | Shop manager | After 1 st FE and 3 rd FE |
| Café and Pub | Restaurant manager | After 1 st FE |
| Clothing Store 1 | Shop manager | After 1 st FE and 3 rd FE |
| Clothing Store 2 | CEO | After 1 st FE |
| Book Store 2 | Advertising manager | After 1 st FE and 2 nd FE |
| Clothing Store 3 | Administrative manager | After 1 st , 2 nd , and 3 rd FE |
| Cooperative | Communication manager | After 2 nd FE |
| Dental Clinic | CEO | After 3 rd FE |
| Design Shop | Shop manager | After 1 st FE |
| Electrical Supplies Shop | Shop manager | After 1 st FE |
| Furniture Shop | Owner | After 2 nd FE |
| Gift and Decoration Shop | Two owners | After 2 nd FE and 3 rd FE |
| Hairdresser | Hairdresser | After 1 st FE |
| Health Store | Shop manager | After 2 nd FE and 3 rd FE |
| Hobby Shop | Marketing manager | After 3 rd FE |
| Insurance Company | Communication manager | After 1 st FE and 3 rd FE |
| Jeweller | Two shop managers | After 1 st FE |
| Leather Goods Shop | Shop manager | After 1 st , 2 nd , and 3 rd FE |
| Mobile Applications | Manager | After 2 nd FE |
| Mobile Phone Store | Shop manager | After 2 nd FE |
| Movie Store | Shop manager | After 2 nd FE |
| Music Store | IT support | After 2 nd FE |
| Nightclub | CEO | After 1 st FE |
| Nightclub and Restaurant | Restaurant manager | After 3 rd FE |
| Oriental Restaurant | Owner | After 1 st FE and 2 nd FE |
| Physiotherapist | Marketing manager | After 3 rd FE |
| Restaurant 1 | Trainee | After 1 st FE |
| Restaurant2 | Restaurant manager | After 1 st FE |
| Restaurant Chain | CEO and Secretary | After 1 st FE |
| Science Center | Trainee | After 3 rd FE |
| Shoe Shop | Shop manager | After 2 nd FE |
| Telecommunications Co. | Office manager | After 2 nd FE |
| Travel Agency 1 | Customer service manager | After 2 nd FE |
| Travel Agency 2 | Customer service manager | After 3 rd FE |

Finally, the third set of 13 interviews involved representatives of the URG and the technological companies during the research project (see Table 3) to map how the M-ad solution had met the expectations and contributed to the goals and activities of these parties.

Table 3. List of interviews with the representatives of the research group and technological companies

| Organisation | Duration | Interviewee position | Time period of the interview |
|------------------------------|-----------------|-----------------------------|-------------------------------------|
| Technology Provider I | 25 min. | Sales director | Before 1st FE |
| Technology Provider II | 40 min. | CEO | Before 1st FE |
| Device Manufacturer I | 30 min. | Regional sales manager | Before 1st FE |
| University Research Group | 75 min. | Research director | Before 1st FE |
| University Research Group | 35 min. | Professor I | Before 1st FE |
| University Research Group | 30 min. | Professor II | Before 1st FE |
| Operator (representative I) | 30 min. | Director | After 1st FE |
| Operator (representative II) | 45 min. | Development manager | After 1st FE |
| Technology Provider I | 20 min. | Sales director | After 1st FE |
| Device Manufacturer II | 50 min. | Product manager | After 1st FE |
| University Research Group | 60 min. | Project manager | After 1 st FE |
| City Center Association | 60 min. | Executive manager | After 3 rd FE |
| Device Manufacturer II | 50 min. | Senior technology manager | After 3 rd FE |

The selection of the interviewees was based on the need to capture an extensive set of perspectives and experiences from different actors involved in the M-ad solution. The chosen interviewees thus represent a variety of different types of retailers, technological actors, and URG researchers which enables access to versatile and widespread data helping us to form a complete picture of the M-ad innovation process. In total, we conducted 79 interviews, and they lasted 30–60 minutes. All interviews were audiotaped and transcribed verbatim.

One of the authors worked as a researcher on the project and was responsible for the practical organisation of the M-advertising, a role that offered access to a variety of information. Observation data were collected during the living lab experiments, for example, when recruiting and training the retailers, and while solving their everyday problems related to M-advertising. The researcher also received all e-mails sent between project personnel and individual retailers, and answered their telephone calls. All this provided an opportunity for observation and informal discussions with the retailers, and thus aided gradual growth in understanding of the

research phenomenon. Although there is a risk of subjectivity in using such personally loaded data, risk was mitigated by using researcher triangulation throughout the research process, and the observation data were used only to improve the general understanding of the research phenomenon. Thus, the observational data were used as complementary data and were not systematically analysed as the interviews were.

