WHICEB 2020 Proceedings                 Wuhan International Conference on e-Business

Summer 7-5-2020

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# Digital Innovation in Organizational Research: A Systematic Review

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**Abstract:** As digital technologies penetrate and integrate into the industry, organizations are facing increasing pressures to apply digital innovation to update and transform their business models. To meet the growing need to guide the practice of digital innovation, progress have been made in the theoretical work of digital innovation management. However, due to digital innovation literature is increasing rapidly in recent years and research in different fields and disciplines is so fragmented, scholars are hard to have a general picture of digital innovation research. For the purpose of addressing this gap, this study tried to provide roadmap for the DI studies by answering the those questions: how digital innovation research evolved over time, how to understand the concept of digital innovation, and what research streams and opportunities exist in current digital innovation research. We conducted a systematic review with a hybrid methodology composed of bibliometric analysis and content analysis, covering the period 2010–2019. Results show that the current digital innovation research covers four perspectives: (1) connotation, process and outcome, (2) strategy, (3) resources, (4) organization and culture. Furthermore, we concluded research questions and opportunities for future research in different research fields.

Keywords: digital innovation, digital technology, innovation management, systematic review

## 1. INTRODUCTION

In the digital era, digital technologies are utilized by organizations to innovate products and services, business processes, or business models. Digital Innovation (DI) is challenging both theories and practices in organizational research，and scholars call for more research on it. Hence, a multitude of DI research springing up in the last ten years has made some achievements, in information systems, strategy management, innovation management and other organizational research fields, including product architecture for organizing DI [1], service-dominant logic of service innovation [2], value space framework explaining the value creation and capture in DI and so on [3]. With their great works, it is essential for the subsequent researchers to have a general picture of existing research, especially influential works, to further DI research.

DI management research substantially can be classified into innovation management research, which revolves around organizations. Therefore, the core issue of DI management is still the interaction between DI and organization. However, the studies of DI in different fields and disciplines are so fragmented that DI literature in organizational research are difficult to be understood clearly and comprehensively. Kohli and Melville (2019) tried to deal with this gap in their literature review, and the theoretical framework they proposed is helpful to understand actions and outcomes of DI [4]. Nevertheless, account of the rapidly increase of DI literature and the fact that some emerging literature cannot be simply integrated into the theoretical framework of "innovation actions and outcomes", it is still unclear what we know about DI in totality.

For the purpose of addressing this gap, this study made a systematic literature review on DI research. Differing from previous reviewing works, we focused on the theme of "digital innovation and organization" from perspective of innovation management, and tried to answer following research questions: how DI research evolved over time, how to understand the concept of DI, and what research streams and opportunities exist in current DI research?

The rest of the paper is organized as follows. The second section refers to research methods and explains the methodological procedures of the systematic literature review in detail. In the third section, through

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bibliometric analysis, we present how DI research theme evolved. In the following section, main findings and discussions on definitions, research streams and opportunities of DI are concluded with the help of content analysis. The paper ends with a brief summary of contributions, limitations and future research.

## 2. RESEARCH METHODS

Systematic reviews start by defining a review protocol. A pre-defined protocol is necessary to reduce the possibility of researcher bias [5]. In general, review protocol includes: research background, research questions, search strategy, study selection criteria and processes, data extracting and synthesis. Figure 1 depicts the main stages in our research.
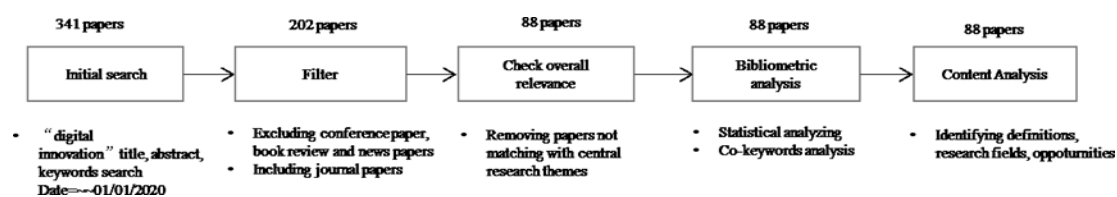
| 341 papers | 202 papers | 88 papers | 88 papers | 88 papers |
|---|---|---|---|---|
| **Initial search** | **Filter** | **Check overall relevance** | **Bibliometric analysis** | **Content Analysis** |
| • "digital innovation" title, abstract, keywords search Date=~-01/01/2020 | • Excluding conference paper, book review and news papers • Including journal papers | • Removing papers not matching with central research themes | • Statistical analyzing • Co-keywords analysis | • Identifying definitions, research fields, oppoturnities |

