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A Framework for Sustainable Management of the Platform Service Supply Chain: An Empirical Study of the Logistics Sector in China

ABSTRACT

Platforms have become an effective means of innovation in the logistics sector. However, not all platform-based business models become a success. This research investigates how a platform strategy can lead to a sustainable managed platform service supply chain. Based on analysis of data collected within the logistics sectors in China, the research results propose a structural mapping of a platform service supply chain, which differs from the traditional service supply chain structure. This research develops a sustainable management framework for the platform service supply chain, including three key elements: mutual facilitation between platform and business ecosystem, transformation from logistics services to supply chain services, and value co-creation/co-opetition. The paper also provides a summary of practical implications to guide practitioners in building a successful platform service supply chain and enacting effective management strategies.

Keywords: Platform, service, supply chain, business ecosystem, sustainable management

1. Introduction

A platform strategy has been widely implemented in many areas, in particular new product development, and it is believed that a platform approach has radical impacts on the product development process or the entire innovation process (Clark and Fujimoto, 1991; Muffatto, 1999). Lately, the strategy has also been broadly applied in service design and development areas (Pekkarinen and Ulkuniemi, 2008; Simpson et al., 2006). The concept has also been adopted in the logistics service sector (Cambra-Fierro and Ruiz-Benitez, 2009; Lapadusi and Caruntu, 2011; Robu et al., 2011; Váncza et al., 2010).

On the one hand, in particular with the fast development of internet technology and digital transformation, platform strategies have been implemented broadly and created many new platform-based business models, and have largely transformed the operations and collaborations of the traditional logistics service supply chain (Geng and He, 2016; Tang, 2014; Wang et al., 2018). To differentiate this approach from the traditional service supply chain, we can define those that implementing a platform strategy as a *platform service supply chain*. However, there is no clear definition of this and, needless to say, research on its management is scarce. On the other hand, not all of the new platform-based business models in logistics have been a great success. Along with the expected advantages like better matching of supply and demand (Li et al., 2014), a logistics platform

may also face many issues, such as high external cost and environmental concerns (Rai et al., 2018). Unfortunately, there is very limited research on how a logistics platform strategy could be a sustainable success for the platform service supply chain.

Moreover, from our previous research, we noticed that a platform strategy always leads to the creation of a business ecosystem (Rong et al., 2013; Rong and Shi, 2014), which is defined as a business community consisting of all stakeholders interacting with each other to achieve a shared common fate (Moore, 1993, 1996). We believe that one condition of a successful platform strategy is that a healthy business ecosystem has been built (Rong et al., 2018). It has been proven that in the enterprise software sector, joining a business ecosystem helps to improve business performance for both software vendors and platform owners (Ceccagnoli et al., 2012). In the mobile payment area, ecosystems are formed along with platform-based innovative service development activities, which help to achieve competitive advantages (Junying, 2015; Kendall et al., 2011). However, for the logistics sector, in the current literature there is a lack of research touching on the impacts of a platform strategy on the development of a business ecosystem.

This motivated us to conduct this research to address those research gaps. This research aims to explore the nature and structure of the platform service supply chain, and to investigate its sustainable management mechanisms and insights via integrating the two concepts of platform and business ecosystem. Hence, the research questions for this paper are defined as:

RQ 1: How can one develop a sustainable platform service supply chain?
RQ 2: How can one sustainably manage a platform service supply chain?

We conducted the research within the logistics sector in China. One of the reasons for this choice was that, from 2014 and by the end of 2018, over 1000 logistics platform companies had entered the market (Cui, 2020). However, many of them were struggling to succeed as they had expected after adopting a platform strategy (CFLP, 2020). This demands urgent research on the above-defined research questions and fits our research purposes perfectly.

The research results are believed to contribute to the area of service supply chain management and platform strategy via proposing a structural mapping of the platform service supply chain and developing a framework of sustainable platform service supply chain management. The research is also expected to contribute to the area of platform strategy through bringing platform and ecosystem together and revealing their mutually influencing mechanisms. It also provides practitioners with managerial and practical insights to guide them in building a successful platform service supply chain and management strategies.

The paper is organized as follows. The next section will review current literature on platform strategy and business ecosystems. After that will be the methodology section, to justify why the case studies were chosen and how they were conducted, in particular the data collection process and data

analysis strategy. Then the research results will be presented and discussed, before the conclusion, which will cover the research contributions and research limitations, as well as future research directions.

2. Literature Review

2.1 Platform for product and service design and development

The concept of a platform originated from the area of product development (Clark and Fujimoto, 1991; Muffatto, 1999). It can be broadly defined as a relatively large set of product components that are physically connected as a stable sub-assembly and are common to different final models (Meyer and Lehnerd, 1997). The implementation of a product platform helps in increasing product variety, reducing complexity, shortening design lead time, reducing cost, and increasing the level of customization (Halman et al., 2003; Simpson, 2004; Simpson et al., 2014). When adopting a platform approach, an appropriate strategy is needed to reconsider the product itself (architecture), the product development process, and also the organizational structure (Muffatto, 1999).

With the benefits of the platform approach, it is quickly being applied in the service design area (Fu et al., 2018a; Meyera and DeToreb, 2001; Simpson et al., 2006; Voss and Hsuan, 2009): for example, patient care services (de Blok et al., 2010; Meyer et al., 2007), e-commerce services (Lin and Daim, 2009; Mahadevan, 2000), internet-based services (Daim et al., 2011), mobile internet services (Ballon et al., 2008; Tee and Gawer, 2009), government public services (Brown et al., 2017), human resources management services (Hofman and Meijerink, 2015), and so on. With services' inherent close interaction with customers, a platform approach supports increasing a firm's flexibility and responsiveness to match customers' needs (Sawhney, 1998) and to improve service quality (Pil and Cohen, 2006). It is also believed that the platform approach can facilitate the implementation of servitization in a manufacturing firm to pursue both customization and operational efficiency (Cenamor et al., 2017).

At the industry level, a platform not only enables the development and innovation of new products and services, but has also influenced strategies, shaped business models, and transformed entire industries (Basole and Karla, 2011; Fehrer et al., 2018).

2.2 Platform for logistics services and its development in China

Beyond those service areas summarized above, the platform concept has also been implemented in the logistics service sector, and a platform is regarded as a way of achieving strategic flexibility, in particular in a dynamic business environment (Abrahamsson et al., 2003; Aldin and Stahre, 2003).

One of the key themes in a logistics platform is that it is regarded as an organizational structure that promotes coordination and connection along the whole supply chain to ensure fluid transportation connections and coordination with different transport modes (Varella and Buss Gonçalves, 2013).

Hence, in some research it is also termed an intermodal logistics platform, aimed at enabling different agents of a supply chain to be integrated in the same physical place (Cambra-Fierro and Ruiz-Benitez, 2009). Normally it becomes a *regional logistics platform*, capable of fostering and facilitating logistics activities, business exchanges, and city development in a specific geographic region (Boudoin et al., 2014; Gajšek et al., 2012; Sainz et al., 2013).

There is another theme focusing on the design and development of the logistics platform. For example, a multi-agent platform was proposed to help optimize the allocation of loads in distributed transportation logistics (Robu et al., 2011). Under the umbrella of the smart city, a logistics platform is proposed to optimize transportation in order to improve the efficiency of transportation and decrease carbon emissions simultaneously (Jiang, 2015). Borrowing the idea of modularization from manufacturing products and processes, the modular platform approach is proposed for logistics services design and delivery in an efficient and flexible manner (Cabigiosu et al., 2015; Pekkarinen and Ulkuniemi, 2008). Based on this, further research proposed a modular service platform by integrating modular logic and quality function deployment (QFD) techniques to improve logistics service design quality and variety (Lin and Pekkarinen, 2011). With the fast expansion of e-commerce, the design of e-commerce logistics platforms is also attracting more and more attention (Barenji et al., 2019; Xu and Huang, 2017; Zhang et al., 2017).

In China, the fast growth of platform-based businesses has also been encouraged by the "Internet Plus" strategy proposed by the Chinese government to promote innovation (Fu et al., 2018b). Many logistics companies tend to use technologies like cloud computing and radio-frequency identification (RFID) to build a logistics service platform (Sun et al., 2012; Wang et al., 2012), or logistics information sharing platform (Li et al., 2014).

However, despite the broad attention logistics platforms have attracted from academia and practitioners, a clear definition and thorough understanding of the concept in its entirety are still lacking (Gajšek et al., 2012).

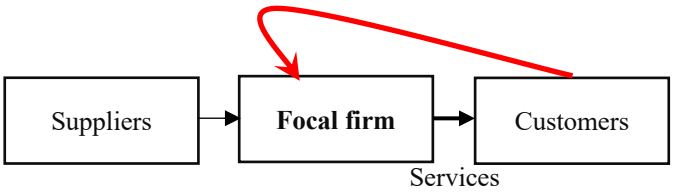
2.3 Platform service supply chain

As mentioned above, we can define the service supply chain with a platform strategy implemented as a *platform service supply chain*. Although it is evolving rapidly, there is no systematic research on this and comprehensive understanding of its structure, operations, and management is still missing. One of the most important tasks is to clarify the difference from the traditional service supply chain concept.