The living lab setting facilitated the study of the digital innovation process in a genuine user environment and provided insights into the interactions and differing contextual settings for the actors engaged in the innovation process. Thus, the living lab setting comprised the first phase in this study as the setting provided rich data on the individual- and innovation network-level dynamics. In the second phase of the case study, we evaluated the innovation process afterwards in 2016 with the aim to investigate the temporal dimension and the dynamics that followed the innovation process and the generation of complementary products or services and substitutes of the M-ad solution. This subsequent evaluation provided a deep insight into why the diffusion of smart phones (complement) was not sufficient at the time to give new rise to the digital innovation in circumstances where other marketing channels in social media (substitute) had developed a lot and superseded the M-ad solution.

The case study analysis

The initial idea for developing the M-ad solution originated from a professor of computer engineering at a Scandinavian university (hereafter, the research director). His ambition was to implement a project that facilitated the testing and piloting of new mobile services in a real end-user environment and to conduct a simultaneous multi-disciplinary academic investigation. Having engaged the key individuals and faculties required to establish a substantial project, the multi-disciplinary URG was formed and constituted the core of the project. Even though the

project involved different types of mobile services, this study focused solely on the M-ad solution as it represents a case that most clearly illustrates the phenomenon under investigation.

The first task for the URG was to set up the technological and user frameworks for realising the M-ad solution. The technological companies were actors such as technology providers, software companies, operators, and device manufacturers with appropriate resources to build the technological infrastructure for the M-ad solution. Given that the digital innovation to be developed provided a potential means for advertising, it was only natural that users would be firms that might actually employ the solution in their marketing communications. The users were 69 local retailers situated in the city centre that could use the M-ad solution in their marketing communications. The URG and the technological and user companies constituted the innovation network.

