

An Outlook of Platform Theory Research in Business Studies

Tatsuyuki Negoro and Satoshi Ajiro

Abstract

There is considerable diversity in the interpretation of the term “platform” and in the subjects being analyzed in platform theory research in the field of business studies. This paper classifies the genealogy of platform theory research into the following three streams with the aim of elucidating its genealogy and current situation: (1) platform technology theory/platform components theory (2) platform products theory: layer-type platform theory, (3) platform products theory: interaction-type platform theory. A review of the literature indicates that, in terms of the platform technology theory/platform components theory, the core stream of research is platform strategy in product development originating from automobile product development research. The core stream of research in the layer-type platform theory is platform leadership and ecosystems theory related to platform leadership. There are two broad streams of research in the interaction-type platform theory, that is, research focused on (1) platform businesses and (2) two-sided platform strategies. Additionally, this paper suggests the fusion of layer-type platform theory and interaction-type platform theory in platform products theory and development of social platform theory as two future directions for the development of platform theory.

Keywords

platform technology theory/platform components theory, platform products theory, layer-type platform theory (L-PF), interaction-type platform theory (I-PF), platform

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leadership, ecosystem, platform business, social platform theory

1. Introduction

This paper classifies the genealogy of the research focused on the concept of “platform(s)” (hereafter referred to as “PF(s),” where appropriate), particularly in the field of business studies, and identifies the prospects for future research.

Platform theory, as described subsequently, can be classified broadly into (i) platform technology theory/platform components theory and (ii) platform products theory. The former platform theory refers to “common backbone technologies in the configuration or roll out of products” or “common parts that are modularized and used in a variety of products.” The latter platform theory refers to “products and services that only have value when combined with products, services or information supplied by other players (such as companies, consumers).” The common aspect between these two platform theories is that they serve as the foundations for a variety of products and services.

The term “platform” was originally derived from the French word “plate-form,” which means a horizontal surface or tableland.¹ This term subsequently began being routinely used to refer to a podium or stage for public speaking and as a place for boarding and alighting from trains at railway stations. Another usage of “platform” is in the computer industry, where it has a more specialized meaning; in this industry, platform is defined as the “hardware and software that forms the foundation of a computer system” (Publishing Bureau of Nikkei Business Publications, 2004, p. 270). The use of the term platform in the following statement may clarify its meaning in the computer industry: “Operating Systems (OSs), such as Windows, are the ‘platforms for application software to run on.’”

In the field of business studies, there is an accumulation of research regarding the concept of platforms as a basis for examining the competitive advantages of businesses or products and services and the value creation mechanisms in networks between companies, which is a departure from the conventional uses of the term platform. Research has been conducted on a variety of subjects and it ranges in scope; therefore, the term “platform theory” has various meanings.

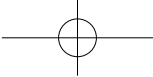
¹ SPACE ALC English “plateau”:

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On consideration of the researched subjects, we find that the concept of platform has mostly been focused on in product development research (Meyer, 1997; McGrath, 2000; Muffatto and Roveda, 2000), and within this, research was predominantly conducted on the automotive industry (Suarez and Cusumano, 2009)². Moreover, considerable research has been conducted on the ICT industry, particularly on the subjects of platform products and services in the computer industry (Deguchi, 1993; Gawer and Cusumano, 2002; Cusumano, 2004), and intermediaries in Internet businesses (Kokuryo, 1995, 1999; Negoro and Kimura, 2000; Eisenmann, Parker, and Van Alstyne, 2006). Most of these studies focus on products and services and their components; however, recently, research has also been conducted for discussing value creation in society using the platform concept focusing on the subject of social communication infrastructure such as community informatization and social networking services (SNSs) (Kokuryo, 2006a, 2006b, 2011; Kokuryo and Platform Design Lab., 2011).

Platform theory research can be classified into numerous different aspects according to the characteristic features of the research subjects. For example, Nobeoka (2006) classified platforms into three types: (1) industry platforms (“industry standards and their design concepts for the purpose of integrating core technologies and parts, complementary technologies and parts, software, etc.” (p. 135)), (2) technology platforms (“groups of unique elemental technologies in particular fields” (pp. 135-136), and (3) product platforms (“product architecture and in particular the design foundations within that” (p. 136)). These classifications are mainly focused on “product function and design concepts,” and primarily target product strategy and R&D/technology strategy. Moreover, Kokuryo (2011) and Kokuryo and Platform Design Lab. (2011) examined platforms from the following two functional aspects: platforms as common elements and platforms as a medium for linkages (emergence). The former focuses on the aspect that is the core for compatibility such as the Windows OS in information systems, and it more or less corresponds to Nobeoka’s (2006) thinking on industry platforms. In contrast, the latter focuses on “linkage media” (Kokuryo, 2011, p. 222), which enabled the connection of diverse elements, which in turn enabled the evolution of the Internet. Specifically, this research focuses on the intermediaries in Internet businesses, such as Internet auction services.

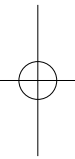
² For example, the common parts of a product, such as a car body (chassis), are referred to as a “platform.”