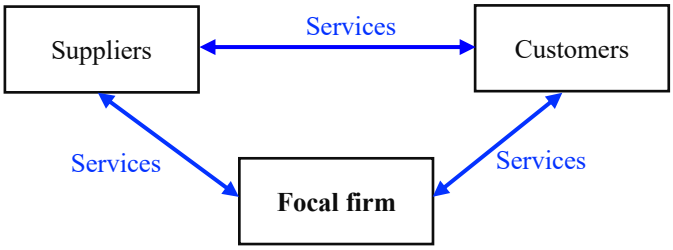
With the service sector playing an increasingly important role in national economies, service supply chain management is already receiving huge attention in relation to classic product supply chain management (Cho et al., 2012; Ellram et al., 2004; Wang et al., 2015). Based on classic supply chain theory, a service supply chain can be defined as "a network of suppliers, service providers, customers and other service partners that transfer resources into services or servitised products

delivered to and received by the customers" (Lin et al., 2010). In order to understand the differences among these three concepts, we summarized them in **Figure 1** for a brief comparison.

(a) Product supply chain (adapted from Harrison et al., 2019)



(b) Service supply chain (adapted from Lin et al., 2010)



(c) Platform service supply chain

Figure 1. Structure of a product/service supply chain and a proposed conceptual structure of a platform service supply chain

Obviously, one key difference between service and product supply chains is that there is no transfer of goods or physical products *per se* in the service supply chain (Ellram et al., 2004). Within a service supply chain, it is the service that is transferred to customers utilizing the focal firm's service assets and staff (capacity; see **Figure 1**a).

Another key feature of a service supply chain is the customer as an input into the service system (Lin et al., 2010). As presented in **Figure 1**b, the customer not only provides themselves as an input, but also offers tangible belongings and specified demand information to the focal firm who is providing the services to customers (Maull et al., 2012; Sampson and Spring, 2012). This can be called a dual-directional supply chain, whose essential nature is different from that of the product supply chain (Lin et al., 2010; Sampson, 2000). Hence, value co-creation is an essential feature of the service supply chain (Ren et al., 2015).

Within a platform service supply chain, the focal firm (normally the platform owner) does not have the products or services that it directly provides to its customers, but mainly exchanges information. However, the focal firm intends to attract as many customers as possible as well as

suppliers via the network effects (Fu et al., 2017), and to make a feasible resource allocation between demand side and supply side to provide or deliver bundles of products and/or services (Zha et al., 2015). Based on this review, we propose a conceptual structure of a platform service supply chain as presented in **Figure 1**c, which highlights a triadic relationship among suppliers, customers, and the focal firm, rather than a single- or dual-directional relationship within the product or service supply chain, respectively.

However, the structure and nature of a platform service supply chain are still unclear. This research aims to fill this gap by understanding the platform service supply chain and proposing a detailed structural mapping of it.

2.4 Platform and business ecosystem

From our previous research, we noticed that a platform strategy is always linked with the development of the business ecosystem (Rong et al., 2013; Rong and Shi, 2014). The concept of a business ecosystem is defined as a loosely connected business community consisting of different levels of organizations, such as industrial players, associations, governments, and other relevant stakeholders, who share a common goal and co-evolve with each other (Moore, 1993).

Some scholars have already emphasized the importance of platform management within a business ecosystem (Tsujimoto et al., 2018). However, within the current literature, research is scarce on the interactions between a platform and a business ecosystem. In fact, there have been some concerns raised about the difficulties of distinguishing the two concepts of business ecosystem and platform (Adner, 2006; Adner and Kapoor, 2010). Hence, in this research we clearly follow the thinking that defines an ecosystem as a structure with four basic elements, *activities*, *actors*, *positions*, and *links*, whose foundation is the value proposition (Adner, 2017, 2006; Adner and Kapoor, 2010). Adner (2017) provided definitions of the four elements of the ecosystem and viewed the ecosystem as a structure in which the elements align with one another. Among the four elements, activities are defined as actions taken for the value proposition; actors refer to entities undertaking the activities; positions mean actors' locations in the flow of activities; and links are the various transfers happening across actors.

On the one hand, with the co-evolutionary nature of a business ecosystem, a platform is considered as a set of *access points* that ecosystem partners can use as functional components to build their own products (and/or services; Iansiti and Levien, 2004). Hence, a platform is regarded as an interface that facilitates the interactions of the business ecosystem (Li, 2009; Rong et al., 2013) and the co-evolution of the whole business ecosystem (Rong et al., 2015). This understanding of a platform is similar to the concept of an industry platform, which is identified as a foundation to facilitate external companies' creation of innovative products/services and the formation of an innovation ecosystem (Gawer and Cusumano, 2014). There is no doubt that joining a platform helps

in encouraging complementary invention and exploiting indirect network effects to achieve better value co-creation (Ceccagnoli et al., 2012).

On the other hand, a platform and a business ecosystem can be treated as different levels of organization in an interconnected world (Gawer, 2014). In that respect, a platform is an organization of things (including technologies and complementary assets), while a business ecosystem is an organization of economic actors (Muegge, 2013). This makes it easier to understand why some researchers argue that a business ecosystem is built around a platform, which interlinks suppliers, complementors, distributors, developers, and so on (Mäkinen et al., 2014), hence such an ecosystem is also defined as a platform ecosystem (Ceccagnoli et al., 2012; Cennamo and Santalo, 2013; McIntyre and Srinivasan, 2017).

However, there is limited research focusing on the interactions between the platform and the business ecosystem (Rong et al., 2013): for example, how the platform owner's decisions impact on complementors' choices and their subsequent success (McIntyre and Srinivasan, 2017); or how they influence the development of the business ecosystem; or how other factors – for example, digital empowerment (Sun et al., 2018) – will facilitate the development of a business ecosystem.

Moreover, the bulk of current research is heavily focused on the high-technology sector, for example information technology industries (Thomas et al., 2014), health care (Kapoor and Lee, 2013), enterprise software (Ceccagnoli et al., 2012), and semiconductor lithography equipment (Adner and Kapoor, 2016). However, research on the logistics service industry is still scarce.

3. Methodology

To address these contemporary phenomena and identified research gaps, this research adopted case study research as a methodology to answer the defined research questions (Yin, 2013).

3.1 Case study design

Multiple case studies were designed for this research in order to comprehensively reflect the current developments and scenarios of a platform service supply chain in the logistics sector. **Table 1** summarizes the three chosen cases considering criteria of representation such as success, history, size, logistics service types, platform types, and ecosystem structure. For example, when we decided on the selection of Case A, we had similar case companies focusing on other specific logistics activities, like warehousing and materials handling. We noticed that they all achieved sustainable success and shared similar strategies and practices, hence we only selected one (Case A), the largest and most reputable one, for this research. Cases B and C were selected to represent successful ones focusing on a logistics facility (a logistics park in Case B) and logistics information technology (Case C).

Table 1. Brief details of the case companies

Case	History	Platform Features	Business Ecosystem
A	Founded in 2006	Platform for small to medium-sized logistics companies; providing logistics activity-based services (transportation)	Business office Logistics companies Banks, insurance companies
B	Founded in 2013	Platform for logistics parks; linking logistics parks in different regions to match supply/demand and allocate resources	Logistics parks Logistics companies Tire suppliers
C	Founded in 2001	Platform for large companies; integrating online and offline services, providing cloud services and software/platform development services	Logistics companies Software suppliers

3.2 Data collection

In this research, semi-structured in-depth interviews were used to collect the data. The interviews were conducted during 2018–2020, with a two-stage strategy to ensure that comprehensive data were collected. An interview protocol and interview question structure were pre-defined to ensure the quality of data collection for this research. See **Appendix 1** for the protocol and the interview questions. The positions of the interviewees varied from CEO to project manager, and our aim was to extract in-depth insight from their practices and experiences (see brief details in **Table 2**).

Two stages of data collection were designed for this research. The first stage of data collection was organized from early 2018 to mid-2019, after which early 2020 was the second stage. The first stage served as the main part of data collection, while the second stage was planned to cross-verify some confusing points from the interviews, and also to collect further insights from the interviewees due to the fact that this sector is now experiencing fast growth with government facilitation.

