

Article

Roadmap Incorporating Data Management Perspective for Platform Business Model Innovation

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Abstract: In recent business environments data has become crucial, especially in the platform business where advances in digital technology continuously increase the platform's value by facilitating user engagement and transactions that strengthen network effects and enhance the ability to access and analyze vast amounts of data. An important challenge for platform firms is, therefore, to establish a business strategy to address data-related issues for a sustainable competitive edge. However, research is surprisingly sparse to incorporate a data management perspective into a business model roadmap which has been widely used as a strategic management tool. In this paper, we argue that the platform business model roadmap integrating a data management perspective supports platform firms in identifying a change of direction and potential gaps that are aligned with the current and future context in terms of sustainability. The purpose of this paper is to suggest a concept of the platform business model roadmap and identify what structure should be incorporated considering the virtuous cycle of the platform and data. An in-depth discussion of the suggested platform business model roadmap is expected to be of high value in terms of practicality for the platform's sustainable growth.

Keywords: platform business; business model roadmap; big data; sustainable growth; strategic planning



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1. Introduction

Businesses are dealing with a barrage of data that requires a lot of their time and attention. Data is increasingly considered a corporate asset that can be utilized to make better-informed business decisions, improve marketing campaigns, optimize business operations, and reduce costs, all with the goal of increasing revenue and profits. Firms are capturing ever-larger volumes of data and a wider variety of data types, both of which are representative hallmarks of big data. In this regard, without good data management, such environments can become unwieldy and hard to navigate. The importance of data management is to guarantee the accuracy, accessibility, and timeliness of data generated or collected by a firm over its operational lifespan in order to obtain deep insights into customer behavior, trends, and opportunities [1].

This is particularly evident in the era of digital transformation where firms around the world are fostered to adopt platforms as technical infrastructures for exchanging products, information, and services [2]. A platform with fast-growing digital technologies continuously increases its value by facilitating user engagement and transactions that strengthen network effects and enhance the ability to access and analyze vast amounts of data. In platform ecosystems, network effects are the fundamental drivers of platform competition, defined as “the incremental benefit gained by an existing user for each new user that joins the network”. Strong network effects create “lock-in” mechanisms, that is, high switching costs that often shelter platform ecosystems from entry by standalone rivals [3] and thus drive competition between platforms to a “winner-takes-all” outcome [4]. These distinctive characteristics have ultimately made Alphabet, Amazon, Apple, Meta, and Netflix a platform business leading firm, successfully disrupting traditional businesses as

they transform existing value creation process and customer behavior [5]. In this situation, data works as an important player in supporting platform firms to achieve sustainable growth by maximizing network effects.

As the platform business has completely reshaped entire industries in only a few years, business model innovation has been emphasized to maintain a firm's competitive edge in the fierce competition with countless platforms. Explicitly representing the business model not only improves the understanding, communication, and analysis of its underlying logic [6] but also provides a basis for defining requirements for business model innovation [7]. In these circumstances, a business model roadmap that combines business model design and roadmapping concepts, is worth the effort. Business model roadmaps have been proposed and utilized as a strategic planning tool for business model innovation in both academia and practice. De Reuver, Bouwman, and Haaker [8] coined the term business model roadmapping as an approach to define the transition path from the current to a desired business model. They describe how operational actions and business model impacts are interrelated through the proposed approach. Toro-Jarrin, Ponce-Jaramillo, and Güemes-Castorena [9] presented a methodology for the building process integration of business model canvas and technology roadmap for generating and planning the business idea or new product concept. The proposed methodology allows the construction of a robust business strategy proposal in a structured mode which considers the benefits of each tool and reduces the disadvantages. Schaller, Vatananan-Thesenvitz, and Stefania [10] described the process of developing a business model innovation roadmap and identified what structure should be incorporated. Despite the great significance of previous works which organized relevant business model roadmap structure and developed roadmapping process, they have common limitations to the effective use in the context of the platform business in terms of the following two aspects.

First, existing business model roadmaps did not sufficiently consider the distinctive characteristics of the platform business: a virtuous cycle of platform and data in line with network effects. Therefore, strategic planning according to the cycle is iteratively required, instead of the horizontal timeline in the short-, mid-, and long-term. Moreover, appropriate strategies for maximizing network effects must be considered and included in the platform business model roadmap. Second, the research direction on platform business model roadmaps should focus on the role of data and digital technologies and properly incorporate them into the strategic planning process. This is, in fact, essential in platform business roadmaps, since a majority of business model innovations are mainly driven by big data and data analytics changing their platform attractiveness. It means that data should be considered not only as means for strategic planning but also as an important subject to be planned for in the platform business model roadmap.

In response, this paper proposes a concept of the platform business model roadmap with a relevant structure incorporating a data management perspective in line with network effects. To this end, the distinctive nature of platform business focusing on network effects and a holistic overview of the business model roadmap are provided through a literature review in Section 2. We then thoroughly review existing studies that have investigated the business management and data management perspectives to further delineate the fundamental basis of platform business model innovation in Sections 3 and 4, respectively. Based on a theoretical basis and practical evidence, we develop data-centered strategies to innovate management areas in Section 5. Next, an expert committee was formed to secure objectivity and reliability regarding the proposed business and data management areas and link strategies for platform business model innovation through focus group interviews. Moreover, the layers and elements of each management area were derived and organized through meta analysis and individual interviews with experts in the field of each management area. Section 6 describes the overall structure of the platform business model roadmap incorporating three management perspectives with an operational guide. Section 7 demonstrates the usefulness of the platform business model roadmap through illustrative simplified examples. Finally, the significance of the suggested platform business

model roadmap and its contribution to knowledge and practice are specified with future research avenues in Section 8.

2. Literature Review

2.1. Distinctive Nature of Platform Business: Network Effects and Big Data

With the increasing prominence of platform business in today's economy, platform firms that replace incumbents are emerging in many major industries [11]. In academia, there also has been much interest in the phenomenon, leading to various definitions of the platform business. In line with existing studies [12,13], this study defines platform business as “a business model that creates a novel value by facilitating interactions between two or more interdependent groups, which are so-called producers and consumers”. In addition, there are several studies on the distinctive characteristics of the platform business. Representatively, among many things, two-sided market, network effects, and ecosystem are suggested as important characteristics demonstrating the specific nature of the platform business [14].