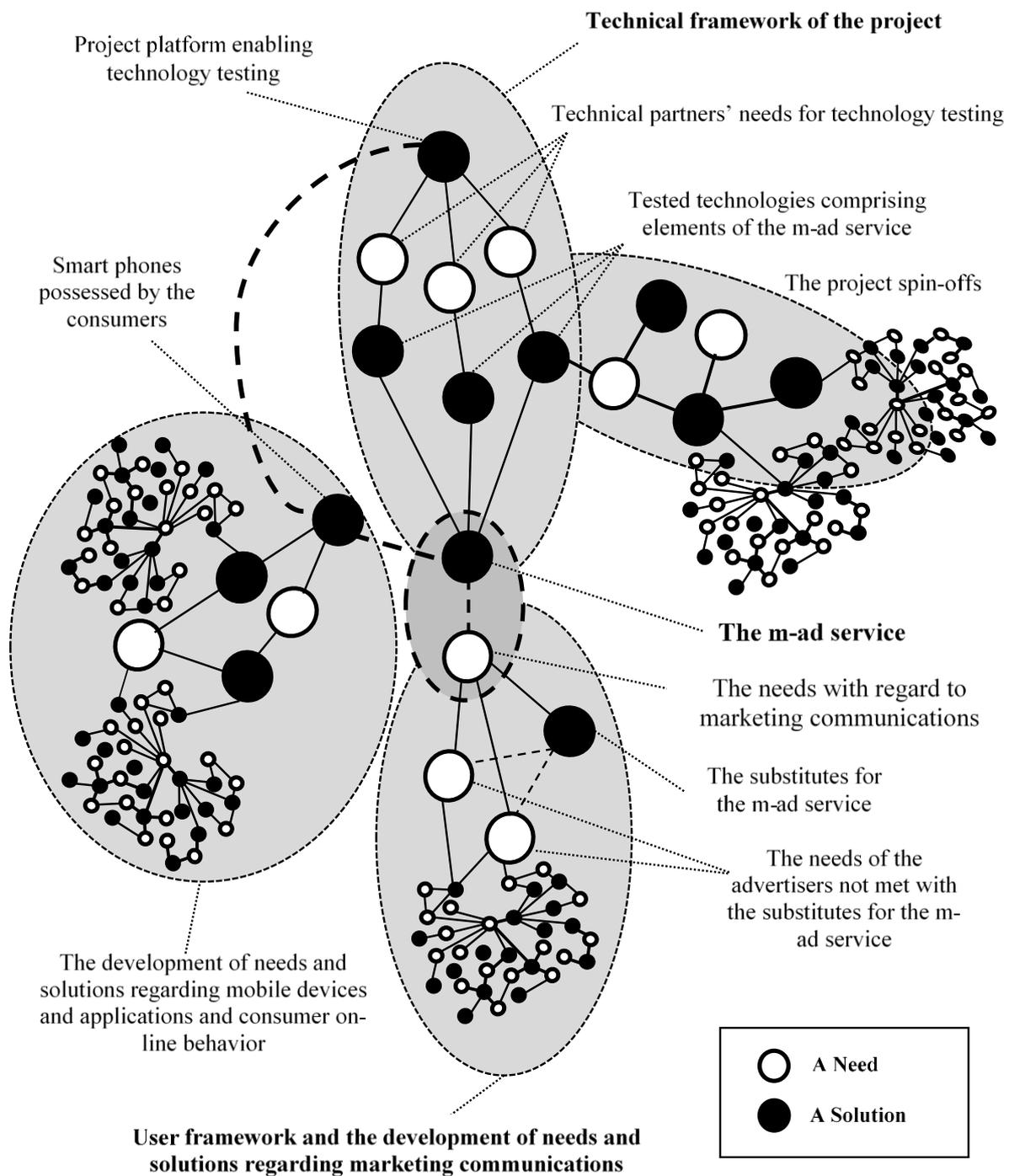


Figure 2. Need-solution representation of the M-ad innovation process.

Figure 2 describes how the innovation process featured solutions for technological and user companies and how these solutions linked to the companies' other current and potential

needs and solutions. The upper part of the figure describes the technological framework of the project that provided the technological infrastructure required for the solution. For the technological companies, the project was a concrete solution providing testing of platform-enabling technology. All the technology companies had some needs in this respect, and thus, by bringing their technologies into the innovation process for testing purposes, the companies simultaneously brought in the elements comprising the technological framework of the M-ad solution. The senior technology manager of a device manufacturer stated, 'All along you have known that you can bring in new things to be tested, and all the time you have the feeling that this works well. It has a solid base, and it has always brought us the results we've been looking for.' The sales director of Technology Provider 1 stated, 'We've had feedback on our product development and improvement suggestions, and good ideas on how we should develop our software.'

The lower part of the figure represents the user framework of the project. The user behaviours and authentic user feedback formed the core of the technology testing. While using the solution, the users simultaneously contributed to the technology testing. The owner of a gift and decoration shop (a user company) said:

It has been great. And also the other way round, we have really tried to make a contribution ourselves, too. We thought that if we can do something for the project, it's great because we have got so much out of it.

These two sets of actors (technological and user companies), their needs, and the solutions developed gave rise to the innovation concept, the M-ad solution, and its use as a marketing communication tool in a real-life context. Ultimately, the URG's role was to manage and control the digital innovation process and maintain all parties' involvement by facilitating the matching of needs and solutions to become need-solution couplings. The research director of the URG stated:

Again, we get back to this broad research setting and framework. We have focused on developing and running it and at the same time enabling all the partners to influence it. We have had many crazy ideas from different partners about what we could do, but then we have to prioritise them.

In theoretical terms, the emergent needs and the evolving respective solutions formed need-solution couplings that fed and directed the innovation process. However, the needs and solutions that converged during the process were only indirectly related to the innovation concept, the M-ad solution as a marketing communication tool. For most of the technical partners, the innovation process was a solution for their need to test their own technologies and applications which were not particularly developed for the M-ad solution but for use in different solutions. These actors were not primarily interested in developing particular technologies for the M-ad solution or in building it as a commercial solution. Although users perceived M-advertising had many features (e.g., targetability, reachability, accuracy, ease of use, and cost-effectiveness) that were promising and may even have led M-advertising to outperform the traditional marketing channels, for most of the users, the innovation process was a route to gain positive publicity and develop their businesses for free.

The reason technology and user companies were not initially motivated to participate in the project with their primary goal to utilise the M-ad solution as a marketing communication tool was simple: The prevailing circumstances at that time, especially the low penetration rate of smart phones with the capability to receive M-ads, hindered uptake of the M-ad solution. The art director of Advertising Agency VI stated:

This is the problem: Different mobile devices are brought to market, but people don't buy them fast enough so it's unprofitable to do it [M-advertising]. Secondly, we need to get all the wireless networks and connections and everything to work properly.