Table 2. Brief details of interviews and length

Case	Company Category	Interviewees' Position in the Company	Length of Interview
A	Platform owner	CEO Sales manager	1 hr 2 hrs
	Logistics company x 3	Operations manager x 3	1 hr x 3
B	Platform owner	CEO Project manager x 2	1 hr 1.5 hrs x 2
	Logistics partners	Operations manager x 5	1 hr x 2 1.5 hrs x 3
	Logistics company x 3	Operations manager x 3	1 hr x 3
C	Platform owner	CEO Sales manager x 2 Project manager x 3	1.5 hrs 2 hrs x 2 2 hrs x 3
	Logistics company x 2	Operations manager x 2	1 hr x 2
		Total hours:	33 hrs

The questionnaire was designed in English and then translated into Chinese. The interviews were conducted in Chinese, and at the end of data collection all the transcripts were translated into English for data analysis.

Meanwhile, secondary data were also used to better understand industry development and the companies' history and profile, and this also served the purpose of verifying the data collected from the interviews. The main sources of secondary data used in this research included industry reports (mainly officially released reports, for example the one published by the China Federation of Logistics and Purchasing, CFLP), company websites, and company annual reports.

3.3 Data analysis

In this research, data were collected through semi-structured interviews. The design of the interview questions drew on the ecosystem-as-structure framework in Adner (2017). The collected data reflected the theoretical constructs and were analyzed within the empirical context. The process of data analysis highlighted the theoretical framework as well as deductive reasoning based on exploratory observations.

Mapping, coding, and theme-building approaches were adopted in the analysis. The codebook involved both concepts from the literature and ideas from the evidence. Themes were built on the connections and relationships sketched out of the observations. The within-case analysis mapped investigations for systematic understanding. Cross-case comparison was then conducted to analyze the similarities and differences in the three case settings (Dey, 2016).

The data analysis in this research was an evolving process, with continuous refinement through chaining observed evidence with research questions (Yin, 2013). Careful steps were taken to avoid omission of important information, ensure consistency and validity, reduce bias, and enhance the accuracy of the analysis. Coding was cross-checked by collaborating researchers for the replication of understanding and interpretation of evidence. Primary data were triangulated with secondary data from a variety of sources (administrative reports, service records, and websites of case companies) to improve the reliability of the results.

Based on the data analysis, the platform service supply chain was mapped, covering the structural elements of the ecosystem (activities, actors, positions, and links). It is presented in **Figures 2**, **3**, and **4**, corresponding to Cases A, B, and C.