In conventional pipeline businesses, firms achieve market power by controlling a linear series of activities (i.e., the classic value chain), ruthlessly increasing efficiency, and fending off challenges from competitors, new entrants, and substitution. Value is added in different steps of the chain from inputs such as raw materials to an output that's worth more: the finished end product [15]. In contrast, a platform business brings together producers and consumers so they can innovate or interact in ways not otherwise possible, with the potential for a nonlinear increase in utility and value [16]. In other words, the flow of value in the platform does not follow a unidirectional line from producers to consumers. A platform is composed of internal operations that facilitate the interaction of two-sided market participants who are both external to the boundaries of the firm. Value is created by matching and connecting these external groups [13], and thus key success factors shift from product quality and process efficiencies to platform cohesion and value co-creation [17]. The groups that are connected to each other through the platform are attracted by the number of users within the network. This principle of value creation of a platform business is known as the network effect illustrated in Figure 1, where the value for each user is a direct function of the number of other users in the marketplace [4]. The reason why existing studies emphasize the network effect as a distinctive characteristic of the platform business is that the value depends on whether or not participants are attracted to the platform and maintained, increased, and expanded within the platform to build an active ecosystem [18]. Once a platform starts a virtuous cycle, the positive feedback loop among different sides of participants can help the platform sustain its user base growth and engagement with its inherent self-enhancing mechanisms [19]. However, the study of how to construct a virtuous cycle enhancing either direct (same-side) or indirect (cross-side) network effects is still an unknown area.

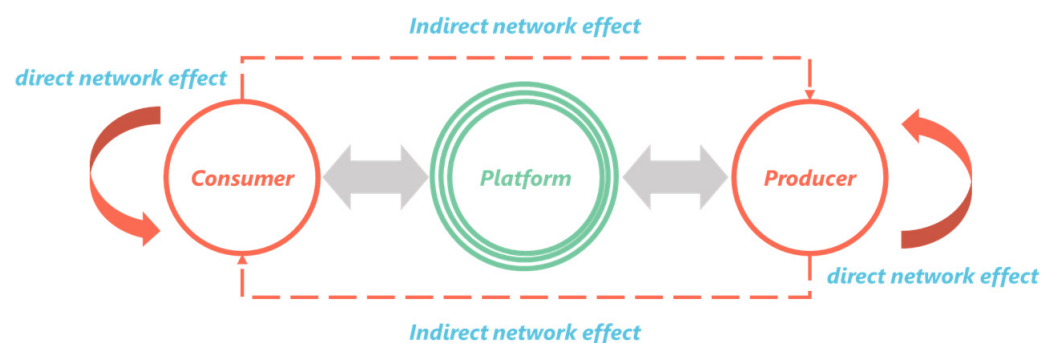


Figure 1. A two-sided platform with network effects.

What is clear here is that data becomes crucial in the platform business where digital technologies make building and scaling up platforms vastly simpler and cheaper, allow nearly frictionless participation that strengthens network effects, and enhance the ability to capture, analyze, and exchange huge amounts of data that increase the platform's value to all [15]. That is, the larger the network, the richer the data, and eventually, the better the match between supply and demand. In the same vein, we observe a tendency where firms increasingly utilize big data and digital technologies in order to capture consumers' attention and develop sustainable and repeatable interactions with long-lasting relations, which are the success factors of the platform [20]. According to representative firms in this domain, such as Amazon, Airbnb, Netflix, and Uber, their business model innovation is achieved successfully, based on a vast amount of data about producers and consumers [21]. They are constantly striving to strengthen data-centered competitiveness by securing digital technologies, such as mobile technologies, sensors, distributed storage, cloud storage and computing, and AI analytics. Therefore, it is not surprising that strategies considering big data and digital technologies play a key role in the platform as a new perspective for a value proposition, creation, and even capture innovation. However, extant academic research has yet to fully examine the platform business from big data and digital technology perspectives. Therefore, it is an essential task that a deeper understanding of how firms can innovate their business models to realize the potential of big data while gaining a competitive advantage in the platform competition.

2.2. Business Model Roadmap: A Strategic Management Tool

The term roadmap is defined as a view of stakeholders on how to achieve their desired goals [22]. Roadmapping, specifically in the field of technology management, is a process that contributes to the integration of business and technology and to the definition of technology strategy by displaying the interaction between products and technologies over time, considering both short- and long-term product and technology aspects [23]. As a means of strategic planning, roadmapping processes have been widely utilized in practice enabling firms to focus on long-term planning and higher priorities. Roadmapping is more likely to be effective in cases in which the market or product is growing, the technology is considered the basis of competitiveness, or the customer's voice needs to be strengthened [24]. In this sense, a roadmap is a suitable tool for strategic planning of the platform business model. Although there is no commonly agreed set of aspects that are always considered in any roadmap, the generic structure of the roadmap is a multi-layered and time-based chart including business/market, product/service, and technology aspects as shown in Figure 2. For the structures and formats, diverse variations have been proposed to reflect various business requirements depending on the firm's circumstances and the purpose of constructing a roadmap [25].

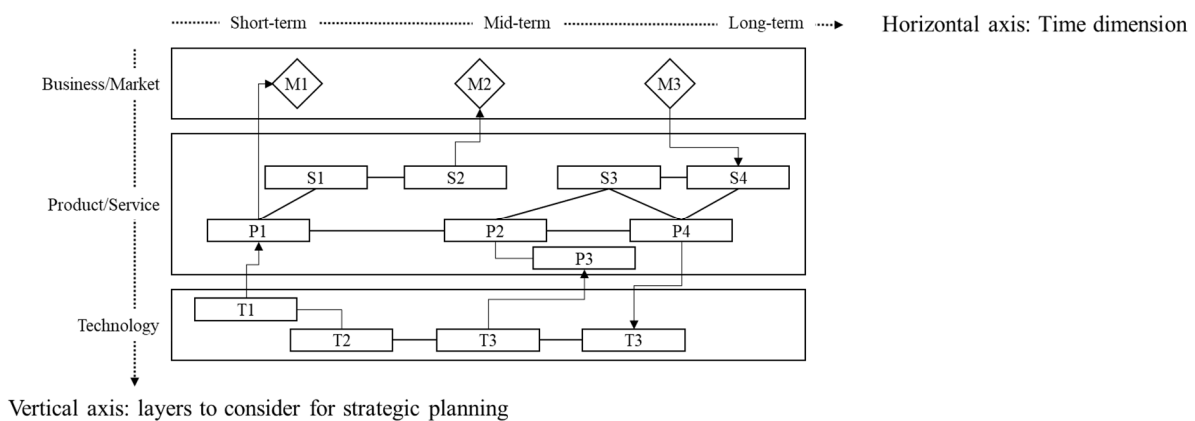


Figure 2. Generic structure of the roadmap.