Specifically, the majority of consumers did not possess a smart phone capable of receiving M-ads. This was a major flaw that contributed strongly to making the solution inadequate for true implementation. This element is described in Figure 2 as a component that links to the solution. In other words, smart phones comprised a complementary solution that was an essential gateway to meeting the advertisers' needs. This element was central to the viability of the solution, and consequently, the goal of introducing the M-ad solution as a new mobile advertising innovation was never attained. When public funding expired after a three-year period, other funders withdrew from the project. As a result, development of the M-ad solution also halted.

Figure 2 depicts the possession of smart phones as a crucial element that links to the M-ad solution. This market-level analysis facilitates understanding of why the later diffusion of smart phones did not give rise to the M-ad solution. Despite the low ownership rate of devices capable of receiving the M-ads being a single critical factor leading to the abandonment of the development process and the failure of M-ad solution, the current high penetration rate of smart phones has not provided a new opportunity for the solution. The idea of the M-ad solution in the form of multimedia messages sent to a mobile phone is not as unique and tempting today as it was during the project. Various other digital channels, social media platforms, and measures for marketing analytics have developed which outperform the M-ad solution as a means of marketing communications.

Although the innovation process did not lead to a commercially viable product, the process facilitated the emergence of new needs and respective solutions, and their convergence in areas other than those directly related to the M-ad solution. With regard to the technical partners, most felt that the project had produced useful information concerning emerging technologies and products, and thus, facilitated further development. This is illustrated in the

two following comments from participants in the project. The senior technology manager of Device Manufacturer II said, ‘In my opinion, this project has very successfully combined the development and testing of mobile multimedia services in a real user environment with multifaceted scientific research.’ The sales director of Technology Provider I said, ‘We have received a lot of feedback about the usability of our technology and some ideas for product development as well.’

Despite the failure of the innovation concept of the M-ad solution, the project was capable of producing solutions that coupled with needs outside the M-advertising context and thus, altered the market dynamics in related fields. On the right side in Figure 2, spin-offs regarding the project are depicted. These emerging technologies and ideas related to the project materialised in solutions, such as a wireless network named panCITYX that was developed during the project and was shown to adequately lead to the convergence of supply and demand. When the project outcomes were evaluated, this network was one of the most remarkable and important societal achievements resulting from close cooperation between the URG and its partners. Currently, panCITYX is a wide-ranging open wireless network enjoyed daily free of charge by citizens and has contributed to the positioning of CityX among the world’s Top Seven Intelligent Communities in recent years.

Discussion

The article synthesises a perspective that balances the technological and market dimensions of the digital innovation process and puts forward a management framework for digital innovation. The current article presents two main contributions. First, the article provides a partial response to the explicit calls for novel strategic frameworks that capture the particular nature of digital innovation and its development process (Nambisan et al. 2017; Yoo, Henfridsson, and Lyytinen 2010). Second, the article explicates the market dimension of digital innovation in particular

and extends the analysis of the market dimension from a limited view of customer information and user knowledge (see Abrell et al. 2016) to cover the needs, actions, and behaviours of various market actors directly or indirectly using, complementing, or substituting the innovation and innovation process. Thus, the article elaborates the recently proposed ideas for further research on digital innovation as an entity at the cross-roads of markets and technology (see Nambisan et al. 2017) and systemises them into a management framework.

The notion of need-solution coupling and a multi-level theoretical framework based on that concept provided flexibility to explicate how the market dimension forms an inherent complement for the technological dimension in the innovation process. The idea of the innovation process as a multi-level coupling of needs and solutions and respective actors' behaviours embedded in a multi-level context was clearly identified in the case study. The actors engaged in the process for various reasons and aimed at employing the innovation and the innovation process as a solution to meet their needs. At the innovation network level, the idea of reciprocity developed as the innovation process progressed further, and the actors' ambitions for self-gain were complemented by the purposes of the common good of the innovation network and for its continuance. The innovation network was surrounded by a dynamic context of interrelated industries comprising other innovation networks producing substitutions and complements for the focal innovation. The dynamics of the other innovations substituting and complementing the focal innovation contextualise and influence the process outcome: the failure to launch the M-ad solution.

Figure 3 presents a management framework for digital innovation. The case study findings on the dynamics regarding the actors, innovation network, and interrelated industries are focused from the viewpoint of how to manage the focal innovation and the digital innovation process.