In this paper, the awareness of the issues begin with understanding the current situation wherein there is considerable diversity in the topics of analysis and the meanings of the term “platform” in platform theory research in the field of business studies, as mentioned above. Numerous studies have clarified the origins of platform theory research and its subsequent development (Suarez and Cusumano, 2009; Tanaka, 2010; Komi, 2011); however, these studies were focused on the platform identification aspects or considered various combinations of platform aspects, and are thus regarded insufficient in terms of actual clarification and organization of the concepts.

Thus, based on a literature review, this paper aims to classify the genealogy of platform theory research into the functional aspects of each of the areas of research focus, and subsequently identify the prospects for future research. We envisage that by doing so, this paper will provide a broad perspective regarding platform theory research in the field of business studies and information regarding current research on this subject.

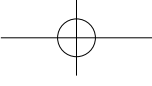
2. Classification of Platform Theory in the Field of Business Studies



As described above, platform theory in the field of business studies has been classified on the basis of the functional aspects of the platforms being analyzed. This paper thus references the streams of research wherein the functional aspects of the analyzed platforms are presented, cites the ideas expounded by Negoro and Kato (2010), and ultimately identifies classifications for platform theory in the field of business studies.

On considering the products and services that have been the subjects of research in platform theory thus far, we find that their platforms can be broadly classified into two types: those where the shared scope of the platform is closed or open only to a few designated companies, and those where it is open to an unspecified number of companies.³

³ The modularization debate is an example of similar topics being debated in the context of “closed/open.” Modules are a design concept used in engineering and other fields, and they form the elements that make up a system. Moreover, modularization refers to “building a complex product or process from smaller subsystems that can be designed independently yet function together as a whole” (Baldwin and Clark, 1997, p. 84). Although there are parts of platforms and modules that conceptually overlap, the difference between the two is that the former is a discussion premised on complementary products and services. In other words, irrespective of whether the shared scope of the



The former platform theory considers, for example, the core technology that is common to many digital products, such as display technology, the chassis in cars, printed circuits in AV equipment, etc. This theory involves debates regarding the design concepts for technologies and components and the fundamental technologies and components for developing various products. In this paper, such platform theory is termed “platform technology theory/platform components theory.”⁴ This platform theory includes the aspects of what Nobeoka (2006) referred to as product platforms and technology platforms.

In contrast, the latter platform theory, where platforms are open and the products and services are subject to the participation of an unspecified number of players other than one’s own company, such as complementary players and users, is termed “platform product theory” (Negoro and Kato, 2010). According to Negoro and Kato (2010), the development of this platform product theory is based on two aspects. One of these aspects is classified as layer-type PF theory, where the discussion is focused on those products and services for which complementary products and services exist, such as game consoles and game software, OSs, and applications. In other words, this aspect focuses on “the products and services, which combined with a variety of complementary products and services, form the foundations that achieve the functions demanded by customers” (Negoro and Kato, 2010, p. 81). The subjects of discussion in this layer-type PF theory are believed to be almost the same as those in Nobeoka’s (2006) industry platforms and Kokuryo’s (2011) common elements as platforms; however, focus on the functional aspects of platforms is characteristic only of the layer-type PF theory. In other words, this theory focuses on the realization of value for customers premised on the existence of complementary players. The second aspect of the platform product theory is classified as an interaction-type PF theory and focuses on services with functions for intermediation between different users, that is, being a medium for communication or transactions, such

platform is open or closed, a module that has complementary products and services can be regarded as a platform. More simply, there is an argument that regards platforms as “modules that provide the base functionality” of products and services (Suematsu, 2002, p. 224).

⁴ The name “product platforms” for product development platforms is thought to be a rational nomenclature; however, in this paper, we shall call these “platform components” to clearly distinguish it from the term “platform product theory,” which is another major stream of platform theory.

as intermediation, settlement, or communication functions. The subject of research for this theory is Internet services, the obvious examples of which are Net auction services and Internet communities; however, electronic money and credit cards, in that they mediate the interaction between consumers and merchants, are also examples. “Products and services that provide a forum for conscious interaction within player groups and between groups” (Negoro and Kato, 2010, p. 81) also fall under this category for discussion, because platforms are considered as a connection medium here, as indicated by Kokuryo (2011) and Kokuryo and Platform Design Lab. (2011).

In this paper, platform theories in the field of business studies are categorized into three theories according to the differences in the functional aspects of the platform that is being studied (Figure 1): (1) platform technology theory/platform components theory, (2) platform products theory: layer-type platform (L-PF) theory, and (3) platform products theory: interaction-type platform (I-PF) theory. Subsequently, we classified the theoretical genealogy and streams of development of the discussions regarding each category.