With its flexibility in the architectural structure and versatility of developing processes, a few studies have applied the roadmapping concept in business modeling as summarized in Table 1. The business model roadmapping was proposed by de Reuver, Bouwman, and Haaker [8] to help switch between the old and new business model by visualizing how they change over time. They define a business model roadmap as a plan that describes what intermediate steps and critical decisions have to be taken to achieve a desired business model. In this regard, they arranged the business model roadmap into two layers. The first consists of the changes that are made to realize the new business model and business model domains that are impacted by the desired changes. The second layer outlines the required activities to be executed in order to realize the changes in the business model domains. Schaller, Vatananan-Thesenvitz, and Stefania [10] suggested a new roadmapping, which supports business model innovation. Adapting the general structure of a roadmap, the horizontal axis is the timeline, which is composed of the initial situation, short-, mid-, and long-term. The vertical axis, which addresses the question of why, what, and how, represents the market trends, business model domains, and related activities. The business model domains are divided into four sub-layers; customer value proposition, profit formula, key resources, and key processes, which were initially identified by Johnson and Lafley [26]. Related activities are divided into three sub-layers, content, structure, and governance, which were drawn from Zott and Amit's [27] activity system perspective. Existing studies have presented the relevant structure and process of a roadmap for business model innovation, but only a sole business management perspective has been considered independently. However, the research on platform business model roadmaps requires a paradigm shift toward a data-centered approach [28,29]. Since successful platform businesses cannot be realized without data and digital technologies, more focus should be placed on the data domain, rather than the business domain. For this reason, this paper aims to integrate well-known management concepts including business, strategy, and data into the roadmap that were not previously considered together. By linking these management areas that have been scattered without being linked to each other in the integrated roadmap, more operational and tactical planning can be established.

Table 1. Previous research on business model roadmap.

Literature	Structure	Description
de Reuver et al. [8] To define transition path from a current to a desired business model	1st layer: Business model change	Change in the service, technological, organizational, or financial domain required to realize the desired business model
	2nd layer: Activities	Practical actions that must be executed to realize the changes needed in the business model domains
Schaller et al. [10] To identify potential gaps and also to recognize and act on events that require a change of direction in the actual value proposition	1st layer: Market	Market trends and drivers, which influence the business model (Why?)
	2nd layer: Business model domain	Change in the customer value proposition, profit formula, key resources, and key processes (What?)
	3rd layer: Activities	Content refers to the purpose of the business model domain; structure is concerned about the arrangement of the business model domain; and finally, governance refers to the right people in charge in a specific business model domain (How?)

3. Business Management Perspective

3.1. Business Model Innovation

From a management perspective [30–32], a business model can be regarded as a set of management areas about the value firms provide to their customers and partners ('value proposition'), how the value is generated by combining different resources and activities ('value creation'), how provided value can be monetarized by the firm in return ('value capture'), how the created value is delivered to customers through distribution channels ('value delivery'), and how firms communicate with customers and partners about their value ('value communication').

Recently, a business model is not just a fundamental element of doing business anymore but rather becoming an important locus of innovation [33–36] not only to preserve market position but also to preoccupy the novel industry or market. In more detail, business model innovation can occur in the five management areas mentioned above: (1) a value proposition innovation, developing a high perceived value with a new offering to customers and markets; (2) a value creation innovation, achieving or acquiring new capabilities, new technology/equipment, new partnerships, and new processes; (3) a value capture innovation, including new revenue models and value cost structures; (4) a value delivery innovation, differentiating the channels affecting both price and cost to convey the created value to stakeholders; (5) a value communication innovation, constructing successful relationships to continual change and renewal.

3.2. General Elements for Business Model Innovation

From reviewing the literature, business model innovation can be achieved by modifying a single business model element, altering multiple elements simultaneously and/or changing the interactions between elements of a business model [37]. In this regard, a business model can be defined as a conceptual tool that contains a set of elements and their relationships and allows the business logic of a specific firm to be expressed [6]. Although there is little consensus on the various elements that constitute a business model, some key constructs are frequently discussed in several business modeling studies [30,38]. The business model canvas was introduced by Osterwalder and Pigneur [39] to provide a visual framework to describe existing business models and design new ones. It is a simplified diagram that contains nine building blocks that further connect the four main segments of business: offering, infrastructure, customers, and finances [40,41]. It provides an organized way to lay out not only the key resources, key activities, and partner network of the value chain, but also value proposition, customer relationships, channels, customer segments, cost structure, and revenue streams. These nine building blocks have a very specific relationship to each other and cover the above-mentioned five management areas as shown in Table 2, thus providing a basis for defining the requirements for business model innovation [7].

3.3. Data-Driven Business Model Innovation

Recognizing the importance of data as an asset for business model innovation, several researchers have attempted to identify the relevant dimensions for the data-driven business model framework. According to Brownlow et al. [42] and Hartmann et al. [43], the following six key dimensions are commonly found among various authors: data sources, key activity, offering, target customer, revenue model, and specific cost advantage. Fruhwirth, Ropposch, and Pammer-Schindler [44] maintain that a data-driven business model encompasses the following main characteristics: data is used as a key resource, data analytics as a key activity, and data or information is part of the value proposition and can be monetized. Moreover, the six fundamental questions are also discussed as guiding questions to successfully implement the data-driven business model [42]: (1) What do we want to achieve by using big data? (2) What is our desired offering? (3) What data do we require and how are we going to acquire it? (4) In what way are we going to process and apply this data? (5) How are we going to monetize it? (6) What are the barriers to us accomplishing our goal?

Table 2. The nine building blocks in business model canvas.