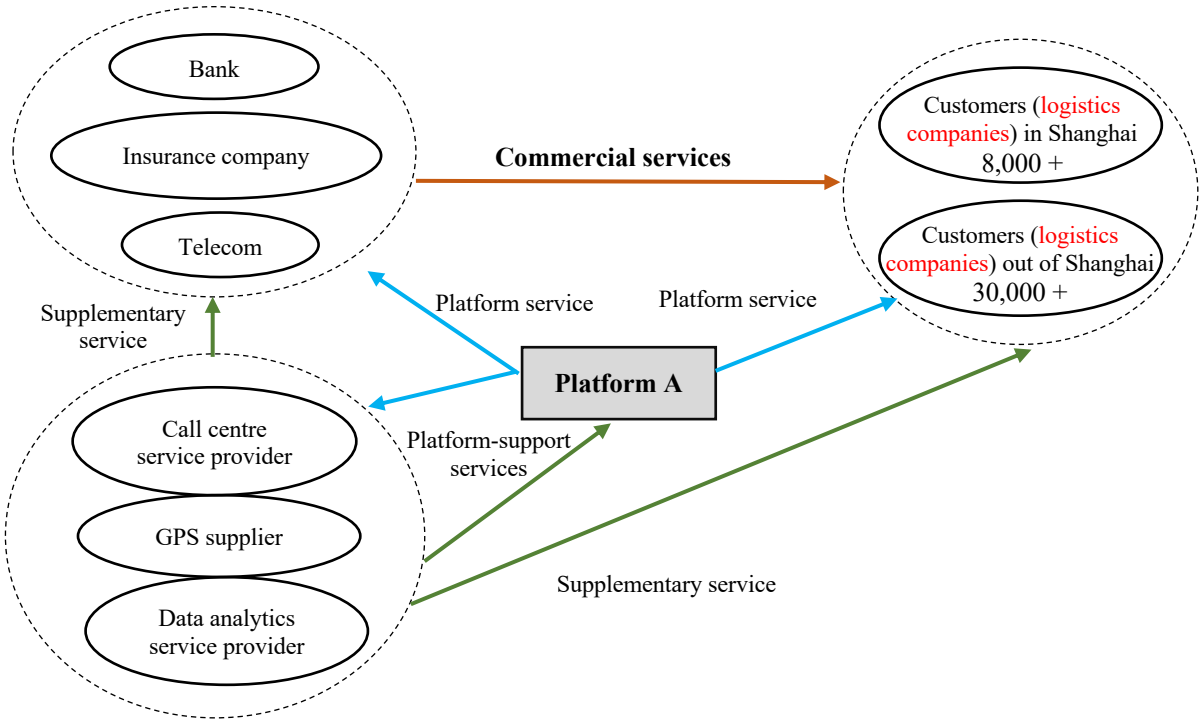


Figure 2. Case A

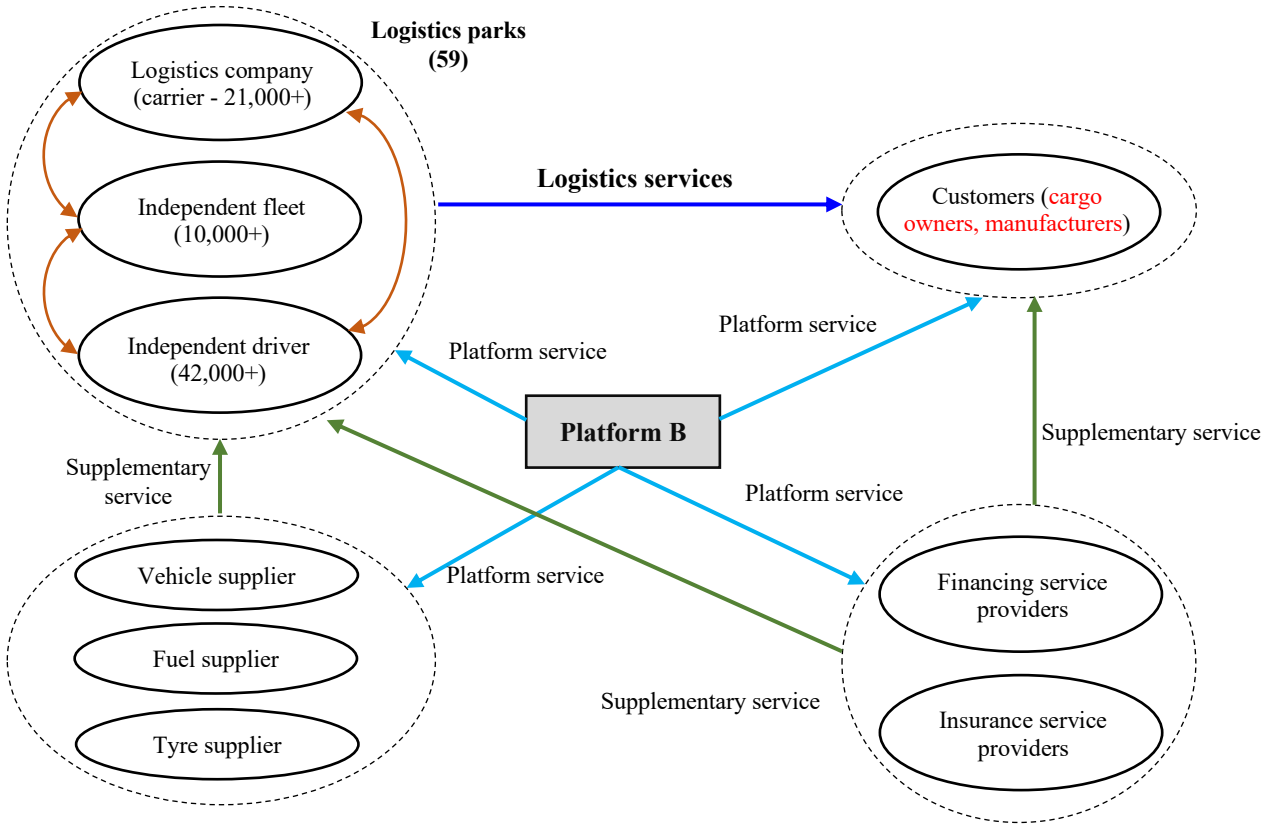


Figure 3. Case B

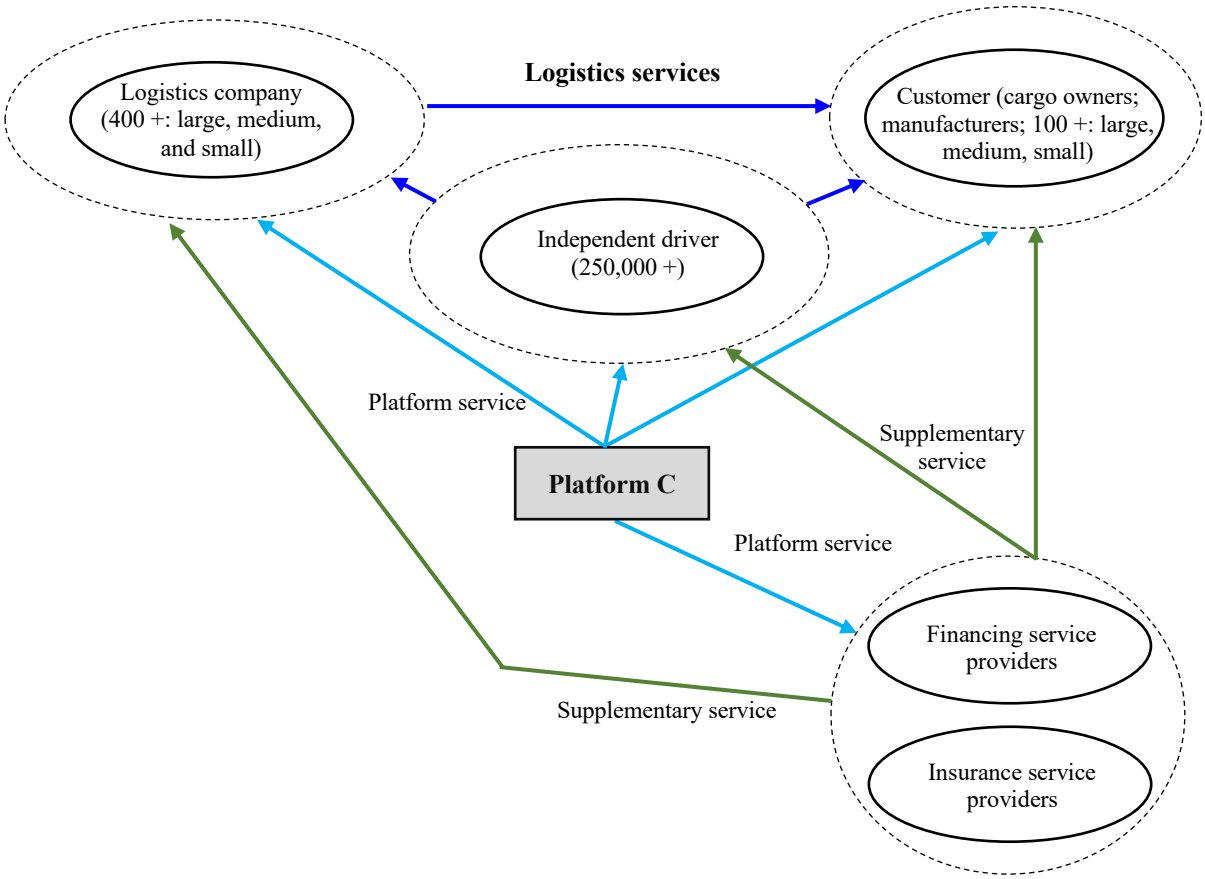


Figure 4. Case C

A summary of the three case studies is presented in **Table 3** with the four structural elements.

Across the three cases, *activities* are closely associated with the value proposition of the service platform. In Case A, the platform is devoted to providing integrated logistics-related commercial services to small to medium-sized logistics companies. The commercial services are provided by banks, insurance, and telecom companies via the platform to customers (logistics companies). These commercial services are supplemented by call center, GPS, and data analytics service supplies. In Case B, the platform serves as a linkage among various logistics parks in different regions, to match supply and demand sides to ensure effective and transparent transport services. The transport and warehousing services are provided by logistics companies, fleets, or independent drivers registered with the logistics parks, and the main customers are cargo owners (manufacturers). To assist the transport services, support is required from vehicle, fuel, and tire suppliers as well as finance service support from financing and insurance suppliers. These are supplementary services, the same as observed in Case A. Case C is a cloud-based Software as a Service (SaaS) platform, which aims to provide software services and information management services to help customers to integrate their online and offline logistics business. The software and information services provided to platform customers, including logistics companies, cargo owners (manufacturers), and independent drivers,

will help better manage the logistics service among them. As in Case B, there are supplementary financing and insurance services to support those operating the logistics services.

There are similar activities involved in the three cases: logistics services, financing, and insurance services. Hence, similar actors can be observed across cases: logistics companies, banks, and insurance companies. Across the cases, it is observed that the same type of actor may possess different positions in different platform service supply chains. For example, logistics companies are customers of the commercial services in Case A, whereas their positions in Cases B and C are as suppliers of logistics services. Financial services are considered supplementary to the logistics services in Cases B and C, but they form part of the primary services in Case A.

The above-mentioned actors and activities are linked through the transfer of resources and information. The transfer of resources takes the form of products, funds, and services and is realized in the activities of service provision. The transfer of information is bidirectional and embedded in the coordination and cooperation in the value-creation process. The transfer of resources and information also takes the form of joint innovation activities in developing new services. The platform owner builds a bridge between the supply and demand sides, leading to triadic interactions among actors and enabling multilateral transfer of resources and information. As a result, the activities realized through these links feature co-creation of value, co-development of knowledge, and co-evolvement of all actors.

Table 3. Cross-case summary of ecosystem elements

Ecosystem Element	Case A	Case B	Case C
Activity	• **Commercial service** - Business administration - Tax administration - Social security - Commercial factoring - Bank financing - Logistics insurance • **Platform service** - Matchmaking supplier and customer for commercial services - Coordinating commercial services between service provider and customers - Invoicing and bookkeeping - Joint innovation with service providers and customers • **Supplementary service** - Call center service - GPS service - Data analytics services	• **Logistics services** - Freight transport - Warehousing service • **Platform service** - Matchmaking supplier and customer for logistics services - Coordinating logistics services between service provider and customers - Quality control and assurance of logistics services - Transportation management (e.g., route optimization and cargo tracking) - Warehousing management - Joint innovation with service providers and customers • **Supplementary service** - Financing service - Insurance service - Product supply (tires, fuel, vehicles)	• **Logistics services** - Freight transport - Warehousing service • **Platform services** - Cloud software services (TMS, WMS) - Software development - Integration and optimization of information system on transportation and warehousing - Joint innovation with service providers and customers • **Supplementary service** - Financing service - Insurance service
Actor	• **Company A** • **Commercial service provider** - Bank - Insurance company - Telecom company • **Supplementary service provider** - Call center service provider - GPS supplier - Data analytics service provider • **Customer** - Logistics company	• **Company B** • **Logistics service provider** - Logistics company - Independent fleet - Independent driver • **Supplementary service provider** - Vehicle supplier - Fuel supplier - Tire supplier - Financial service provider - Insurance service provider • **Customer** - Cargo owner - Manufacturer	• **Company C** • **Logistics service provider** - Logistics company - Independent driver • **Supplementary service provider** - Financial service provider - Insurance service provider • **Customer** - Product suppliers - Cargo owners - Manufacturers
Position	• **Platform owner** • **Commercial service provider**	• **Platform owner** • **Logistics service provider**	• **Platform owner** • **Logistics service provider**

	• **Supplementary service provider** • **Customer**	• **Supplementary service provider** • **Customer**	• **Supplementary service provider** • **Customer**
Link	• **Transfer of resources (product, fund, service):** - Platform owner → Customer - Platform owner → Commercial service provider - Platform owner → Supplementary service provider - Commercial service provider → Customers - Supplementary service provider → Commercial service provider - Supplementary service provider → Customer - Supplementary service provider → Platform owner • **Transfer of information:** - Platform owner ↔Customer - Platform owner ↔Commercial service provider - Platform owner ↔Supplementary service provider - Commercial service provider ↔Customers - Supplementary service provider ↔Commercial service provider - Supplementary service provider ↔Customer	• **Transfer of resources (product, fund, service):** - Platform owner → Customer - Platform owner → Logistics service provider - Platform owner → Supplementary service provider - Logistics service provider → Customer - Supplementary service provider → Logistics service provider • **Transfer of information:** - Platform owner ↔Customer - Platform owner ↔Logistics service provider - Platform owner ↔Supplementary service provider - Logistics service provider ↔Customers - Supplementary service provider ↔ Logistics service provider - Supplementary service provider ↔ Customer	• **Transfer of resources (product, fund, service):** - Platform owner → Customer - Platform owner → Logistics service provider - Logistics service provider → Customer - Supplementary service provider → Logistics service provider - Supplementary service provide → Customer • **Transfer of information:** - Platform owner ↔Customer - Platform owner ↔Logistics service provider - Platform owner ↔Supplementary service provider - Logistics service provider ↔Customers - Supplementary service provider ↔ Logistics service provider - Supplementary service provider ↔ Customer

4. Findings and Discussion

Based on the data analysis, this research derived several findings in relation to the research questions. These include the structure of the platform service supply chain, the features of platform services, the facilitation mechanism between platform and business ecosystem, the digitalization and competition in the service platform and its ecosystem, and the sustainable management framework of the platform service supply chain. The rest of this section will discuss these findings in detail.