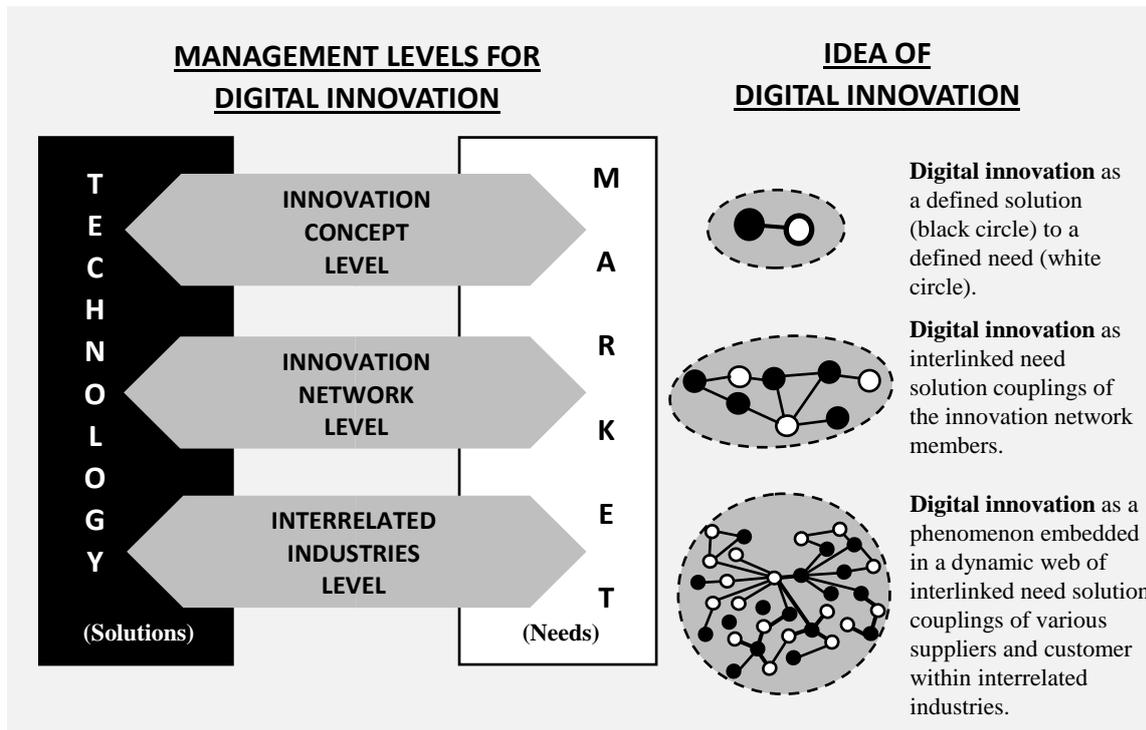


Figure 3. The management framework for digital innovation.

The levels of innovation concept, innovation network, and interrelated industries feature key levels of interest at which the technology-market interplay is to be taken into account in management. The right side of the framework provides a graphical illustration of the need-solution couplings for each level.

The issue of which form the solution takes and the benefits it brings to the customer comprise the innovation concept. Thus, the innovation concept defines the key solution, the key need, and their mutual fit. The M-ad solution represents an innovation concept: The solution articulates a defined solution (the communications technology, the respective devices, and the technological infrastructure) and a defined need (the retailers' marketing communications needs). At the time of the innovation process, the innovation concept was not viable; consumers

did not possess phones capable of receiving the M-ads, and thus, the M-ad did not comprise a marketing communications tool for retailers. The later development and diffusion of smart phones and tablets did not give rise to M-advertising as other solutions developed simultaneously had already generated better options for advertising consumers via social media platforms. The innovation concept did not represent a viable need-solution coupling (cf. Nambisan et al. 2017; von Hippel and von Krogh 2016).

The management in terms of the innovation concept is a framing issue: the definition of what needs the innovation targets and how. The framing should be an open, reflexive, and participatory process in which the potential of the emerging technology to meet different types of needs is continuously monitored and improved. For example, a company producing mobile advertising solutions could consider to have a variety of innovation concepts some of being full service concepts while some may comprise a platform or tools for a customer to design and conduct mobile advertising more independently as a self-service.

Analysis of the innovation network level generated understanding of the participation of the actors in the innovation process. Although the innovation concept was perceived as not viable in the focal M-ad solution case, the actors participated in the innovation process because of the other benefits it offered for them. For technology companies the technology testing, and for retailers the options for developing in collaboration with the university were perceived as worthwhile.