Block	Description	Guiding Question	Segment	Management Area
Value Propositions	Products and value-added services delivered by a company to fulfill customer needs and which are of value to customers	What value do we deliver to the customer?	Offering	Value Proposition
Customer Segments	The type of customers that a company wants to address and attract by offering value propositions	For whom are we creating value?		
Channels	The ways in which a company reaches out to its customers about its value propositions and enables the customers to communicate with the company	Through which channels do our customer segments want to be reached?	Customers	Value Communication Value Delivery
Customer Relationships	The relationship that a company builds and maintains with its customers	What type of relationships does each of our customer segments expect us to establish and maintain with them?		
Revenue Streams	The incoming money stream of a company by offering value propositions	For what value are our customers really willing to pay?		
Cost Structure	The costs incurred by a company for delivering value propositions to its customers and doing all other business activities such as building partner relationships and marketing	What are the most important costs inherent in our business model?	Finance	Value Capture
Key Activities	The actions that a company performs in order to create, market, and deliver value propositions to its customers and make profits from them	What key activities do our value propositions require?		
Key Resources	Inputs and capabilities that a company needs in order to deliver value to its customers	What key resources do our value propositions require?	Infrastructure	Value Creation
Partner Network	The voluntarily initiated cooperative agreement of a company with other companies in order to carry out activities related to value propositions	Who are our key partners/suppliers?		

From the same perspective as a conventional innovation research, the literature reveals two opposed courses for data-driven business model innovation [45,46]: refining and improving existing business models with data (incremental innovation), and designing totally new business models (breakthrough innovation). This study corresponds to incremental innovation aimed at the sustainable growth of the platform.

3.4. Business Management Area for Data-Driven Business Model Innovation

Based on a thorough literature review related to business model innovation, this study adopts the above-mentioned six guiding questions and re-organizes the following business management area for data-driven business model innovation as shown in Table 3. We illustrate that value creation is a sole business management area where data can directly affect changes in elements for a new value proposition. This study, therefore, targets the situation where business model innovation is achieved by focusing on the change of value creation and the relationship with other business management areas is also discussed consecutively.

Table 3. The first layer (business management area) of the platform business model roadmap.

Know-What to Innovate	Guiding Questions for Data-Driven Innovation	
Value Proposition	What is our desired offering?	Desired value for organizations and/or for users
Value Creation	What data do we require and how are we going to acquire it?	Data resource and sources
	Which interfaces are appropriate to transfer data or information?	Data interface
	In what way are we going to process and apply this data?	Data-related activities
Value Capture	How are we going to monetize it?	Pricing mechanism
Value Delivery	How does the customer interact with the offerings?	Delivery mechanism
Value Communication	What ethos and story do we communicate with customers and partners?	Marketing strategy

4. Data Management Perspective

4.1. Virtuous Cycle of Platform and Data

Big data is defined by five key attributes, commonly referred to as the Five Vs: high Volume, wide Variety, high Velocity, uncertain Veracity, and Value [47,48]. Value is considered the most important of these attributes [49]. Value can be financial (for example, increased revenue and reduced costs) or intangible (for example, improved customer satisfaction and informed strategic decisions), or a combination of both. While the other four attributes stress data collection, the creation and appropriation of value defines the potential and means for monetization or benefiting from data [50]. The emergence of big data has made a significant impact on the development of high-tech platform firms [51] and has promoted the transformation of firms from being traditional-factor driven to being innovation driven.

In spite of the growth of data, many firms do not have strategies to use big data effectively [52,53], and thus are failing to benefit from integrating big data into their business models [54,55]. In response, a substantial number of studies have attempted to manage big data from the perspective of business model innovation, however, scholars have paid limited attention to the nature of the platform. Specifically, business competition no longer revolves around how to control the value chain but around attracting platform-related generative activities [56]. Therefore, this study suggests data management areas focusing on network effects among participants for platform growth and expansion. To this end, we first explain the virtuous cycle of platform and data in line with the network effect as shown in Figure 3.

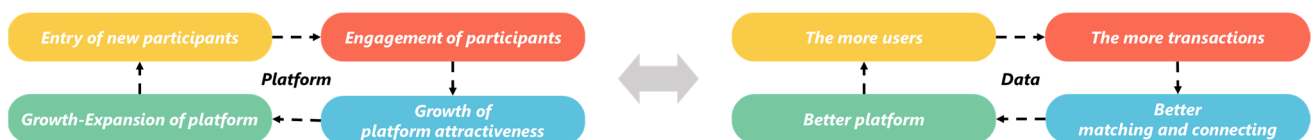


Figure 3. A virtuous cycle (i.e., flywheel) of platform and data in line with the network effect.

In order to maximize the network effect, quite naturally, firms have to increase the number of users on both sides and the degree of engagement of participants, which increases the attractiveness of the platform from the perspective of consumers and producers. Consequently, this leads to the growth and expansion of the platform. The concept of these network effects has been well described as a flywheel situation where a product or service becomes more valuable when more people buy and use it [57]. Note that the key success factor in the platform business is to form a virtuous cycle of data that is in line with the platform virtuous cycle to build a better business model [58]. As more users enter the platform, and transactions among producers and consumers increase, it enables firms to collect potentially usable data efficiently. Using data analytics, firms can not only improve and customize existing offerings, such as products, services, and information [59] but also increase the efficiency and effectiveness of matching and connecting, which is the core operation of the platform. A representative case is the magic of Uber which benefits from a virtuous cycle of platform and data. Uber becomes more valuable for every participant as more drivers and more customers join the service. At the same time, a virtuous cycle of data enables Uber to constantly improve its routing algorithms to get customers a car as quickly as possible and to ensure its drivers get as many jobs as they can handle, making the platform more likely to be attractive to members of the network.

4.2. Data Management Area for Data-Driven Innovation in Platform

A capability is a qualification or skill required to perform a certain activity [60]. As a reference to recent studies of firms' digitalization efforts [61,62], this study conceptualizes data capability, analytic capability, connect capability, and intelligence capability as a set of digital capabilities for data-driven innovation. On the other hand, the management of big data consists of optimizing the aspects of data preparation, analytics, interaction, storage, and effectuation [63]. This study, therefore, explains the digital capabilities and data management areas required for data-driven innovation in conjunction with the value creation process as shown in Table 4.

Table 4. The third layer (data management area) of the platform business model roadmap.

Know-How to Innovate	Digital Capability	Guiding Questions for Data-Driven Innovation
Data preparation Data storage	Data capability	What types of processes related to data generation, transmission, storage, and access are to be established in the firm?
Data analytics	Analytic capability	What types of processes related to analytics are to be established in the firm?
Data interaction	Connect capability	What types of channels and interfaces related to data interaction are to be established in the firm?
Data effectuation	Intelligence capability	What types of offerings (products, services, and operations) are to be established through utilizing the data analysis results?