**Figure 1. Phases of systematic literature review**

### 2.1 Search strategy and selection criteria

The main academic bibliographic database for the search was 'Web of Science (WoS)'. To ensure the direct relation of results with DI domain, the review is performed in studies only where the phrase 'digital innovation' is found in their title, abstract or keywords. Moreover, the search duration is between years of 2010-2019. Based on this search criterion, 341 articles were returned from WoS database. Duplicate articles, conference papers, book reviews were removed which left a total of 202 articles. The abstracts of articles were then reviewed to ensure their relevance to the focus of our theme. Some articles despite containing the "DI" in the title or abstract or keywords, actually are not relevant to our research theme, are excluded, such as articles on education innovation, finance innovation. This led to a final sample of 88 articles that were reviewed in this study.

### 2.2 Bibliometric analysis procedures

Bibliometric analysis can generate quantitative information from a large number of historical document data using statistical and social network analysis [6]. Firstly, we obtained the number of published articles by journal and year which help us to analyze how the publications evolved over time. And then, presuming that the more it is cited, the greater the influence it has on a given field of research, we listed the most- cited articles from the sample. Finally, by using author-selected keywords' analysis, we could obtain summary important information from studies without access to full-text studies.

In addition, to determine the research themes in DI, the author-selected keywords network of the 88 papers were analyzed. Network structure was based on the following scenario: keywords were chosen as the vertices and co-occurrence of two keywords in an academic paper was defined as an edge of network. Analysis of keywords network was performed by Gephi 0.9.2 tool. The keywords network considering two periods of analysis (2010–2015, 2010– 2019) was used to identify emerging concepts associated with DI research.

### 2.3 Content analysis procedures

In this stage, we designed a data extraction form in order to record all the information accurately. The research steps are presented as following. In the first step, we extracted the definitions of DI given by the 6 articles from the list of 17 articles more than 10 times-cited. To better understand these definitions, comparisons are made by dividing them into two categories according to the common characteristics presented in the definitions. This process was performed by reading each study carefully.

In the second step, we identified research filed of current DI literature. There are different frameworks for

research classifications in the innovation management area. Inspired by the outstanding work of Chen and Zheng (2016) in innovation management [7], we extracted five key elements: research perspectives, research fields, research questions, representative contributions and opportunities for future DI research.

## 3.　BIBLIOMETRIC ANALYSIS

### 3.1　Descriptive statistics

The left picture in Figure 2 shows that the number of DI literature is increasing year by year. From 2010 to 2018, the increase was gradual, while in 2019 it became almost exponential. This reminds scholars that DI research is in a period of great concern. 10 most frequently cited journals published approximately 44% of the articles in sample. Results are presented in the right picture in Figure 2.
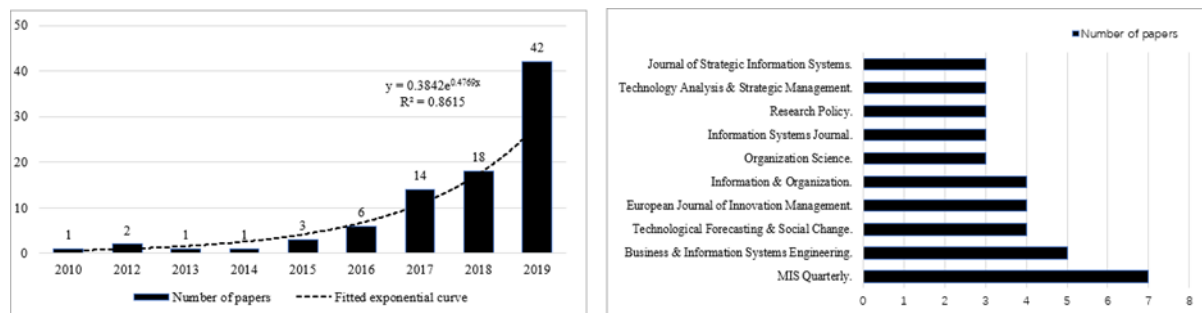


**Figure 2. Distribution of papers by publication and year.**

The right picture in Figure 2 shows that five of the 10 journals are belonging to the field of information systems, which means more attention has been paid to DI research from this field. But the top journals focusing on organization and innovation management, such as European Journal of Innovation Management, Organization Science, and Research Policy, are also following up the DI research.