4.1 Structure of the platform service supply chain

From the mappings of the three cases (see **Figures 2**, **3**, and **4**), a generic structure of a platform service supply chain is formulated and proposed in **Figure 5**.

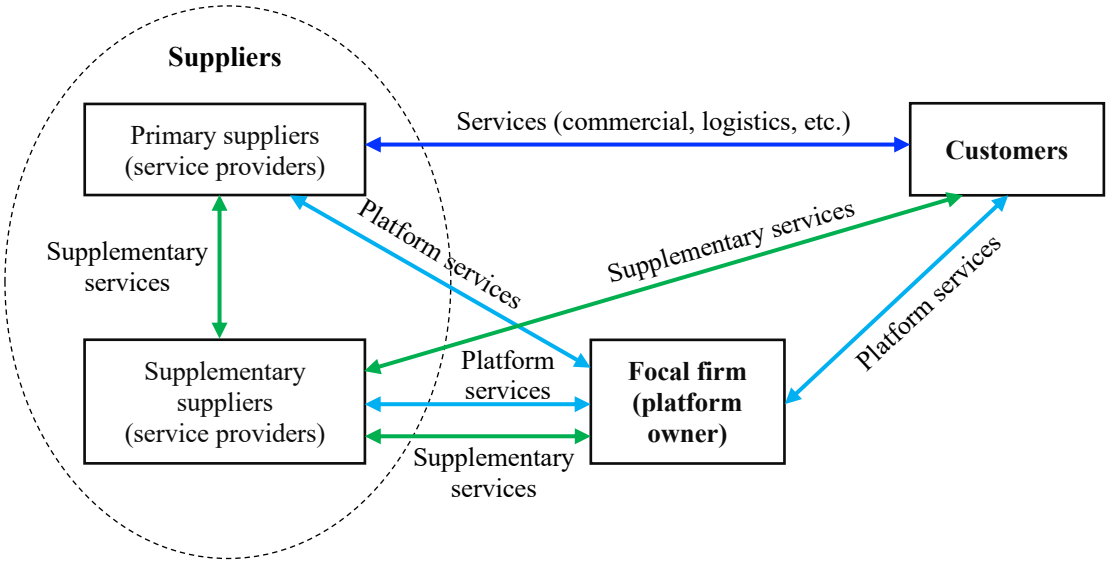


Figure 5. Structure of the platform service supply chain

The key *actors* in the proposed structure include the focal firm, primary suppliers, supplementary suppliers, and customers. The focal firm is *positioned* as the platform owner, who serves the same roles as the focal manufacturer in the product supply chain, or the major service provider in the service supply chain. The platform owner uses its platform to attract and collaborate with actors from both the supply and demand sides to accomplish the fundamental logistics services. There are two types of suppliers on the supply side. Primary suppliers are those service providers offering logistics services or logistics-related commercial services to customers. Supplementary suppliers normally provide necessary parts, components, or products (such as tires and fuel in Case B) or supportive services (such as call center services and data analytic services in Case A, and financing services in Cases B and C) to those primary suppliers for them to better deliver their services to customers.

Within the structure, customers could be logistics companies who need commercial services (e.g., in Case A), or cargo owners or manufacturers (e.g., in Cases B and C) who need professional logistics services, such as warehousing and transportation.

What is interesting here is that, from the viewpoint of the platform owners, all the other actors (service providers and customers) become the platform's customers, receiving platform services from the focal firm. The platform *links* all the other actors with the platform service supply chain. On the one hand, this enables the integration of services from various providers; on the other, it offers service providers access to customer information (Gawer, 2014). As a result, the platform enables triadic interactions among service providers, the platform owner, and the customers. Such triadic interactions or triadic links are the essential foundation for the concept of the platform service supply chain proposed in this research. This triadic structure-based supply chain is different from the traditional, linear supply chain of activity flows in product or service supply chains, as the latter is based on a dyadic structure with a clear focus on upstream suppliers and downstream customers (Ki-Hyun and Jae-Young, 2020; Wilhelm, 2011).

In the traditional product supply chain, the upstream and downstream activities of a focal firm mainly focus on transferring goods and information along the supply chain, while the service supply chain is more about service provision along the supply chain, but with the essential feature of customer involvement (Maull et al., 2012; Sampson and Spring, 2012). Within the platform service supply chain, the platform acts as a bridge between the supply side and the demand side. Hence, service delivery *activities* consist of two critical steps: demand–supply matching via the platform, and service provision between supplier and customer. We define the first step as platform services, and the three cases showed that these services include information sharing and management matchmaking of suppliers and customers, software services, service standardization, and quality assurance. The second step is defined as primary services in this research, including logistics-related commercial services in Case A and logistics services in Case B.

From the perspective of the business ecosystem, a product-centric supply chain has a distinctive upstream and downstream. Elements bundled by the focal firm in upstream activities are considered *components*, and these are provided to the focal firm by manufacturers of the final product. Offers that are bundled in downstream activities by customers are considered *complement*s (Adner and Kapoor, 2010). Providers of these offers are complementors, and they are regarded as a critical factor in the success of the product. The situation is different in the platform service supply chain, which does not have distinctive downstream complements.

4.2 Features of the platform service supply chain

Different from the traditional service supply chain, the platform service supply chain has unique features discussed as below.

Triadic interactions

As mentioned above, triadic interaction is regarded as the essential feature of the platform service supply chain we proposed in this research, it happens among service suppliers, customers, and the platform owner. This triadic interactions also happens in other platform-based business environment, for example within the e-commerce environment where the interactions is existing among platform owner, suppliers and customers (Lin et al., 2016).

This triadic interaction is distinctive from the *dyadic interactions* between suppliers (or manufacturers) and customers in the traditional product or service supply chain. Through these triadic interactions, the platform services provided by the platform owner lead to integration of multiple service suppliers (including supplementary suppliers) and customers. This is normally considered as the supply side and demand side of a platform, which is then in line with the concept of a two-sided market (Rochet and Tirole, 2003). The dependence on the platform to enable such triadic interactions is one of the key differences between the platform service supply chain and the traditional service supply chain, which is more rely on the mutual interactions between suppliers and customers (Chen et al., 2017).

It is clear that a platform service supply chain is different from the traditional product or service supply chain. A service supply chain aims at providing specified, specialized services to customers (Liu et al., 2013), for instance transportation, warehousing, freight, and distribution management in the logistics sector. These services are expected to be provided by the focal firm directly to customers in the service supply chain. In the platform service supply chain, however, there is *supply-demand matchmaking* via the platform before the services are delivered by the providers to the customers. These two parts forms the triadic interactions within the platform service supply chain.

It was observed as a common feature in Cases A, B, and C that the platform owner plays a key role in matching supply and demand sides to facilitate transactions between the two. The activities of the platform owner also encourage and promote cooperation among actors in sharing information and developing knowledge and capabilities. By these means, the platform coordinates value co-creation among actors, where co-dependence forms through the links and co-evolvement is achieved via activities.

> *We started with informatization software and gradually turned to build our platform… our platform aims at sharing resources among members. These include transportation capacity, supply of goods as well as information of customers. (Interviewee, Case C)*

Through such matchmaking, the platform connects and coordinates a variety of services and this enables multilateral sharing of resources and information. As a result, the utilization of resources along the supply chain is optimized to achieve higher efficiency. This allows cost-cutting and brings more options to benefit both suppliers and customers. An example of such benefits in the cases is the solution to the issue of returning empty vehicles (Case B): the matchmaking and coordination of the

platform enable return loads for empty vehicles, and this reduces the costs of the transport service provider while satisfying customer needs at the same time.

> *Many enterprises [in the sector] serve as third-party service providers, but our company is a platform. Building a platform is challenging as it requires proper values to be proposed to partners; providing third-party services is more straightforward. (Interviewee, Case B)*

Supply chain-oriented platform services

In the traditional service supply chain, services normally focus on professional services, for example specific logistics activities (e.g., transportation, inventory, and warehousing), and are developed at the company level (Juho et al., 2012). Platform services are different, as they are developed at the level of the whole supply chain and focus on the facilitation and optimization of transactions and cooperation among multiple parties, or the optimization of the supply chain integrated operations. Across the cases in this research, the key platform activities include the establishment and continuous optimization of the platform system, collecting and sharing market information, coordinating communication among platform members (players from both supply and demand sides), conducting quality control and assurance, and so on.

> *Our company is responsible for the quality control on the side of [primary and supplementary] service providers, and meanwhile we are in charge of optimizing order management on the side of customers. (Interviewee, Case B)*

The integrative feature of platform services requires a holistic view of the supply chain. The value creation of the platform service supply chain depends on its systematic efficiency in resource utilization and information sharing among actors on both supply and demand sides, or across the whole supply chain. This leads to the strategic priority of network effects in the platform service supply chain. The direct network effects relate to the size of the system; that is, the number of members including suppliers and customers registered on the platform. The indirect network effects are reflected through complementary invention and value co-creation among members at various positions in the activity flow (Ceccagnoli et al., 2012).