First, firms work with the combination of data from different sources into a single platform with consistent access for analytics. A novel value proposition and value creation cannot be extracted from data if the firm does not generate or have access to data, and if that data is not transmitted and stored appropriately [62]. Therefore, data preparation and storage must be planned with considerable effort and deemed an essential dimension of data capability. Second, data analytics has played a central role in the innovation of many products and services with the transformation from raw data to actionable knowledge. Valuable information and insights can only emerge when data are processed and analyzed properly. Hence, these activities comprise their analytic capability. Third, the derived results from data analytics are nothing but more data unless firms and users interact with them [63]. From the perspective of value creation, data interaction must be considered from business model innovation, which constitutes connect capability. Lastly, designing

new applications based on the results of analytics and interactions can be regarded as the ultimate goal of data-driven business innovation. It means that a series of processes with digital capabilities have a direct positive effect on the business by optimizing product, service, decision, and operation to increase the intelligence level of the system [63].

5. Development of Data-Centered Strategy

Considering data generation and ownership in terms of platform structure, a two-sided platform consists of three key elements: platform, consumer, and producer. This study states that the activities and results of all third parties that make up the platform ecosystem are aggregated on the platform. More clearly, the platform defined in this section includes the platform provider or owner and third-party stakeholders participating in the platform. Therefore, a data-driven innovation in the platform can be explained by four intersections where data communication occurs among the elements as shown in Figure 4a. A platform provider or owner can collect a vast amount of data related to not only the participants but also their transactions. For this, platform firms must possess the digital capabilities of software and hardware technologies to deal with these big data. In this study, we classify technological requirements into two sides depending on whether a technology is related to big data or not, as shown in Figure 4b.

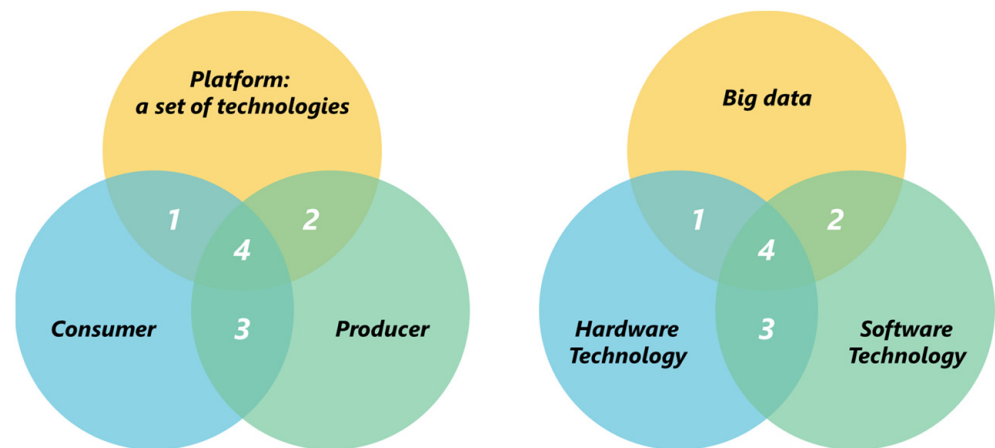


Figure 4. Conceptualization of data strategy with the structural and technological aspects in the platform.

The most important questions in structural aspects are: (1) data source: where does the data come from? and (2) data flow: what does the data affect? According to the data source and data interaction, the four intersections can be described as follows (see Table 5). For intersection area 1 ('consumer communication'), the more consumers there are on the platform, the more important it is to develop a better system by grasping their heterogeneous tendencies and behaviors. The platform can innovate the consumer experience by providing personalized services through data obtained from consumers. For intersection area 2 ('producer communication'), the platform can provide optimized advertising infrastructure and marketing solutions based on information of the firm's offerings and supply plan. Intersection area 3 ('user communication') refers to the exchange of data and information between producers and consumers occurring outside the platform. As direct accessibility increases, the value of the platform inevitably decreases. In this situation, the firm can lure users onto the platform by both reducing the cost of information access and transaction, and resolving the information asymmetry. For intersection area 4 ('platform communication'), consumers and producers share their data and information via the platform, and the platform plays the role of matching the most suitable transaction target based on the data collected from both sides.

Table 5. Data communication in structural aspects.

Intersection	Data Source and Interaction	Data-Driven Business Strategy
1: Consumer communication	Consumer \Leftrightarrow Platform	Providing personalized services
2: Producer communication	Producer \Leftrightarrow Platform	Optimizing advertisement and marketing
3: User communication	Consumer \Leftrightarrow Producer	Reducing the cost of information access and transaction
4: Platform communication	Consumer \Leftrightarrow Platform \Leftrightarrow Producer	Matching the most suitable transaction pair

While the structural aspect of a two-sided platform with data source and data flow is addressed at the macro level, the micro level deals with the technological aspect of a firm's digital capabilities. Ultimately, the value of a certain platform depends on how the platform handles the big data. As emphasized, hardware and software technologies necessary to maximize the value of the big data are the key components of the platform as shown in Figure 4b. In this situation, hardware technologies, including electrical and mechanical parts of a device, mainly focus on generating, detecting, collecting, and storing data. Meanwhile, software technologies such as an embedded operating system, algorithms, computing, and cloud storage are required to store, manage, transmit, and analyze the big data in and out of the platform. According to the technological capability based on big data context, the four intersection areas can be interpreted as follows (see Table 6). For intersection area 1 ('data giant'), firms can access and obtain entirely new types of data more efficiently. They are able to utilize superb hardware devices to differentiate data capability. For intersection area 2 ('data expert'), firms can personalize and optimize the offerings to improve the convenience of the platform users. These firms have analytic tools and skills that can cope with big data, so they can actively utilize the analytic capability to derive deeper and better insight to give a novel value to products, services, and operations. Intersection area 3 ('technology leader') refers to the stability and reliability of the technological infrastructure. In this situation, the firm can increase its value by expanding into data-driven businesses with a strategy to secure users and data. For intersection area 4 ('data-driven value innovator'), the firm can improve its existing value proposition and furthermore enable the development of innovative value propositions [42,43,64]. In order for the platform to achieve a virtuous cycle sustainably, firms must develop their digital capabilities in the direction of cultivating both big data and hardware and software technologies, while also taking appropriate business strategies to differentiate the platform.

Table 6. Firm's digital capabilities in technological aspects and business strategy.