**Table 1. List of the 10 most-cited articles in the sample**

| Author | Journal | Times cited | JCR(2018) | AIF |
|---|---|---|---|---|
| Lusch & Nambisan (2015) | Mis Quarterly | 291 | 4.373 | 1563.5 |
| Yoo et al. (2012) | Organization Science | 268 | 3.257 | 1140.9 |
| Yoo et al. (2010) | Information Systems Research | 325 | 2.457 | 1123.5 |
| Nambisan et al. (2017) | Mis Quarterly | 93 | 4.373 | 499.7 |
| Nylen & Holmstrom (2015) | Business Horizons | 61 | 2.282 | 200.2 |
| Svahn et al.( (2017) | Mis Quarterly | 35 | 4.373 | 188.1 |
| Yoo (2013) | Journal Of the Association for Information Systems | 42 | 3.103 | 172.3 |
| Huang et al. (2017) | Mis Quarterly | 29 | 4.373 | 155.8 |
| Lee & Berente (2012) | Organization Science | 34 | 3.257 | 144.7 |
| Saldanha et al. (2017) | Mis Quarterly | 17 | 4.373 | 91.3 |

Presuming that the citation of a paper represents its influence, Table 1 lists the 10 most-cited articles and the calculation of their impact index ($A_{IF}$). $A_{IF}$ was proposed by Carvalho et al. (2013) and was calculated according to the equation: $A_{IF} = Citation * (JCR + 1)$ [8]. Although the work of Yoo et al. (2010) ranks third position in the list, they are pioneers in the study of DI. A lot of interesting and insightful concepts have been proposed by them, such as the Layered Modular Architecture of Product. Lusch & Nambisan (2015) offered a broadened view of service innovation based on service-dominant logic, which incorporate some concepts, such as DI, digital infrastructure and software-based platform, into a more general framework.

### 3.2　Keywords network analysis

In the following part of this study, we got the general situation of DI research with the analysis of keywords. The main content of our analysis includes evolution of keywords network, identification of communities, influential keywords under different research theme.

### 3.2.1　Evolution of keywords network and communities

From 2010 to 2015, there are 40 keywords extracted from 8 articles. Figure 3 shows that "Digital innovation" and "Service innovation" are in the central of the keywords network. During this period, connections among nodes in the same subgraph are relatively close, while connections among subgraphs are relatively loose. The situation changed in the period of 2010-2019: the size of keyword network has increased rapidly to 288 nodes due to the mushroom of publishing papers. The overall connectivity of the network was significantly higher than period from 2010 to 2015. The maximum connected subgraph covered 93.4% (269 nodes) of the total number of nodes. This shows that different research topics are more closely related. Due to the large number of nodes in Figure 4, nodes of network which degree is less than five were filtered. The size of nodes was distinguished according to the value of betweenness centrality. The betweenness centrality is used to measure the control of resources by nodes. Generally, greater betweenness centrality means stronger role it plays as a bridge.

### 3.2.2　Communities and influential keywords

We detect distinct communities in the network using the modular algorithm in Gephi. There are 5 components, and 21 communities in the Figure 4 (the modularity index is 0.6558), which represented the diversity in DI research. Five larger communities and the ratio of community size to the maximum connected subgraph size showed as following: digital innovation (20.82%), open innovation (14.87%), innovation (11.15%), case study (10.04%) and service innovation (8.55%). Nodes with higher degree centrality in each community are also listed in Table 2. The degree centrality is used to measure the importance of a node in the network. Greater degree centrality of a node means greater prestige or influence of it.