> *We developed 24-hour access to transport insurance for our customers. The integration of customer orders through our platform leads to the need and possibility of having 24-hour access. (Interviewee, Case A)*
>
> *A few innovative services were created based on our platform, e.g., drop-and-pull transport and non-truck-operating common carriers. The connection that we built among logistics parks serves as the foundation for continuous innovation. (Interviewee, Case B)*

We help partners to design and develop new software products. Through joint effort with partners, we provide technology and professional expertise, and partners contribute demand information and product ideas. (Interviewee, Case C)

Role of the platform owner

The three cases in this research highlight the platform owner's role in connecting and matching service providers and customers. The platform owner hence serves as the key to the transformation of operations from the traditional service supply chain to the platform service supply chain.

Our platform aims at improving the industry level of application and management of information technology, increasing supply chain efficiency and reducing costs. (Interviewee, Case C)

Our objective is to build a united community of groups in this sector, like an association… These people [logistics companies] have limited capabilities for and do not excel in coordination with administrative authorities and service providers. They need our platform to help them and they can focus on their specialized businesses. (Interviewee, Case A)

The platform owner's essential function in bridging the supply and demand sides places it at the center of the operation of the platform service supply chain. As a result, the platform owner undertakes the role of leading and managing the optimization of resource use and promotion of transfers among multiple actors. This requires the platform owner to strategically sustain and expand the networks of actors connected via the platform interface for the purpose of enhancing the network effects in value creation.

Table 4 provides a summary of the differences among the platform service supply chain and the traditional product and service supply chains.

Table 4. Summary of differences among product supply chain, service supply chain, and platform service supply chain

	Product Supply Chain	**Service Supply Chain**	**Platform Service Supply Chain**
Structure	Distinctive upstream component and downstream complement	Linear flow of activities with bilateral interactions among actors	Circular flow of activities with triadic interactions among actors
Output of focal firm	Physical product for customers	- Specific professional services for customers - Servitized product for customers	Integrated platform services for both suppliers and customers
Management focus	- Product variety - Customer	- Service variety - Customer	- Platform service - Matchmaking between service provider and customer
Strategic priority	Cost, quality, time, flexibility	Customer satisfaction	Network effect (scale)

4.3 Facilitation mechanism between platform and business ecosystem

The results of the data analysis demonstrate that in the platform service supply chain, the platform owner integrates primary and supplementary services and bridges service providers and customers. This forms the foundation of the triadic interactions for the transfer of resources and information among all actors. Interactions are considered critical if a successful contract between two parties depends on a third party (Chen et al., 2017; Song et al., 2016). In the platform service supply chain, the platform plays an essential role in enabling transactions between service providers and customers. Meanwhile, the operations of the platform also depend on the participation and coordination of partners from both the supply and demand sides. As a result, the critical, triadic interactions in the platform service supply chain enable a circular flow of resources and information among all actors, distinguishing itself from the linear flow of resources and information in the traditional product and service supply chains. The bilateral partnership in traditional product and service supply chains is transformed into multilateral interdependence in a business ecosystem, which features co-evolvement of member actors and co-creation of value through critical and multilateral interactions.

Co-dependence and co-evolvement in the business ecosystem mean that actors share each other's fate while maintaining an independent value proposition that differentiates them from competitors (Adner, 2017; Lu et al., 2014; Rong et al., 2020). The cases in this research demonstrate that three business ecosystems developed through collaboration among the actors involved. Case A features logistics-related commercial services to individual industrial customers. This business ecosystem consists of commercial service providers, logistics companies, and supplementary suppliers (including call center, GPS, and data analytic service providers). Case B features professional logistics services, matching logistics service requests and available resources through linking a number of logistics parks in logistics activities (e.g., transportation and warehousing). This leads to the establishment of a business ecosystem where collaboration is happening among logistics parks in different regions and across all kinds of partners associated with these parks. Case C focuses on a SaaS platform with digital technologies and develops a business ecosystem that facilitates the provision of logistics services. In Case C, software services and information management are key to the connection of supply and demand sides.

In order to understand the development and success of the platform service supply chain, it is important to consider the relationship between the platform and its business ecosystem. The cases in this research demonstrate that the platform enables triadic interactions among actors and achieves a circular flow of resources and information. These interactions serve as the mechanism through which a business ecosystem is established and value co-creation among the actors is realized through the transfer of resources and information (Clarysse et al., 2014). The platform services highlight network

effects from member suppliers and customers, and the platform owner plays the key role in building the networks, sustaining existing members as well as expanding the scope of the network. Taking Case A in this research as an example, the platform owner retains existing members by setting up local offices to facilitate communication and by conducting on-site visits to customers for regular feedback. The platform owner organizes teambuilding events to create a sense of community and group identity among existing members. This is also for the purpose of attracting new members to expand the scope of the networks.

The platform plays an essential role in developing the business ecosystem, and the success and growth of the business ecosystem equally feed back into the sustainable development of the platform. In the example of Case A, the network built by the platform owner facilitated the coordination of local tax and business administration. As a result, the platform received support from governmental authorities (e.g., local tax and business administration bureaus) in facilitating its operation and expansion in the area. Case B provided an example where the good reputation of the platform brings new members into the ecosystem, and the expansion of the ecosystem leads to increasing demand for platform services. This, in turn, brings needs and opportunities to upgrade the infrastructure and technology of the platform in order to fulfill the high requirements for system efficiency. Such upgrades push forward structural improvements in the operation and management of the platform, promoting its continuous optimization.

In conclusion, the results of the data analysis indicate that a *mutual facilitation mechanism* exists between the platform and the business ecosystem in the platform service supply chain. On the one hand, the platform enables critical, triadic interactions among actors within the platform service supply chain, promoting the establishment of the business ecosystem, sustaining its development, and expanding its scope. On the other hand, the success of the business ecosystem feeds into the platform with a good network reputation, rising demand for services, and increasing external support. This pushes the platform to upgrade and optimize its operations and management. The mutual facilitation between the platform and the business ecosystem highlights a dynamic development mode. It facilitates and promotes continuous innovation and improvement opportunities in services and businesses, leading to the emergence of new business models as well as industry sectors. **Figure 6** summarizes the mutual facilitation mechanism between the platform and the ecosystem.

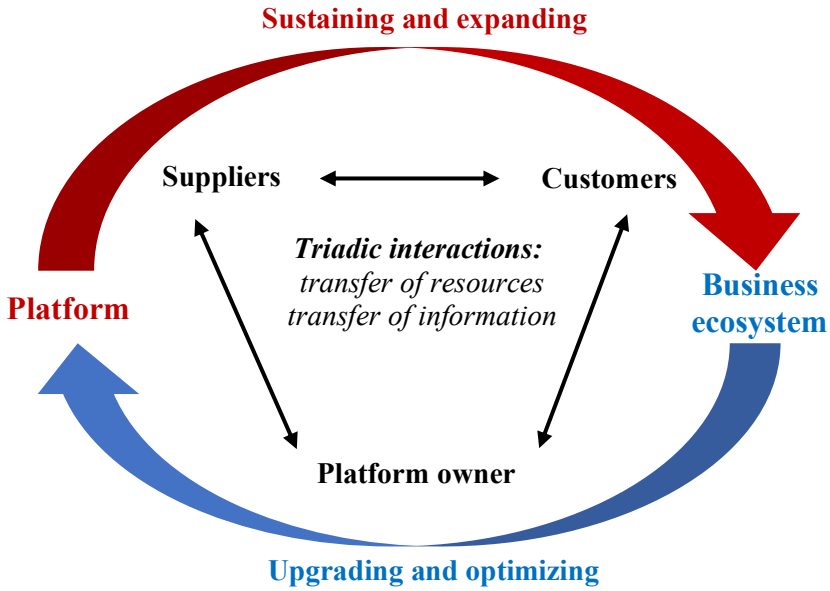


Figure 6. Facilitation mechanism of the platform service supply chain

4.4 From firm-based competition to business ecosystem-based co-opetition

The research result shown that the activities in the platform service supply chain highlight value co-creation and co-evolvement among actors for development and success. This leads to a transformation from the traditional linear flow of resources and information to circular flows, and along with this transformation come changes in the business context for growth and competition: from firm level to ecosystem level.

In the platform service supply chain, the links among actors have extended from dyadic relationships between suppliers and customers to triadic interactions built on the platform. The members connected by the platform form a business ecosystem, where the co-dependence and co-evolvement of members are reflected in their growth as well as competition. For one thing, the platform owner's activities and decision-making have a critical impact on a wide range of members, and hence the strategy and management of the platform affect the development and success of the entire business ecosystem. This means that competition has extended from the individual firm level to the business ecosystem level (Rong et al., 2015); that is, there is competition among different platform service supply chains in the form of different ecosystems against each other. As the platform service supply chain features integrative services for member actors and network effects, it is the proposed value and system efficiency for which the ecosystems compete.