In connecting actors from distinct fields, the network of actors and their relationships comprise the core of innovation management (cf. Markus and Loebbecke 2013). The previous research on digital innovation has explicitly described the idea of the innovation network to resemble loosely coupled coalitions rather than a clearly defined and organised set of actors to realise the innovation (Pagani 2013). The idea of the innovation process as an emergent, multi-

level need-solution coupling process further develops the idea of the innovation network for digital innovation. The framework in Figure 3 sets the focus on the emergence and coupling of variant needs and solutions linked to the innovation process in the network. In this sense, the managerial action in the innovation network resembles orchestration (Dhanaraj and Parkhe 2006; see also Nambisan et al. 2017) which facilitates the actors in identifying needs and solutions regarding the innovation process and matches them for the benefit of themselves and the network (see Parker, Van Alstyne, and Jiang 2017).

The orchestration in the case study was about the actions of the hub actor (the URG) in creating and strengthening the mutual relationships between the actors in the innovation network to support their interactions and guiding and shaping the interactions to contribute to the innovation development. In this study, it was evident that many of the benefits were related to the innovation process, not to the innovation under development itself. This raises a managerial issue of how the innovator should facilitate the innovation process- and the innovation-related benefits, in terms of timing the process. These two type of benefits are the key to engage the relevant actors to the innovation process as well as improve its viability on the market. Process-related benefits might be critical during early phases of the innovation process, but they are a secondary consideration, and the innovator's resources put into its involvement should not detract from the creation of innovation-related benefits. Ultimately, innovation-related benefits are most crucial for the emergence of innovation, that is, for the viability of the innovation concept. The proposed concept of need-solution coupling facilitates the managerial task of identifying and creating the sources of benefits regarding the process and the innovation.

The broadest level of analysis for interrelated industries refers to the other innovation processes and other innovation networks that produce complementary solutions and substitutes

for the focal innovation. This study shows how some of the technology companies were able to leverage their M-advertising-related technologies to tackle opportunities outside the M-ad innovation. In this sense, these technologies comprised complementary ideas related to other innovation processes in other innovation networks. Similarly, the development of social media marketing, a result of variant developments in numerous innovation processes and networks on a global scale, replaced the idea of M-advertising as a potential marketing communication concept. In terms of management, innovation is to be managed and posited according to this far-reaching web of need-solution couplings and its continuous dynamics. The identification of dynamics generating complements and substitutes and their incorporation into the digital innovation process is a principle for success. It is also crucial to identify and understand the parallel developments in other innovation networks for which the focal innovation could produce a critical complement and consider these dynamics with reference to the innovation concept.

Conclusions

The study discusses the special characteristics of digital innovation and sketches a research framework that provides a balanced perspective on the technology and market dimensions of digital innovation. The case study supported the idea of multi-level scrutiny and the conceptualisation of the innovation process in terms of need-solution coupling. Based on the case study, we put forward a management framework for digital innovation. The framework emphasises the innovation concept, innovation network, and interrelated industries as key arenas for innovation management. The innovation concept is a framing issue: what the innovation is and which user needs it satisfies. Innovation management of the innovation network level is about value facilitation for the actors participating in the process: how to improve the innovation process capability to satisfy the needs of the participating actors to engage them in the process. The interrelated industries represent the broadest management

level. It is about identification of substitutes and complementary solutions that affect the innovation, as well as the identification of areas where the innovation may complement some other innovation.

The article contributes by providing a partial response to the explicit calls for novel strategic frameworks that capture the particular nature of digital innovation and its development process. Furthermore, the article explicates the market dimension of innovation and extends the analysis of the market dimension from the limited view of customer information and user knowledge to include the needs and those actions and behaviours of various market actors directly or indirectly using, complementing, or substituting the innovation and innovation process.

The scope of this study imposes some limitations and opens avenues for further research. The context of the study was specific in representing a public-private collaboration, and the study was different from a purely commercial project launched by a business organisation instead of a university. Thus, the emphasis of these findings might differ in other contexts. In addition, not all products and services in the business-to-business context are as strongly connected to the consumer as in the studied case. This is because ultimately the consumer market and the limited possession of smart phones at that point in time were crucial factors that limited the success of the M-advertising solution examined in this study. Care must therefore be exercised in suggesting more specific areas and implications that may be derived from this study. Further cross-sectional research is required to define contextual differences regarding industry specifics. However, at the theoretical level, the conceptualisations provided might be carefully considered universal, and generalised to some extent to other types of contexts.

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