**Table 2. Representative keywords with high centrality in Top 5 communities**

| Community | Keywords (degree centrality in keywords network) |
|---|---|
| Digital innovation | digitization (46), digital transformation (13), IoT (12), new product development (10), digital business model (10), industry 4.0 (9), smart product (8), digital-physical (8), digital product and services (6) |
| Open innovation | open innovation (25), value creation (17), innovation process (15), social media (10), crowdsourcing (10), IT (10), innovation management (10), collaborative innovation (10), digital innovation ecosystem (9) |
| Innovation | innovation (23), digital (18), affordances (16), innovation practices (11), artefact (9), mobile payment (7) |
| Case study | case study (23), digital technology (20), building information model (9), organizational performance (9), capability (9). sustainability transformation (5), green IS (5), architectural practice (5), digital capability (4) |
| Service innovation | service innovation (24), business model (19), value co-creation (15), service-dominant logic (14), agency (10), resource integration (8), platforms (8), ecosystems (8) |

## 4.　CONTENT ANALYSIS

In this part, definitions of DI given by influential articles are discussed, and different research perspectives and research fields are identified. Content analysis helps us to figure out the answers of two important problems: (1) what are the similarities and differences in definitions of DI; (2) what are the research streams existing in DI studies, and what are the interesting research questions and opportunities in those streams.

### 4.1　Definitions of digital innovation

Two main viewpoints of how DI has been defined in the most influential studies are elaborated. The first classification of DI definition views it as the use of digital technology/IT in a wide range of innovations. The similarity of the definitions of DI given by the scholars is that they all recognized the importance of technology in the process of innovation. They consider that the use of technology can explain how and why the "same" technology can be repurposed by different actors or has different innovation outcomes in different context [9]. However, (1) although they all emphasized the technology in innovation, they did not reach an agreement on the

connotation of it, such as Nambisan et al. (2017) used the term "digital technology", Saldanha et al.,( 2017) noted that the technology means IT, and Shibeika & Harty (2015) did not specify the type of technology [9]-[11].
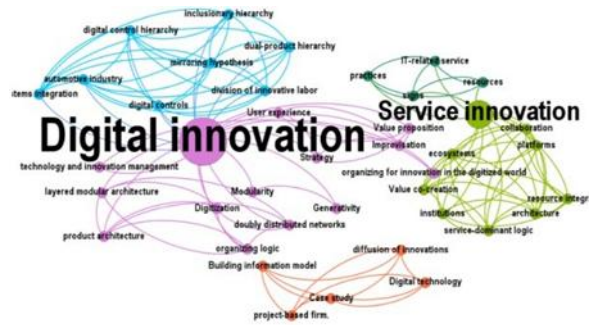


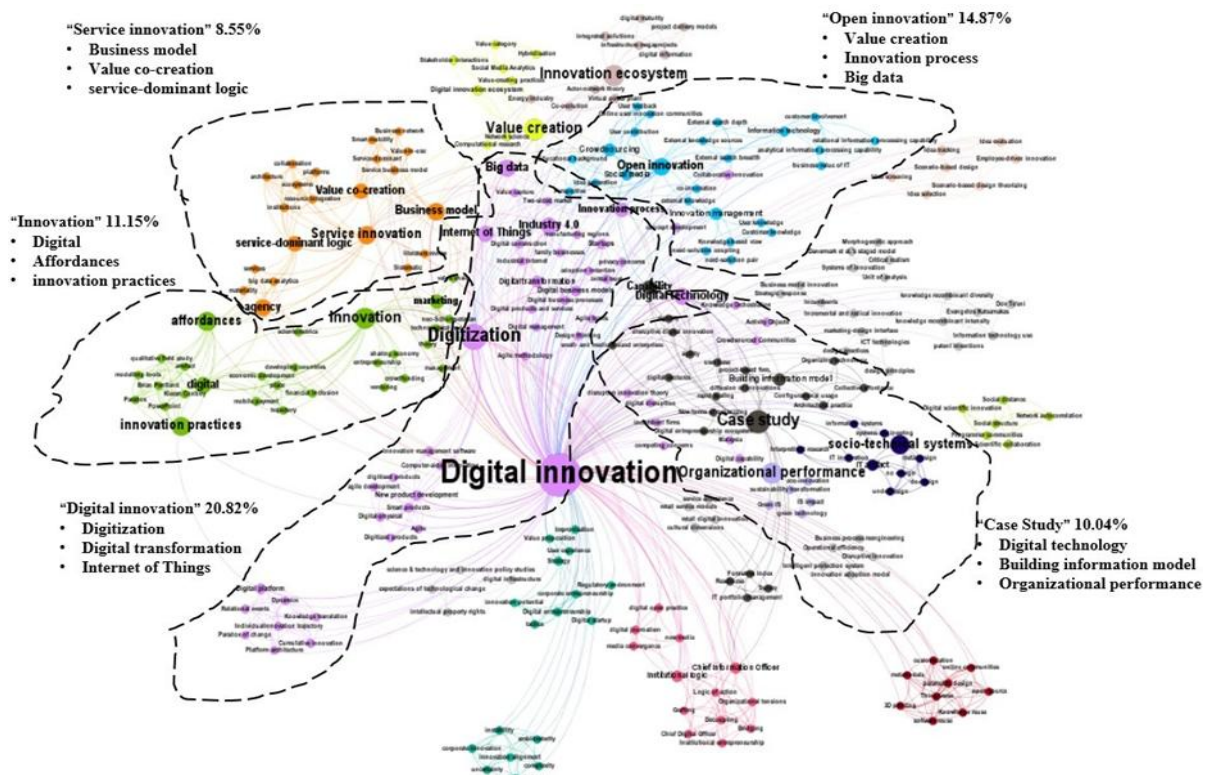**Figure 3. Keywords network from 2010 to 2015**