Platform Technology Theory/ Platform Components Theory		Platform Products Theory	
		Layer-type Platform (L-PF) Theory	Interaction-type Platform (I-PF) Theory
Closed: Limited to one company or shared among a few specified players	<u>Platform Shared Scope</u>	Open: Open to an unspecified number of players	
<ul style="list-style-type: none"> - Fundamental technologies & components for developing a variety of products - Design concepts for technologies & components, etc. 	<u>Subject of Discussion</u>	Products & services that combine with a variety of complementary products & services serve as the foundations that achieve the functions demanded by customers	Products & services that provide a forum for conscious interaction within player groups and between groups
<ul style="list-style-type: none"> - Display technology - Nonwoven technology - Car chassis - Printed circuits in AV equipment - Razor bodies 	<u>Typical Examples</u>	<ul style="list-style-type: none"> - OS (applications) - Smart phones (applications, peripheral devices) - Game consoles (games software) - iTunes (music, video, & other content) - * The items in () are complementary products & services 	<ul style="list-style-type: none"> - Net auctions - Internet communities - Booking sites - Credit cards - Electronic money

Source: Created by the authors (See Negoro and Kato (2010, p. 81) for the “Subject of Discussion” portion of the layer-type PF theory and interaction-type PF theory.)

Figure 1 Three Areas Covered by Platform Theory in the Field of Business Studies

3. Genealogy of Platform Theory in the Field of Business Studies

3-1. Platform Technology and Components Theory

Research that focused on automobile platform commonalization

The platform technology theory/platform components theory originated from the research that originally focused on product industries (Suarez and Cusumano, 2009), and within this, as previously mentioned, research was predominantly conducted on the automobile industry. The background to this research is the move towards platform commonalization⁵ by the automobile industry from the 1980s to the first half of the 1990s (Nobeoka, 1996). Initially, in the 1980s, automakers responded to the demands to continuously develop a variety of products at low costs owing to diversifying customer requirements by developing common platforms used by the companies that had capital tie-ups. In the late 1980s, European automakers moved on to integrating platforms between multiple brands. Subsequently, in the early 1990s, as the recreational vehicle (RV)⁶ market expanded, Japanese automakers started using the same platforms for RVs as the ones they used for the cars that were their main product lines, with the objective of effectively utilizing their business resources.

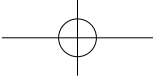
In concert with a series of these moves was the appearance of research dealing with platform commonalization in automobile product development (Wheelwright and Sasser, 1989; Wheelwright and Clark, 1992; Nobeoka 1996; Meyer and Lehnerd, 1997). For example, Nobeoka extended the multi-project strategy map, which is a concept proposed by Wheelwright and Sasser (1989) to deal with multiple product development projects, and discussed how automakers deploy platforms among multiple product development projects. These studies focusing on platforms in automobile product development apparently provided the first research findings for the platform technologies and components theory.

Platform Strategy/Management Research Centered around Meyer's Work

The research group centered around Meyer's work, while still researching the subject of automobile product development (Meyer and Utterback, 1993), extended the

⁵ Here, automobile industry platforms "stipulate the car's basic structure (architecture) and components are structured around the floor pan and suspension system" (Nobeoka, 1996, p. 34).

⁶ RV stands for "recreational vehicle" and this is the generic term used for station wagons, box wagons, off-road 4WDs, and semi-cab wagons (Nobeoka, 1996, p. 36).



focus on platform technology theory/platform components one to a broader discussion regarding product development management. Based on Meyer (1997), the research group indicated that a company's continued success does not originate from a single product, but is fueled by product families comprising a core technology and derivative products. For example, razor manufacturer Gillette builds its competitive advantage, not by producing a single product, but by producing product families of razors with multiple derivative products. According to Meyer's research group, it is possible to efficiently create product families from a core technology foundation that is common to all the products. This research group interpreted platforms, which are the core technology foundation, as "an aggregate of the subsystems and interfaces that make up the common structure for the efficient development and manufacture of derivative products" and developed the debate on this basis (Meyer and Lopez, 1995; Meyer and Zack, 1996; Meyer and Seliger, 1998; Meyer, 1997; Meyer and DeTore, 1999).

Product development management with the platform as the "lever," dealt with in the Meyer's research group is "the strategy and management for performing technological commonalization between product lines strategically as well as systematically, and for handling multiple product development projects in an integrated manner" (Nobeoka, 2006, p. 137) and is referred to as platform strategy/management.

Companies pursue platform strategies/management with the following three broad objectives (merits) (Eisenhardt and Tabrizi, 1995; McGrath, 2000; Muffatto and Roveda, 2000; Nobeoka, 2006). First, to improve product development efficiency. Platform commonalization enables companies to maintain low costs and to flexibly develop a variety of products. Second, to expedite product development. In market environments where customer needs are not only diversifying but also rapidly changing, companies are required to carry out new product development continuously to succeed in the face of fierce competition; utilizing platforms enables companies to carry out product development that promptly responds to these needs. Third, to build robust organizational capability. When multiple product developments are managed independently, building sustainable organizational capabilities is difficult (Nobeoka, 2006). Designing and developing platforms that support multiple products contributes to building organizational capacity.

However, companies have also encountered a few issues related to platform strategy/management. First, platforms restrict the directions of the product families generated from them (Meyer, 1997; Muffatto and Roveda, 2000). This is the downside of platform strategy/management, and since the platform is the starting point, it limits the

direction of and possibilities for innovation in product development. Second, there is a lack of differentiation among products that are generated from a common platform. Despite the advantages of reducing costs and expediting product development, excessive platform communalization leads to a loss of product features and lowers competitiveness. Apparently, platform communalization was one of the factors that contributed to the reduction of Nissan and Chrysler's competitiveness in the 1980s (Nobeoka, 2006).