> *We have competitors in the market of specialized services, but we consider our businesses holistically as a system, which involves various services in the supply chain. As a result, the*

one-stop services provided by us are not challenged by specialized service providers. (Interviewee, Case B)

The business expansion of some of our service providers enables them to extend service scope and to gradually evolve into a platform themselves. They then run their own system and become a competitor of ours. (Interviewee, Case A)

The cases in this research demonstrate that competition and cooperation coexist in the development of the platform and the business ecosystem, this also has been evidenced in innovation ecosystem (Bacon et al., 2020). The above-mentioned example from Case A shows that the service provider, through cooperation with Platform A, gradually developed into a separate platform and formed its own business ecosystem to compete with Platform A. This illustrates that cooperation among actors can stimulate competition. Meanwhile, the cases also demonstrate that cooperation among actors can moderate competition. For instance, in Case A, the platform owner had an opportunity to expand its services into a specialized area but chose not to do so. Instead it kept the focus on bridging and matching suppliers and customers. This decision was based on the consideration that the platform's customers run businesses in the same area and by avoiding entering the area, the platform owner was preventing direct competition with partners. Another example is that the platform owner of Case C serves as a software service provider in Case B. These two ecosystems share overlapping actors and activities and their platform owners cooperate in specialized areas. Such examples indicate the platform owners' strategic considerations in balancing cooperation and competition for the stability and success of the ecosystem (Charleton et al., 2018; Hannah and Eisenhardt, 2018). In this research, we term the coexistence and balance of competition and cooperation in the platform service supply chain "ecosystem-oriented coopetition".

In the competition at an ecosystem level, Case A illustrates that customers' decision to choose and switch platforms is based on their loyalty to the system. This depends on their trust in the platform owner and their business dependency on the primary, supplementary, and platform services. Under circumstances where strong trust or high dependency is lacking, customers' switching decision is based on the cost/price of services. This points to a service-dominant logic in the platform service supply chain, where services and customers are at the center of competition and success. **Figure 7** summarizes the transformation from firm-based competition to business ecosystem-based co-opetition.

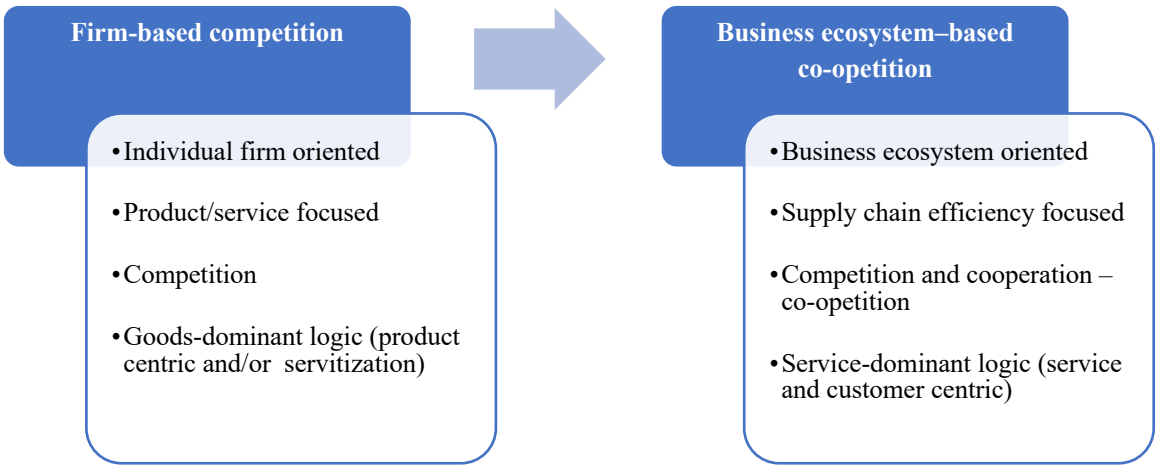


Figure 7. The transformation from firm-based competition to ecosystem-based co-opetition

4.5 Digitalization

The research results highlight the importance of digitalization in the platform service supply chain, this is in line with current literature that digitalization is a facilitator for advanced service offerings in particular when adopting a platform strategy (Cenamor et al., 2017). Information technologies support network connectivity, facilitate innovation, and promote the absorptive capacity of the platform. In this research, the platform services in Case C focus on the use of the internet and information systems. The other cases also demonstrate the importance of digitalization, where the platform owner invests in information technologies, such as big data, cloud computing, and the internet of things (IoT). In these platform service supply chains, the platform owners either develop digital capabilities by themselves or cooperate with supplementary service providers with specialized competence.

Case A exemplifies the need for online capacity from the platform's growth in offline businesses. The platform uses internet technology for the management of customer orders. When the volume of transaction data increased, the platform needed to expand its capacity in information management. Meanwhile, digitalization helped the platform to improve system efficiency through avoiding operational mistakes with the increasing complexity of customer needs and portfolios.

Information technology is also needed for the management of the platform owner's internal business units. Digitalization contributes to the combination and integration of data from multiple areas and activities for a comprehensive analysis. For example, in Case A it was used to analyze customers' credits and profits in order to match their needs with suppliers' services. To some extent, digitalization not only affects focal firm's business (Kohtamäki et al., 2019), but it also pushes focal firm to align with the business of partners within the platform service supply chain. This also facilitates the platform owner's exploration of innovation opportunities as well as the expansion of service range and ecosystem scope, which could eventually lead to business model innovation (Michael et al., 2019).

4.6 Sustainable management of the platform service supply chain

Drawn from the successful development experience of the three cases in this research, this research develops a sustainable management framework (see **Figure 8**) to provide implications for managing the platform service supply chain. summarizes the framework for sustainable management of the platform service supply chain.

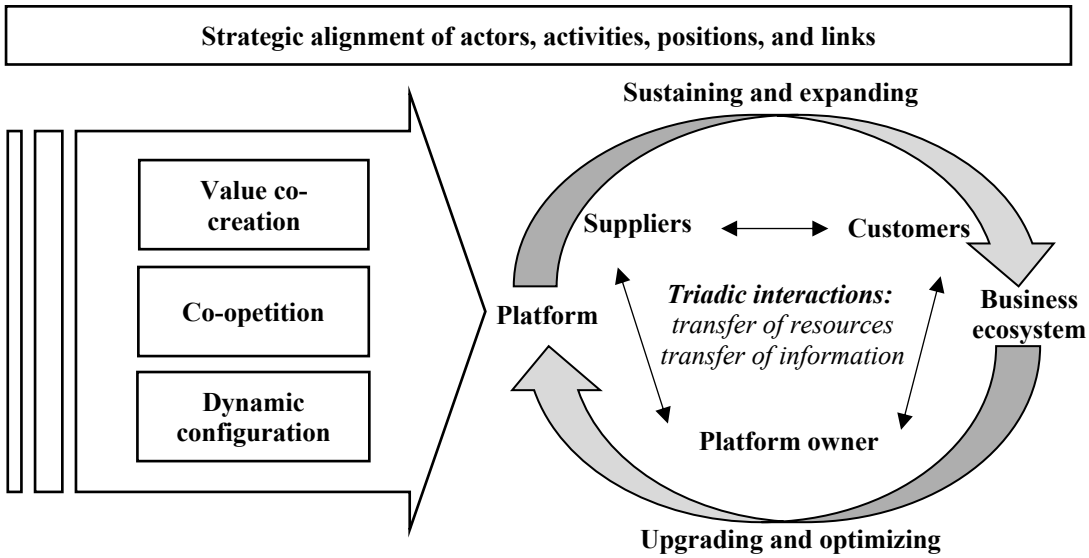


Figure 8. Sustainable management framework for the platform service supply chain

The discussion in Section 4.3 indicated that once the business ecosystem forms, the platform leads to the alignment of ecosystem actors and their interactions in value **co-creation** and **co-opetition**. The platform owner plays a key role in sustaining and expanding network connections, promoting the transfer of resources and information among actors, and balancing competition and cooperation. This requires the platform owner to develop a clear strategic vision for the value proposition of the holistic supply chain.

The three cases in this research show that to sustain growth, all platform owners established clear visions of co-created value with member suppliers and customers. The platform in Case C aimed to serve as the access to the biggest business-to-business (B-to-B) logistics ecosystem in China and to improve the industry level of information technology management. In Case B, the platform owner has the objective of building a mainline transportation network that connects 60 cities within China. In Case A, the platform aims at extending the geographic scope of services to countries of the Belt and Road Initiative, with the objective of contributing to environmental sustainability by promoting resource sharing, increasing resource efficiency, and reducing waste. The strategic vision on the proposed value guided the platforms' operations and decision-making. It was discussed in Section 4.4

that Platform A once faced the option of entering a new service area for business development, but decided to focus on its core activity of bridging and coordinating suppliers and customers. Platform A's choice avoided direct competition with its suppliers in their specialized service areas and led to stable cooperation among actors in the ecosystem. Such a balance between cooperation and competition also demonstrated the platform owner's strategic priority of the proposed, co-created value of the holistic platform service supply chain.