Intersection	Characteristic	Capability-Driven Business Strategy
1: Data giant	High data capability	Accessing and obtaining entirely new types of data
2: Data expert	High analytic capability	Customizing and optimizing the offerings
3: Technology leader	Low intelligence capability	Expanding into data-driven business with reliability
4: Data-driven value innovator	Without digital deficiency	Developing innovative value propositions

Reconstructing fragmented knowledge in order to deepen the understanding of the big data in the platform business, we define data strategy as activities that attract, retain, and promote existing participants and even potential participants of the platform. It serves as the starting point of the roadmap for platform business model innovation, guiding directions in determining which business domain and elements to innovate and what data-related activities are necessary to realize them. Depending on the purpose of the activity and considering the virtuous cycle of platform and data, we also define a different set of decision-making issues to be considered in Table 7 briefly.

Table 7. The second layer (strategic management area) of the platform business model roadmap.

Know-Why to Innovate	Platform Virtuous Cycle	Data Virtuous Cycle	Data Management Area and Decision-Making Issues
Attracting	Entry of new participants	More users	Data preparation—source, privacy, security Data storage—hardware technology Data analytics—software technology Data interaction—cost, hardware, software Data effectuation—offerings (optimizing and personalizing)
Retaining	Engagement of participants	More transactions	Data preparation—source, privacy, security Data storage—hardware technology Data analytics—software technology Data interaction—rule (community, reward, review system) Data effectuation—offerings (operation)
Promoting	Growth of platform attractiveness	Better matching and connecting	Data preparation—privacy, security Data storage—hardware technology Data analytics—software technology Data interaction—interface, user experience, design Data effectuation—cost, benefit, ecosystem

6. Integrating Three Management Perspectives into Platform Business Model Roadmap

This section proposes a concept and structure of an iterative roadmap incorporating a data management perspective for platform business model innovation. As defined previously, the given task is to change one or more elements of value creation for incremental innovation of the platform business. The underlying assumption of the iterative roadmap is that network effects make the continuous virtuous cycle of platform and data and thus data needs to be planned according to the cycle stage to properly design and develop platform businesses. The generic roadmap template for platform business model innovation is illustrated in Figure 5. It consists of three management layers which have been discussed in Sections 3–5. In our study, the data management layer is added to the conventional structure of the business model roadmap.

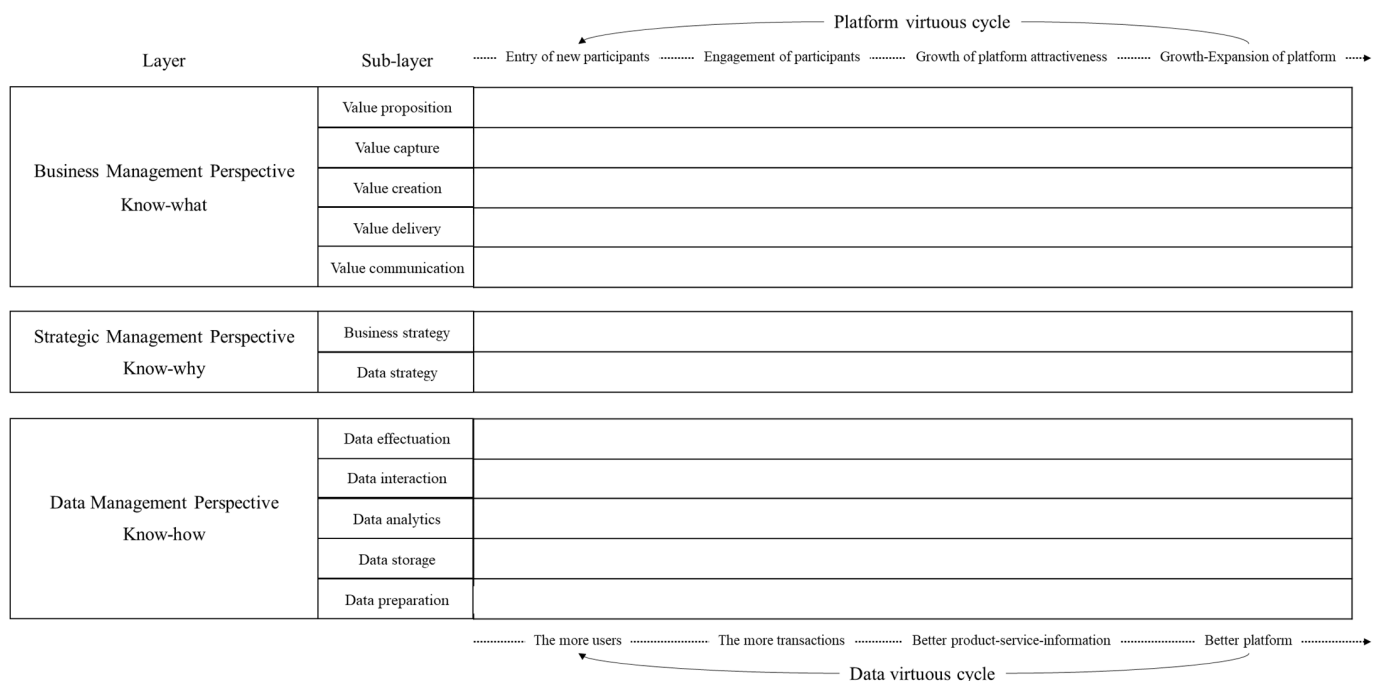


Figure 5. Roadmap template for platform business model innovation.

Note that each layer consists of several sub-layers. First, the strategic management perspective layer consists of two sub-layers: business strategy and data strategy. It serves as a starting point for operating the platform business model roadmap. To define the elements of this layer, firms should clarify the purpose of innovating the platform business model. There could be three different data strategies, depending on whether the firms intend to attract new and potential users to the platform, retain existing users who are currently participating in the network, or promote the attractiveness of their platform by offering better matching and connecting. In addition, firms need to plan appropriate and viable business strategies based on the structural state of the current platform ecosystem and the level of their own digital capabilities. They should objectively evaluate the current state, and specifically establish business strategies according to the situation derived by referring to Tables 5 and 6.

Second, the business management perspective layer is divided into five sub-layers of value; the value proposition, capture, creation, delivery, and communication. As described in Section 3, we designate the area where innovation can occur in terms of data-driven business model innovation as value creation. Once data and business strategies are clearly defined, firms must discover which elements need to be changed in value creation in order to achieve them, and further explore which elements could be affected by implementing the strategies. Moreover, all elements in other business management areas that might be affected by changes in elements of value creation must be explored and linked. In order to find the answer to what to innovate, the questionnaire presented in Table 3 should be expanded and customized.