**Figure 4. Keywords network from 2010 to 2019**

The second classification of DI definition views it as a kind of recombination. The pioneering work of Yoo et al., (2010) emphasized the nature of innovation, "new combinations of digital and physical components to produce novel products" [1][13]. Their definition stressed the role of digitization which makes physical products programmable, addressable, sensible, communicable, memorable, traceable, and associable as the necessary but insufficient condition for DI [1][14]. And they also pointed out that DI is different from process innovation and implied a focus on product innovation [1]. However, the differences of other scholars who following this perspective lie in two aspects: (1) Huang et al., (2017) proposed that DI is both a process and an outcome, and he also proposed that DI needs to generate new value-in-use from the users' perspective[12]; (2) Henfridsson et al., (2018) pointed out that in order to better understand value creation and value capture in DI, not only design recombination but also use recombination should be considered[3]. The work of these scholars mentioned above developed and supplemented the view that "DI is a kind of recombination" defined by Yoo et al., (2010), especially the influential view of Henfridsson et al., (2018), which has been clearly supported by other scholars.

**Table 3. Definitions of DI and two classifications of them**

| Classifications | Definitions of digital innovation |
|---|---|
| Use digital technology/IT for innovations | • Nambisan et al. (2017): "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology"[9]. <br> • Saldanha et al.(2017) and Fichman et al. (2014): "broadly defined as a product, process, or business model that is perceived as new, requires some significant changes on the part of adopters, and is embodied in or enabled by IT" [10]. <br> • Shibeika & Harty (2015): "the technologies and associated digital working practices used for the management and delivery of projects in construction" [11]. |
| Recombination of digital and physical components | • Yoo et al. (2010): "the carrying out of new combinations of digital and physical components to produce novel products"[1]. <br> • Huang et al. (2017): "the recombination of digital components in a layered, modular architecture to create new value-in-use to users or potential users of a service"[12]. <br> • Henfridsson et al. (2018) : "the outcome of the activities by which a set of digital resources are recombined in both design and use through connections across value spaces" [3]. |

### 4.2 Research perspectives and fields in digital innovation

In following content, 88 DI articles are coded into diverse research perspectives and fields, with keywords of each article are classified into the corresponding perspectives. Four research perspectives, twelve fields and representative keywords with higher frequency identified in each perspective are listed in Table 4.

Insights can be revealed from Table 4: (1) The research perspective of connotation, process and outcome of DI have the largest number of papers in our sample, and then following order is organization and culture, innovative resources and strategy; (2) Research field of connotation, type and outcome of DI gained the most attention among twelve fields, which means the ontology of DI are concerned by scholars mostly. Table 5 shows more details about examples of research questions and corresponding contributions in each research field.

**Table 4. The distribution of research perspectives and fields**

| No# | Research perspective/ research filed (number of articles) | Keywords with high word frequency |
|---|---|---|
| I | Connotation, processes and outcomes (29) <br> • Connotation, processes and outcomes (23) <br> • Innovation diffusion process (6) | innovation, digital ventures, case study, disruptive innovation theory, digital technology innovation management software, new product development, adoption intention |
| II | Strategic perspective of innovation (13) <br> • Open innovation (5)     Innovation strategy (5) <br> • Innovation capabilities (2) Innovation Management (1) | open innovation, collaborative innovation, strategic response, incremental and radical innovation, ambidexterity, innovation alignment |
| III | Organizational & Cultural Perspectives of Innovation (26) <br> • Process management (17)Innovation system (5) <br> • The organizing forms (3) Institution and culture (1) | digitization, service innovation, innovation process, business model, value creation, innovation ecosystem |
| IV | Innovative resources perspective (20) <br> • Information and knowledge Management (14) <br> • Human resources management (6) | knowledge recombinant diversity, design thinking, knowledge-based view, customer knowledge, venturing |