Platform Technology Research

The discussions regarding platform strategy/management form the core of the genealogy of platform technology theory/platform components one (Tatikonda, 1999; Krishnan and Gupta, 2001; Funk, 2002; MacCormack and Verganti, 2003). The focal point of discussion in this theory is platform components, which are the foundation of the development of a variety of products. In Japan, after Nobeoka's (1996) automobile product development research, platforms, which are the development foundations for a variety of products as the basic tools in product domain strategies, have been classified into two types (Nobeoka, 2002). The first type is product platforms (referred to as "platform components" in this paper), which are the product design concepts and framework architecture for development, for example, car chassis, printed circuits in AV equipment, etc. The second type is platform technology, which is the core technology that supports multiple products, for example, the display technology common to product families of personal computers (PCs) and cell phones.

The term "technology" in the second type of platform, given that the term has many possible meanings, has been discussed as a part of "platform components" in the existing research; however, Nobeoka (2006) has classified elemental technology platforms as an independent category. In this paper, we introduce the research pertaining to platform technology, which has been steadily generated in recent years, after discussing the platform technology theory/platform components one.

For example, in Marukawa, Yasumoto, Imai, and Shiu (2007), the communalization of Printed Circuit Board (PCB) platforms by makers of cell phone handsets and the communalization of chipset units mounted on multiple types of PCBs, are discussed as "technology platforms" (p. 10). As a corporate technology strategy issue, Sakakibara (2005) states that it is important to build a "technology platform as a fertile seedbed" (p. 251) that goes beyond individual technologies and products in order to continuously produce individual technologies, products, and businesses. Furthermore, through System on Chip (SoC) case studies, Koyama (2006) stated that in order for

companies to succeed in the SoC field, it is important to build a hierarchical application platform for product development with a “technology platform that is silicon technology with integrated device process technology and manufacturing technology” (p. 210) as its foundation. These discussions also can be said to have been, since the beginning, in line with what has been referred to as core technology in the context of companies’ technology strategy management. It is anticipated that future bodies of research pertaining to platform technology will be based on and extend these schools of thought.

3-2. Platform Products Theory: Layer-type PF Theory

Deguchi’s Platform Industry Research

Layer-type PF theory is a series of discussions dealing with “the products and services, which combined with a variety of complementary products and services, form the foundations that achieve the functions demanded by customers” (Negoro and Kato, 2010, p. 81). Here, differing from the platform technology theory/platform components theory in the previous section, the subject of discussion is shared platforms that are open to an unspecified number of complementary players.

Deguchi (1993) was probably the first researcher to study the subject of such platforms in the field of business studies.⁷ In the course of examining the characteristics of network industries, typified by the computer industry, Deguchi (1993) reinterpreted “platform industries” as “industries where it is possible to provide some sort of device or software as a platform in addition to some sort of service” (p. 45). Subsequently, Deguchi’s (1995) defined platforms as “equipments or systems, or even standards that provide more fundamental services that make it possible to connect service providers (servers) and service users (clients)” (p. 23). Furthermore, Deguchi (1996) made the hierarchical relationship between computer clients and servers the focus of his research. Further, as a precondition for a horizontal client-server relationship to be achieved, he defined low-order goods and services from a vertical perspective (p. 46) as “platform goods.” It can be envisaged that these platforms in Deguchi’s series of studies are discussed as “low-order structures (foundations) that prescribe the high-order structures, which can be interpreted hierarchically, in products and industries” (Negoro and Kato, 2006, p. 7).

⁷ Although Suematsu (1991) had used the platform concept in the management information systems field before Deguchi (1993), his study is said to have been only an examination of “platform” as a technical concept (Deguchi, 2005).

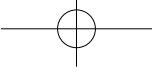
Group of Studies Pertaining to Network Externalities

In this section, we study the “network effect” (Katz and Shapiro, 1985, 1986, 1994; Shapiro and Varian, 1999; Rohlfs, 2003) in information economics as a theoretical genealogy that has influenced layer-type platform theory to supplement our research; this was also studied by Deguchi (1993, 2005). Generally, the network effect refers to the “nature of benefits obtained from the increase in the sale of a product because of an increase in the number of users of that product” (Kobe University Graduate School, Business Administration Research Office, 1999, p. 676). Katz and Shapiro (1985) interpreted network effect as “the user benefits generated when the number of other people using the product increases” (Negoro and Kato, 2008, p. 5). The successful example of the Windows OS clarifies the reason for the significance of the network effect in the layer-type products and services debate, that is, the benefits that the network effect generates are important incentives when complementary players and users choose a platform (Negoro and Kato, 2008). Given this, in relation to the strategies of platform companies that provide layer-type products and services, Negoro and Kato (2008) indicated that when discussing the network effect, it is important to consider not just the number of people accessing the network but also the value (frequency and importance) of the accesses to the network.