Third, the data management perspective layer consists of five sub-layers of data; its preparation, storage, analytics, interaction, and effectuation. Once the elements of value creation to be innovated are selected, specific operational activities and technological requirements could be identified. Therefore, it deals with how to achieve the intended innovation. As arranged in Table 4, it is necessary to identify what data-related activities are required as well as the digital capabilities in detail to properly perform them. In the process of roadmapping the three layers, recognizing the gap between the present and the desired future is a fundamental basis, however, it is especially important in this layer. This is because it is the stage of defining the more tactical and operational actions among the three layers.

7. Illustrative Example

This section illustrates a scenario-based simplified example to confirm the effectiveness of the suggested platform business model roadmap. By-products are presented in order according to the guidelines constructed in the previous sections to fill in the three layers and related elements. At each decision point, the authors with the expert committee reached agreement through open discussion. The expert committee has a high understanding of the roadmapping process because they participated in designing the three management layers and sub-layers and linkage structures proposed in this study. They consisted of 12 personnel with diverse hands-on experience, including business experts, marketers, consultants, and database administrators, scientists, and engineers. First, we assume the current status of the platform business and define the desired status that the firm has to achieve through a virtuous cycle. It is targeted as a virtual platform firm that has just launched a C2C secondhand platform. Therefore, the number of users (including providers and consumers) has not reached enough mass to have a positive network effect, and the situation where the users have to be retained on the platform becomes a natural business problem. New and potential users should be attracted to the platform, and encouraged to participate more on the platform. Second, in terms of structural aspect, the overall data interaction has not occurred due to the lack of users, and the transaction volume is inevitably small as there are not many items registered. In this situation, the platform firm should motivate both producers and consumers to use the platform, which is expected to lead to an increase in registered products and transaction volume. Third, from a technological perspective,

the firm has software and hardware technology capabilities, however, lacks market and user data. Therefore, business strategies utilizing data generated and collected from the platform are expected to become crucial in the future. The situation in the above scenario is organized and summarized in Table 8. In this way, objectively evaluating the current state of the platform and setting the direction and goal to move forward is to fill the middle layer, the strategic management perspective.

Table 8. The current status and desired status of the virtual platform business.

Virtual Platform Business: Consumer-to-Consumer (C2C) Secondhand Platform		
Aspect	Current Business Status	Desired Business Status
Data strategy	Too small number of users	Attaining critical mass
Business strategy (structural)	Not many items registered Low frequency of transactions	Personalizing and optimizing transaction process
Business strategy (technological)	Low intelligence capability	Data-driven business

The next step is to consider the elements that must be changed and modified to successfully implement the planned strategies. This is a process to fill the upper layer corresponding to business management perspective. In order to attain a large number of users, we consider the data-driven functions that the firm is able to provide to each producer and consumer. Currently, there are two main problems with registering a product: (1) a producer does not know the price level of the used market, and (2) it is difficult to assess what advantages a producer's product has compared to other used products. In response, the firm decides to provide a market price notification service and a function to provide tags on consumers' selection attributes in accordance with product category. Meanwhile, consumers have the following difficulties when searching for the desired product. They have to query search every time whether the product they want to purchase is registered and if there is a product that corresponds to the desired price. In this situation, the firm can implement and provide a function that delivers push notifications when the product is registered so that the consumer enters the desired product and price range. In addition, the transaction area can be utilized as a filter based on the local information of producers and consumers.

Finally, a lower layer, the data management perspective, could be created to provide sufficient digital capabilities by identifying the operational activities and technological requirements needed to realize the newly defined value creation process. There is a need for a relational database including market price information and selection attributes for each product category affecting consumer purchase intention. Moreover, an effective interface such as a dashboard is necessary to visualize and provide related information. In order to build a push notification system, the development of an algorithm that matches consumer inputs and registered product data is basically required, and an appropriate UI/UX design from the perspective of data interaction should be determined. Three management perspective layers, determined through a series of decision processes, can be linked and integrated through the platform business model roadmap shown in Figure 6.

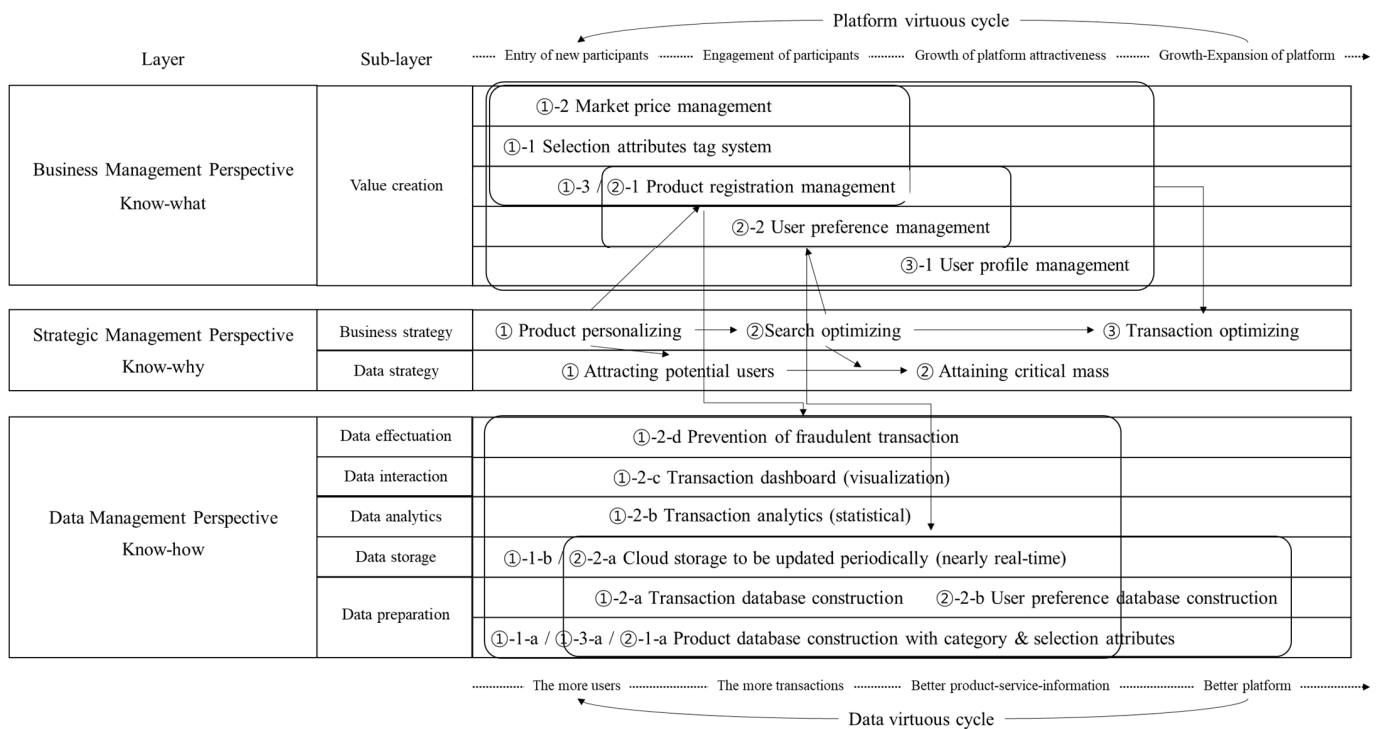


Figure 6. An illustrative example of applying platform business model roadmap.