### 4.3 Research opportunities

#### I. Connotation, processes and outcomes of digital innovation

• Connotation, processes and outcomes. Articles in Connotation, processes and outcomes of DI are more deductive which discussed how to comprehend the nature of DI, how to explain the value creation and value capture in the process of DI, and how DI has an impact on organizations. Some influential articles pointed out

the directions of future research. For example, Yoo et al. (2010) pointed a series of research questions related to the new strategic framework and IT infrastructure management of the organization, and Henfridsson et al. (2018) proposed that future research can focus on recombination of use and design in DI [1][3].

• Innovation diffusion process. DI is not only about the creation, but the diffusion. This research area focuses on process and influencing factors of innovation diffusion, which is not a new theme in innovation management. But in the context of DI, new theories and lens need to renew probably. For example, Shibeika & Harty (2015) suggested that there is a need to understand the diffusion of DI at the interface between the firm and the industry by understanding the dynamics and challenges of DI diffusion in relation to technology standards and best practice [15]. In addition, more other factors (from the perspective of inventor or adopter) influencing DI can be investigated and more theories (such as institutional theory) can be integrated into this field.

## II.  Strategic perspective of digital innovation

• Innovation strategy. In this filed, firms' strategic responses related to DI are the focus. Scholars discussed strategic contradictions caused by DI and how to adjust these strategies. We identified some opportunities for further research: (1) empirical patterns and intellectual tools need to be developed for understanding and managing the competing concerns faced by incumbents as they embrace DI [16]; (2) how incumbents may strategically respond to the challenges posed by the emergence and diffusion of digital technologies [17].

• Innovation capabilities. In this filed, the role of organizational capabilities in the process of DI was explored. Researchers concerned how firms build and improved capabilities taking advantage of digital technology or the carrier of digital technology (such as social media) to profit from DI. Two essays in this field are identified and authors suggested (1) scholars to empirically test, enrich and refine their conceptual framework[18] (2) and delve into other technology-related drivers of DI, such as technological culture [19].

• Open innovation. This field focuses on how companies use open innovation and benefit from it. The concepts of ecosystem, collaborative innovation and value network are often mentioned. We have identified opportunities for further research: (1) future work are encouraged to focus on operationalizing service-dominant business models through service compositions to support business processes [20]; (2) future research need to further the understanding of the dynamic and co-creation processes enable by digital technologies, such as the supply-demand interactions taking place in the value creation and capture processes in the digital economy [21].

## III.   Organizational & cultural perspective of digital innovation

• Process management. This area focuses on the coordination of elements and the optimization of their combination in DI processes and how digital technologies can be integrated into the innovation process. Future research should do more on: (1) the topic of the division of innovative labor, especially from a supplier perspective [22]; (2) how digital processes and product innovation are related and how they can be integrated in firms [23]; (3) the potential of digital technologies (such as Big Data Analysis Technology) in developing service automation and human-material service practices [24].

• Organizing forms. This area focused on how companies and the ecosystems they engaged in are organized to respond to DI. The emergence of new organizing forms, such as digital platforms, is affected by DI deeply. Hinings et al. (2018) proposed that "digital organizing forms"is one of the types of DI, which indicates some clues in this stream. However, more exploration is required in how the DI interacted with organizing forms [25].

• Innovation system. The evolution of DI ecosystem and the value creation in it are concerned in this field. Opportunities identified in this field: (1) how interactions between consumers sand stakeholders create value and whether it would be different in various context; (2) how to study the evolution of DI ecosystem using big data and advancing digital technology.