Gawer and Cusumano’s Platform Leadership Research

We now return to the discussion of the genealogy of layer-type products and services. In Japan, since Deguchi (1993), numerous studies have been confirmed to have the same level of awareness of the issue (Yoda, 1998; Suematsu, 2002; Negoro and Tsutsumi, 2004). On the other hand, a group of studies by Gawer and Cusumano (2002, 2004, 2008) and one by Cusumano (2004) developed layer-type platform theory outside Japan.

Although Gawer and Cusumano (2002) did not clearly define the term platform, they interpreted it as “a core product that exists within a single system of products or services produced by various companies” (Japanese translation, 2005, p. i). Here, the core product is something that is “(1) part of a system that is itself evolving and (2) not valuable itself without complementary products or services” (Gawer and Cusumano, 2002, p. 131). From this explanation of platforms and definition of core products, it can be said that Gawer and Cusumano (2002) developed a layer-type PF theory based on the precondition of complementary products and services being supplied by various external companies and not just a single company.



Of these studies, the research of “platform leadership” focusing on companies such as Intel, Microsoft, and NTT DOCOMO (Gawer and Cusumano, 2002) is particularly important. Platform leadership is the “ability to drive other companies to generate complementary innovation around a special fundamental technology at the broad industry level” (Japanese translation, 2005, p. i). Gawer and Cusumano (2002) classified the subjects that platform leadership managers have to decide on to demonstrate platform leadership into four categories and termed these categories the “four levers” (p. 40).

Lever one is the “scope of the firm.” This lever describes “what to do inside the firm, and what to let external firms do.” (Gawer and Cusumano, p. 40) In other words, this item addresses the issue of what should be produced internally and externally with regard to complementary products. Lever two is “product technology.” This refers to the “system architecture (the degree of modularity), interfaces (the degree of openness of the interfaces to the platform), and intellectual property (how much information about the platform and its interfaces to disclose to outside firms). Lever three is “relationships with external complementors.” This lever refers to the issues related to the power balance with complementary companies, and includes “how collaborative versus competitive should relationship with complementors be, how will consensus be created, and how will conflicts of interest be handled.”⁸ Lever four is “internal organization.” This refers to the organizational strategy issue of the type of internal organizational structure that should be in place to support the three levers mentioned above.

Based on this conceptual arrangement of the four levers, Gawer and Cusumano (2002) conducted case studies for analyzing the actions actually taken by platform leaders. This platform leadership research was subsequently developed by Negoro and Kato (2006) and Gawer and Cusumano (2008). Negoro and Kato (2006) added core technologies to Gawer and Cusumano’s (2002) platform concept and interpreted the structure of the final product, including the platform, hierarchically. Following this, they advocated a framework assuming that high-order and low-order players sandwich both sides of the platform and suggested the “revenue model” as the “fifth lever,” which considerably influences the incentivization of high-order and low-order players. In contrast, Gawer and Cusumano (2008) studied the current situation and found that many companies were not succeeding in becoming platform leaders; they attributed this to the failure of the strategies of the companies to appropriately deal with both the

⁸ The definitions of lever 1-3 are more or less the same as those given in Gawer and Cusumano (2002, p. 40); however, we have made some grammatical changes.

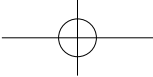
technical and the management aspects of platform leadership. Thus, Gawer and Cusumano (2008) stated that two strategy options, coring and tipping, should be considered as strategies to overcome issues related to both these aspects. Coring refers to the structural design issues of a platform, and tipping is the management of the contributing factors to the platform in a market that is based on the structural design of the platform.

Ecosystem Theory and Platform Leadership Research

Gawer and Cusumano (2002) indicated that platform leadership aims to have a strong controlling influence on the “ecosystem,” which comprises platform and complementary products (Negoro and Kato, 2006). While investigating the relationship between the platform leader and complementary players at the end of the discussion of the genealogy of layer-type platform theory, we will introduce the ecosystem theory⁹ (Moore, 1993, 1996; Iansiti and Levien, 2004a, 2004b; Adner, 2006; Iansiti, 2008).

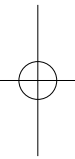
Although Iansiti and Levien (2004b) were influenced by Moore, they employed the following description of the concept of ecosystem: a concept that likens the network relationship between companies to a biological ecosystem and represents the situation of mutual interdependence of a multitude of loosely connected participants for the purposes of joint survival and development. The roles of the companies in the ecosystem are then

⁹ Sugiyama and Takao (2011) advocated classifying the manner in which ecosystem concepts have been used in prior research and subsequently performing the demarcation of ecosystems from the perspective of value creation. The newly proposed definition of ecosystems from this perspective is as follows: “A collection of agents that contribute by developing and producing artifacts for the realization of a new value system concept.” Although the ecosystem concept in existing research was “substantialism” (where it is assumed that the concept counterparts actually exist), this definition can be said to be “under construction” (where the concept is established for analysis). In the existing research, the “system borders” (the criteria for judging what is an ecosystem element) are said to be unclear; however, the new definition is said to indicate the theoretical border judgement criteria of “contribution to realization of the value system concept.” Sugiyama and Takao (2011) asserted that this definition is the foundation for the analysis of ecosystem formation, including cases where the parties involved are unaware that there is an ecosystem, or cases when they include agents who are not in a direct trading relationship or do not have an information relationship with the platform company.