8. Discussion and Conclusion

8.1. Theoretical and Managerial Implications

With the growing role of digitalization, the contribution of data and digital technologies to business models and building an ecosystem to achieve sustainable innovation have become challenging issues for platform firms. To our knowledge, conceptual research that aims to reflect network effects, the unique character of the platform business that determines the success in business modeling, is rare. The contributions of this research are largely fourfold from theoretical and managerial perspectives.

First, a data management perspective is integrated into the business model roadmap and the role of data and digital capabilities of the platform business discussed, making it easier to define required operational activities [8]. Previously, research on business model roadmaps has highlighted the changes in business domains for transition to a new business model [10]. In the platform business, however, the importance of activities related to data with digital capabilities is stressed as a silver lining to business model innovation [65]. For all those reasons, the emphasis of this study is that the data itself should be the subject of planning for sustainable innovation in the platform business. We categorize the data management area for data-driven business model innovation into five sub-areas and provide a room to figure out and visualize specific operational activities with related business and data strategies.

Second, the *x*-axis of the roadmap, which had been defined as the timeline, is replaced with a virtuous cycle of platform and data to clarify management’s objectives to be achieved at each phase. It should be noted here that the development of a platform business model roadmap must be repeatedly performed in order to continuously achieve the network effects [66]. The formation of a positive ecosystem does not guarantee that the platform business model has been completely successful, therefore new and novel ecosystems may have to be rebuilt by new drivers of change in the business environment [67]. In this situation, existing developed platform business model roadmaps can be the most efficient and effective reference material. A roadmap recorded every cycle can form a novel database, which becomes a resource for applying a kind of case-based reasoning approach. In other

words, feasible strategies can be found more easily when faced with similar business situations in the process of platform development and evolution.

Third, the conceptualization of data strategy with structural and technological aspects in the platform presents discussion space to practitioners. The outlined strategies in this study can be divided into the following three purposes: (1) business domain expansion, (2) user and data acquisition, and (3) digital capability enhancement. Firms with sufficient data with excellent digital capabilities can consider business domain expansion based on already designed and matured platforms. On the other hand, firms that lack either users participating in the platform or data being generated from the platform to perform data-driven innovation, should consider a partnership or corporate acquisition strategy to obtain users and data [68,69]. Furthermore, some businesses can establish strategies to compensate for deficiencies and to prepare new requirements in digital capabilities.

Fourth, the suggested template of the platform business model roadmap can be utilized as a customizable communication tool for analyzing and generating a platform business model with strategic planning [70]. At each phase of the platform cycle, a platform business model roadmap could be a collaboration tool designed to represent the strategy and objectives of a platform that evolves with time. It is the one source of truth for the evolution of a platform that enables bidirectional feedback between stakeholders.

Fifth, data itself can serve as a source of innovation leading to the development of new value propositions along the platform business model roadmap. We define this innovation aspect as “data-pull” and “data-push” which together are a distinct perspective from the typical linear models of innovation such as technology-push and market-pull [29]. New data might be required in the value creation process (data-pull), or new data-related activities and digital capabilities might be necessary to deal with generated data from inside or outside the platform (data-push). These two different way innovations enable platform firms to deliver a novel value proposition to achieve business model innovation.

8.2. Conclusion and Future Research

This research suggests a concept and structure of the platform business model roadmap incorporating a data management perspective considering the virtuous cycle of platform and data. The layers and components of the roadmap are mainly derived from recent business model innovation literature and platform business literature, focusing on the role of data and digital capabilities. We distinguish three layers: a business management perspective which defines the subject of innovation; a data management perspective which defines the required data and digital capabilities; and a strategic management perspective which defines the purpose of innovation as a starting point. We conclude that the proposed platform business model roadmap helps firms link strategies to the more tactical and operational levels. Moreover, visualizing roadmaps elicits how operational actions and business model impacts are related.

Despite our conceptual work providing an integrated perspective, there remains a substantial amount of work to be done for the development of a stronger theoretical and methodological foundation. First and foremost, just as a few authors have tested the efficacy of the business model roadmap, so too does the platform business model roadmap require a sufficient case study to determine its influence in designing and generating successful platform business where network effects continuously evolve the ecosystem. The core concept of the proposed platform business model roadmap is that the roadmap should be repeatedly updated according to the platform and data virtuous cycle. Therefore, it is necessary to examine through practical cases whether the structure and linkage suggested in this study are effective in strategic planning. Second, in addition to big data and digital capabilities, user interfaces and user experience design work in combination to attract and retain users to the platform in the real-world platform business. Therefore, the design perspective should also be considered in line with the business and data management perspectives. That is, design elements can be placed in the independently new layer and the relationship among the other layers' elements should be examined, just as data is an

important asset of planning in this study. Third, merger and acquisition (M&A) is being adopted as a representative means of business strategy for platform firms, and the number of cases is increasing worldwide. M&A is a typical strategy to expand the business area within an ecosystem in the platform evolution stage. A close review of M&A cases is required to identify the evolutionary path of the platform business and how M&A can be utilized as an option for business strategies according to their purpose. This is likely to be mapped to business domain expansion, user and data acquisition, and digital capability enhancement suggested in this study. Fourth, the role of third parties on the platform is becoming more important than ever from an open innovation perspective. Thus, the need to more deeply consider the role of third parties in future research. Lastly, as discussed in much of the digitalization and data-driven innovation literature [71,72], another dimension of digital capability is human resources and organizational culture. Therefore, it is also necessary to investigate how to place appropriate people according to data-related activities and construct a congruous organizational culture.

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