**Table 5. Research fields, questions and corresponding contributions**

| Research fields | Examples of research questions in this field | Corresponding contributions |
|---|---|---|
| **I:** Connotation, process and outcome | • How to understand DI and its impact on organizational logic? <br> • How to create and capture value in DI? | • A framework to describe the emerging organizing logic of DI. <br> • A framework to explain value creation and capture in DI |
| **I:** Innovation diffusion | • What factors influence in the adoption of innovations? <br> • How start-ups improve the diffusion rate of DI through business model design? <br> • How DI diffuse across complex firms? | • The impact of cultural dimension on global in-store retail innovations is empirically studied. <br> • The design strategy of business model. <br> • A range of activities and dynamics of a non-linear diffusion process are showed; |
| **II:** Innovation strategy | • How do firms manage competing concerns in DI? <br> • How do firms adjust business models to deal with the impact of DI? | • The strategies to deal with four competing concerns faced by firms. <br> • The elements of business model that enterprises should adjust <br> • to deal with technological innovation. |
| **II:** Innovation capabilities | • How to use social media to benefit from innovation? <br> • How to use digital technologies to benefit from products and services innovation? | • A conceptual framework of the capabilities allowing companies to benefit from social media. <br> • The driving factors of DI and its mediating role between the <br> • driving factors and firm performance are studied; |
| **II:** Open innovation | • How can organizations benefit from co-innovation ecosystem? | • The process of external knowledge acquisition under different collaborative innovation models are revealed. |
| **III:** Process management | • How to reconcile the opposite hypothesis in the division of innovative labor? <br> • How do companies manage the process of DI? | • Reconciled two competing views by distinguishing two different product hierarchies. <br> • A managerial framework supporting ongoing improvements <br> • in DI management; |
| **III:** Organizing forms | • How small medium enterprises achieve agility to respond to disruptive DI? <br> • How the Digital Entrepreneurship Ecosystem (DEE) is organized? | • A framework on agility. <br> • Eight processes around the themes of division of labor and integration of efforts in DEE; |
| **III:** Innovation system | • How the interactions create value in the DI ecosystem? <br> • How the DI ecosystem evolves? | • Value creation and its types in DI ecosystems are revealed. <br> • Two mechanisms of the evolution of DI Ecosystems. |
| **IV:** Human resources management | • What are the types of Chief Digital Officers (CDO) and the reasons why organizations adopt the role? <br> • How to find and management the digital project team for innovation? | • Domains where successful CDOs build digital capabilities and three types of CDO are identified. <br> • The role, empowerment, learning and leadership development <br> • in digital teams are identified. |
| **IV:** The information and knowledge management | • How do IT-enabled capabilities influence firms' ability to leverage customer involvement and shape the amount of firm innovation? <br> • What role of big data in the innovation process? | • Important complementarities between specific types of customer involvement and specific IT-enabled capabilities are found. <br> • Big data is the trigger and the enabler of the DI process. |

## IV.  Resources perspective of digital innovation

• Human resources management. The role of leaders (Chief Information Officers, Chief Digital Officers and IT experts), entrepreneurship and digital team is mentioned in this stream. Especially the study of digital teams is an emerging theme in innovation management. Future research can explore other human resource

management issues in organizations.

• Information and knowledge management. This field is about information and knowledge management in DI. There are 14 articles in this field which means relatively high outputs are generated. The knowledge-based view, organizational learning, signal theory and other theories closely related to knowledge and information management are mentioned. Opportunities identified in this field: (1) how the digital technology affects the knowledge management; (2) how companies take advantage of information and knowledge from another stakeholder's evolvement (such as customers and suppliers) in innovation process.

## 5. CONCLUSIONS

As digital technology continues to transform the landscape of the industry, research interests and activities on DI in organizations have been on the rise. This paper has provided a systematic overview of the DI research based on categories extracted from the extant literature, serving as a roadmap for the DI studies. Contributions of this study can be concluded into following aspects. First, evolution of DI research is revealed in this study. The amount of DI literature has increased rapidly in recent years, and the interaction among research fields and disciplines is getting deeper. This fact is also approved by the evolution of keywords network. Second, we compared and summarized the definitions of DI given in some influential papers with the conclusion of that the use of digital technologies and the recombination are two main viewpoints. Third, by referring to relatively mature innovation management framework, we classified the research streams of DI into four perspectives and twelve research fields. This provides reference for other researchers to further DI literature. Forth, we identified future research opportunities under each research fields.

The limitations of this article are articulated as following. First, some articles covering several research fields or perspectives are divided into one specific classification according to the focus of them, which may neglected the fusion among different research streams. Second, some new emerging research areas, such as institutional and cultural design of organizations, are also included in the innovation management framework. However, as only few literatures are classified into these areas, we do not specify them in this paper. Third, this study does not make further analysis on connections among research fields and future research are suggested to make more progress in this respect. Finally, the theories adopted in DI research need more analysis in future work.

## ACKNOWLEDGEMENT

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