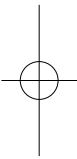


classified into keystones, dominators, hub landlords, and niche players. The indicators productivity, robustness, and niche creation are used to measure the healthiness of the ecosystem, and they indicate that a healthy ecosystem necessitates the existence of rules and a company to play the role of the keystone. Moreover, in Iansiti and Levien (2004b), the platform is a series of solutions that enable the ecosystem members to use the platform through access points or interfaces and the keystone is a “package” to share the ecosystem and the value.

The movement of on-premises software to cloud services software was cited as an example of innovation by Inansiti (2009) to indicate that thriving ecosystems have the three core principles of “opportunity, choice and interoperability.” Here, choice refers to the principle that companies should be tolerant of customers and partners choosing other companies’ competing complementary products and services, even if the platform product company supplies similar complementary products and services. Opportunity is the principle of encouraging access to the platform by developers, innovating platform technology, and enabling the creation of new products and services based on these. Interoperability refers to the principle that vendors should make products that can use the complementary products of rival products.



Considering what these studies have indicated, the keystones in Iansiti and Levien’s (2004b) ecosystem theory appear to be virtually the same concept as referred to by platform leaders in Gawer and Cusumano’s (2002) work. Moreover, in Iansiti and Levien (2004b), the ecosystem member companies performing common problem solving is a key function of the platform; they also examine subjects, such as the issue of the degree of openness of the platform, indicating the key tenets of platform management, as in Gawer and Cusumano’s (2002) four levers. Furthermore, Adner (2006) defines the three risks that are inherent in ecosystems as follows: (1) initiative risks, (2) interdependence risks, and (3) integration risks. In terms of risk management, each of these risks is a problem that can arise between a company that is attempting to become the center of the ecosystem and companies involved in the ecosystem. This issue can be considered as the key tenet of risk management when the four levers are used. In other words, there are parts where ecosystem theory debate overlaps with platform leadership debate; however, ecosystem theory can be said to have a more holistic standpoint on the relationship with complementary players. Here, holistic means maintaining the value of the overall ecosystem and emphasizing the perspective of expansion.



3-3. Platform Product Theory: Interaction-type PF Theory

Kokuryo's platform business research

In this paper, interaction-type PF theory refers to the discussion focused on “products and services that provide a forum for conscious interaction within player groups and between groups” (Negoro and Kato, 2010, p. 81). In this context, the first research was the research group centered around Kokuryo (Imai and Kokuryo, 1994; Kokuryo, 1995; Kokuryo, 1999).

In the early 1990s, there was debate that the progress of electronic marketplace type transactions (Malone, Yates, and Benjamin, 1987) would probably eliminate all middlemen. However, the Harvard Business School research team, of which Kokuryo was a member, through case studies of leading-edge Internet services (Konsynski, Warbelow, and Kokuryo, 1989), suggested that trust between trading parties, that is, between companies and consumers, is important in e-commerce and that this trust is imparted by entities other than existing intermediaries (Kokuryo, 2011). Moreover, at the time, although they did not use the term “platform” directly¹⁰, Rayport and Sviokla (1994), also members of the Harvard Business School research team, were also conducting research in the context of the case studies mentioned above.

Kokuryo subsequently termed the entities other than existing intermediaries “platform businesses” and defined them as “entities that operate as private businesses and provide the foundation for starting new businesses and stimulating trading between third parties by providing products and services that anyone can access under clear conditions” (Imai and Kokuryo, 1994, p. 4). Therefore, such platform businesses can be said to belong to the category of the interaction-type PF theory, based on its definition presented above.

The types of businesses that were the subject of research at the same time as the case studies of platform businesses can be termed intermediary businesses, such as credit cards, second-hand car auction sites, industry information infrastructure for the everyday sundries industry, etc. (Kokuryo, 1999). Based on the analysis of these case studies, Kokuryo (1999) classified platform businesses as providing the following five functions to effect the same transactions on the Internet as in the case studies: (1) searching for a trading partner, (2) imparting confidence (information), (3) evaluating economic value,

¹⁰ In Negoro and Ogawa (2000, 2001), which was influenced by Rayport and Sviokla (1994), the concept of “context” used by Rayport and Sviokla (1994) was replaced with “platform.”

(4) preparing standard trading procedures, and (5) integrating various functions such as distribution.

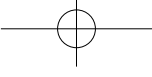
Influenced by the abovementioned issues in Kokuryo's (1999) research, Negoro and Kimura (1999, 2000) subsequently classified the platform businesses introduced by Kokuryo (1999) into the following three categories. The first category is "infrastructure-type platform businesses," which are private businesses that provide the foundation for enabling production and commercial transactions among unspecified entities. Credit card businesses and application services providers are examples of this category of platform business. The second category is "transaction mediation-type platform businesses," which refers to private businesses that mediate between business entities to stimulate trading between them, for example, real estate agents, information magazine businesses, and auction businesses. The third category is "Internet platform businesses," and is a subset of the transaction mediation-type platform businesses. These are private businesses that are involved in enabling communication between multiple third parties on the Internet and stimulate commercial transactions; an example of this type of business is second-hand car auction sites, as noted by Kokuryo (1999).