The development of the platform service supply chain goes through various stages and features a **dynamic configuration** of actors and interactions. The interviews in this research collected retrospective information on the platforms' development and hence reveal their strategic focuses at different stages along the development cycle. For example, at its initial birth stage, Platform B adopted a "light asset model" through building connections with existing logistics parks rather than building logistics parks itself. This was for the purposes of saving resources and facilitating the establishment of platform services. Entering the expansion stage, the platform faced increasing complexity in the business portfolio, and this led to its decisions on recruitment and investment in financial services for efficiency in internal management. In the meantime, the platform established cooperation with supplementary service providers to benefit from their infrastructure and expertise in data analytics activities. The cases in this research illustrate the platform owners' dynamic configuration of actors and interactions along the development cycle of the business ecosystem.

All three cases in this research are currently in the expansion stage in terms of the platform development cycle. This stage features fast growth in services that call for strong network connections and effects. The platform owners face the generic risk in network externality (Katz and Shapiro, 1994) – the under-utilization of platform services. In Case A, the platform provides over 70 different kinds of services, among which 20 were frequently used by customers and make up 90% of the platform's turnover. Platform A hence faces the need to promote the usage of other platform services. The platform in Case B is under a similar pressure: the platform owner offers a standard price for transport services to match service providers and customers. Platform B can only gain profit at the standard price when the volume of orders reaches a certain threshold. If the services are under-utilized, Platform B faces losses.

The solution to under-utilization is to expand the range and increase the number of users (Adner, 2017); that is, the ecosystem members. For the purpose of maintaining existing users, the platform owner in Case A is observed to adopt a membership hierarchy with a standardized algorithm of selection criteria and corresponding incentives. The platform provides different incentives to customers at different levels, for example inviting high-level customers to join teambuilding and networking events that provide exclusive access to key market information. Case B demonstrated a similar effort in relationship management and adopted a clear member-sustaining strategy through profit-sharing with partners. For the exploration of potential new users, the platform owner in Case A

is considering expanding its services from B-to-B to business-to-consumer (B-to-C), to attract individual and other non-logistics entrepreneurs to join the network. The platform is also exploring similar potential among its supplementary service providers, to whom the platform can possibly offer more services. These examples from the cases show that the platforms developed systematic structures and processes to sustain and expand network connections with members of the business ecosystem.

This research adopts the business ecosystem framework to analyze the structure of the platform service supply chain. It highlights the strategic alignment among actors in different positions, through the configuration of activities and via the corresponding links (Adner, 2017). The results of the data analysis indicate that in the platform service supply chain, the platform and its business ecosystem mutually facilitate each other's development and success. The sustainable management of the platform service supply chain therefore requires maintenance and improvement of the mutual facilitating mechanisms and elements. The platform leads the development of the business ecosystem through dynamically configuring actors and activities for value co-creation and balancing cooperation and competition in the interactions.

5. Conclusions

This research investigates the nature and management of the platform service supply chain. Building on the extant literature and in-depth studies of three cases in the Chinese logistics sector, it defines the concept and develops a generic structure of the platform service supply chain, and also develops a sustainable management framework for it. Based on the results of the data analysis and discussions, this section summarizes the theoretical contribution of this research as well as its managerial implications for practitioners. The limitations of this research are then discussed along with directions for future studies.

5.1 Theoretical contributions

The research results of the proposed definition and the generic structure of a platform service supply chain are believed to contribute to the current literature bank of logistics service supply chain management. Different from existing literature of service supply chain focusing on customer involvement (Maull et al., 2012; Sampson and Spring, 2012) or dual direction (Lin et al., 2010; Sampson, 2000), this research emphasized the adoption of platform strategy in the logistics service supply chain, and also applied an ecosystem perspective to observe the operations and management of the platform service supply chain. Hence, the proposed definition and the structure contribute to the foundation of research on platform service supply chain, but also it enhances the understandings of platform service supply chain via extending the traditional firm level view to a broader ecosystem

view. This also contributes to the current knowledge on platform-based business models as well as platform services.

Moreover, the identified nature of triadic interactions from this research contributes to the development of the theory of platform service supply chain. This triadic nature is different from the main body of literature highlighting the supplier-customer dyads (Chen et al., 2017; Tseng et al., 2018) in the service supply chain. Investigating into the triadic interactions helps better understand the relationships of actors within the platform service supply chain. Comparing to the traditional product and service supply chains, this research revealed that the platform-enabled triadic interactions transform the linear flows in the traditional supply chains into circular flows of resources and information. This distinguishes this research and the nature of the platform service supply chain from that of the traditional product and service supply chains.

Furthermore, in this research, we investigated the relationship of the platform and the business ecosystem and identified a mutual facilitating mechanism between them, this is a further development on the knowledge of the relationship between platform and business ecosystem (Rong et al., 2018). The research results highlighted that the platform plays the essential role in sustaining and expanding the network connections and effects to promote the growth of the business ecosystem; and the healthy development of the business ecosystem brings opportunities to upgrade and optimize the platform's operations and management.

This finding enabled our development of a sustainable management framework for the platform service supply chain and contributes to the understanding of platform strategies as well as business ecosystems. The experiences of the three successful cases of platform service supply chains illustrated the impact of a platform strategy on the development of the business ecosystem, and the focus on the Chinese logistics sector shed light on logistics platform development in emerging markets.

5.2 Managerial implications

This research drew on three cases of platform service supply chains, where a platform strategy successfully led to the healthy development of a business ecosystem. Based on the experiences in the three cases, the research results also provide managerial implications for practitioners in the sustainable management of the platform service supply chain.

This research demonstrated that the strategic vision of the platform owner serves as a key factor in its decision-making in sustaining and expanding the business ecosystem. The strategic vision of the platform owner calls for comprehensive considerations over the proposed value of the holistic supply chain, its integrative platform services, as well as its systematic efficiency. This includes not only the supply chain activities in service provision, but also dimensions of the business ecosystem, such as the geographic scope of the networks, the openness of the system, as well as the environmental and social engagement of the platform.

The results from this research indicated that the platform owner plays the leading role in promoting value co-creation and balancing co-opetition within the platform service supply chain. Hence, it suggested that the platform owner needs to align actors and interactions for the purpose of sustaining and expanding network connections and effects within the business ecosystem. Along the development cycle of the platform, the alignment of actors and interactions is a process of dynamic configuration.

The research result also illustrated that at the operational level, a systematic structure of membership management is important for the platform owner. Therefore, this research suggests that it helps if platform owner provide compatible incentives to existing actors as well as attracting new members to join the business ecosystem.

5.3 Research limitations and future research directions

The research is focused on the logistics service industry, hence the research results should be further tested in other industry contexts/sectors to ensure the validity of the results, to further compare the differences from different industry sectors in order to make the results generic, and to enhance the comprehensiveness of the understanding of the sustainable management of the platform service supply chain.

A qualitative case study does not pursue a large sample, but depth of analysis. This research designed and selected three cases for the study. More cases of successful platform service supply chains could serve as meaningful examples to bring insights into the transformation from firm-based competition to ecosystem-based co-opetition, and to enhance the knowledge development of platform service supply chain.

The research was conducted among logistics-relevant companies in China, an emerging economy. There could be further testing of whether the research results would be valid in other emerging or developing country contexts. Furthermore, the results could be compared with the results from developed country contexts, which will ensure a comprehensive understanding of the platform service supply chain.

Appendix 1 List of Interview Questions

Questions
Part 1 – Company profile information
Could you please introduce your company's background and history? (Different stages)
Could you introduce the platform/product/services your company is offering?
Could you explain the structure of your business ecosystem, including what partners are included (suppliers, customers, and other partners), and what kind of relationship you have with your partners? At different stages? If possible, can you introduce your partners to us? (with contact info)
Part 2 – Strategic vision and plan
What is the vision/plan/strategy and key actions of your company at different stages?
What is the vision/plan/strategy for your future (5–10 years, or more)?
Part 3 – Collaboration with partners (interview at focal firms)
How does your company nurture the business ecosystem? Or is the ecosystem latterly originated by itself?
How do you design your business ecosystem? At an early stage, how did you design the configuration structure of the business ecosystem? Or what does your business ecosystem look like?
How do you promote your vision to partners, convincing them to join and stay with your platform at different stages?
How do you encourage partners to work with you to design and develop new platforms/products/services?
How do you cope with ideas or visions that are initiated by your ecosystem partners? Do you have experience with your partners in co-designing visions?
Do you have other methods to promote your business ecosystem visions and make them well accepted by partners, such as investment in your partners?
How do you collaborate with your partners in the business ecosystem?

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