Two-sided Markets Theoretical Research

The platform products and services that are a subject of discussion in I-PF theory are the forums where interactions among multiple players can occur and "sides" (player groups) consist of two or more players. In economics, discussion concerning the economic principles of the platforms that have two or more multiple sides has been pursued as the theorization of two (Multi)-sided markets theory (Caillaud and Jullien, 2003; Rochet and Tirole, 2003; Hagiu, 2008; Evans and Schmalensee, 2010).

The development of the two-sided markets theory centered around the arguments put forth by Rochet and Tirole (2003, 2006). According to Rochet and Tirole (2006, p. 645), two-sided markets comprise "markets in which one or several platforms enable interactions between end-users and try to get the two (or multiple) sides "on board" by appropriately charging each side." Credit and differed debit cards (interaction between cardholders and merchants), video games (interaction between consumers and consoles and software developers), etc., are examples of two-sided markets (Rochet and Tirole, 2003).

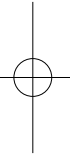
The characteristic feature of these two-sides markets is that (indirect) network externalities operate "between" the sides of these markets (Fuke, 2008). For example, this structure works effectively in case of credit cards because the higher the number of



merchants who accept credit cards, the greater the convenience for cardholders, and the higher the number of cardholders, the greater the revenue for merchants. Evans and Schmalensee (2010) used a mathematical model to discuss critical mass = the critical point, where the sizes of the indirect network effects¹¹ in two-sided markets (more or less synonymous with the cross-side network effect described below) and the direct network effects (more or less synonymous with the same-side network effect described below) changes greatly.

Recently, influenced by the theoretical research in the field of economic science described above, platform research from an interaction-type platform theory perspective has also been progressing in the field of business studies (Eisenmann, Parker, and Van Alstyne, 2006; Hagiu and Yoffie, 2009). The details of this discussion and the core concepts are provided below. Currently, this platform research is at the front line in the I-PF theory genealogy.

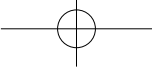
Two-sided Platform Strategic Studies



Influenced by the two-sided markets theory, the research group centered around Eisenmann, Parker, and Van Alstyne (2006) has been developing the two (multi)-sided platform strategy in the field of platform research in business studies. Eisenmann, Parker, and Van Alstyne (2006) define platforms as “products and services that bring together groups of users in two-sided networks” (p. 94). Examples of platforms that employ a two-sided platform strategy include PC operating systems (consumers and application developers), web searches (searchers and advertisers), and shopping malls (shoppers and retailers).

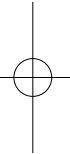
One of the key concepts in this strategy is the “network effects” that exist among user groups (Armstrong, 2006; Eisenmann, Parker, and Van Alstyne, 2006; Eisenmann, 2007). There are two types of network effects. The first type is the “cross-side network effect” and its occurrence can be explained as follows: when the number of users in one of the groups (sides) increases, the value of the platform rises or falls for the user group on the other side. For example, considering the case of the PDF Reader by Adobe Systems, the greater the number of PDF format files publically available on sites, the more the number of users using PDF Reader. The other network effect is the “same-side network effect” and its occurrence can be explained as follows: when the number of users increases,

¹¹ To the best knowledge of the authors, the concept of “indirect network effects” first appeared in Shapiro and Varian (1999).



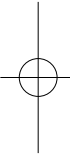
the value of the platform rises or falls for the users belonging to that group. For example, the greater the number of friends who use PDF Reader in a group, the easier it is for the friends to exchange PDF format files amongst the group. The management of these network effects leads to increased platform value or lets a specific platform “winner-take-all.”

Another key concept when considering two-sided platform strategy is “multihoming costs.” Multihoming means the simultaneous use of multiple platforms and homing costs refer to the total costs that will accrue to a user to continue to participate in a platform, that is, from the implementation and operation stages of the platform to its removal (Eisenmann, 2007). Here, the characteristic feature is that the higher the multihoming costs, the more easily a platform tends to become the sole winner. For example, if one tries to use two different social network services (SNSs) and finds that doing so is time consuming, then he/she may ultimately use only one of those SNSs. For platform companies pursuing a two-sided platform strategy, ascertaining the existence of these multihoming costs and managing them may lead to the company’s platform becoming the sole winner or enable it to challenge the platform of the top company.



What Eisenmann, Parker, and Van Alstyne (2011) conceptualized as a specific platform company strategy was the platform envelopment strategy. They proposed this strategy for platform products and services as “an alternative mechanism to platform leadership that does not require dramatic innovation or Schumpeter’s creative destruction.” More specifically, this is the strategy of “a platform company achieving entry into another company’s market by connecting the company’s own functions and the target company’s business functions using common components and (or) shared customer relationships in a form that bundles multiple platforms.” For example, Microsoft bundled Media Player for free with its Windows OS to counter RealPlayer from RealNetworks, which was the leader in the multimedia viewer market.

In parallel with this research by Eisenmann and others, Hagiú’s research group also conducted research focused on two-sided markets (Evans, Hagiú, and Schmalensee, 2006; Hagiú, 2006; Hagiú, 2008; Hagiú and Yoffie, 2009). The work of Hagiú and Yoffie (2009) warrants special mention because their research was conducted from the perspective of complementary players, making it distinct from other research, which generally tended to conduct the discussion from the perspective of a platform company. Specifically, their work indicates the key tenets for selecting a multi-sided platform when complementary players move into multi-sided platforms. In particular, it identifies the following two noteworthy points: (1) how can we differentiate ourselves from



competitors that are conducting business on the same platform, and (2) how can we reduce or mitigate the risk of holdup once we have decided to play (Hagiu and Yoffie, 2009, p.80). The characteristic feature of Hagiu and Yoffie (2009) is that it suggests the behavioral criteria from the perspective of complementary players.

Strategy of Parallel Platforms

Negoro, Kamaike, and Shimizu (2011) presented the strategy of parallel platforms, which is a further development of the two-sided platform theory. A parallel platform market is a market where two two-sided platforms form a set. The markets for Web browsers, video software, e-books, music distribution, etc., are examples of parallel platform markets. More precisely, a parallel platform market is defined as “a market in which the platform that supplies complementary products (such as content) and the platform that uses complementary products mediated by a shared platform (a joint platform of interfaces between PFs, such as standards or specifications) exist in parallel as a set.” In addition to the strategic management challenges of two-sided platforms with regard to (1) network effect across platforms, (2) platform differences between platforms, and (3) multi-homing of platforms, Negoro, Kamaike, and Shimizu (2011) also discussed the existence of the following two challenges as strategic challenges peculiar to parallel platforms: (4) management of platform product as a set, and (5) management of connective platform.

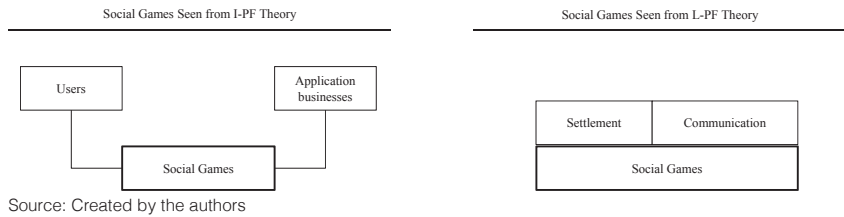
4. Outlook of Platform Theory in the Field of Business Studies

Thus far, we have studied the three streams in the genealogy of platform strategy theory in the field of business studies. Here, with regard to the outlook on how the genealogy of platform theory research will develop in the future, we would like to draw attention to the research that is currently underway and summarize platform product theory from two perspectives.

4-1. Fusion of L-PF Theory and I-PF Theory in Platform Products Theory

As seen above, within platform theory in the field of business studies, research of the two aspects of platform products theory, layer-type platform theory and interaction-type platform theory, has progressed independently of each other. Although the characteristic features of only one aspect of these platform products and services have been considered at one time, in reality, platform products and services have aspects of both the layer-type products and services in addition to that of being an interactive place.

For example, let us consider social games (Figure 2). One of the aspects of social games is that they are an interaction-type platform that provides a forum for interaction between the game users and the application provider businesses. However, on the other hand, when social games are seen as complementary products (services), such as the settlement services required to use social games or the communication services between players, it is also possible to regard them as layer-type products and services.



Source: Created by the authors

Figure 2 Two Aspects of Platform Products and Services

This implies that although one or other aspect tends to be stronger depending on the product or service, platform products and services always have both a layer function and an interactive function. Negoro and Kato (2010) is an example of a research wherein layer-type and interaction-type PF theory are merged and reviewed from the perspective of the two aspects of the platform product theory, which is an integral structure with two sides. Negoro and Kato (2010) focused on this structure of platform products and services and comprehensively defined platform products and services as “the products and services, which combined with a variety of complementary products and services, form the foundations that achieve the functions demanded by customers and provide a forum for conscious interaction among player groups” (p. 81).

Based on the precondition that platform products and services have two aspects, the following can be envisaged as subjects for independent research relating to platform product theory in future. In terms of the interactional aspect, perhaps it is necessary to pursue what type of management would increase the network effects between sides, such as ingenuity when it comes to the revenue model, or the pursuit of winner-take-all or mechanisms to counter it. Moreover, regarding the layer aspect, the challenges of managing complementary products and services, such as product function strategies based on the precondition of complementary products and services or designing incentives for complementary players, could be the subject of research. Here, an important consideration is that subjects for research into these two aspects should not be examined

separately, but together in an integrated manner with the approach of improving the overall value of platform products. Works such as Negoro and Kato (2010), which examined the winner-take-all mechanism in platform products and services, adopted this approach.

4-2. Development into Social Platform Theory

Another prospect that can be envisaged is the expansion of the subjects of research. As discussed briefly at the beginning of this paper, research concerning social infrastructure, which investigates value creation in society using the platform concept, has recently been conducted. For example, Kokuryo (2006a, 2006b, 2011) and other studies have discussed the designing, building, and operating community information platforms to revitalize local communities. Kokuryo states that the interaction between the entities when this happens should be moderately restricted and points to “platforms as language spaces” consisting of the four elements of lexicon (concept sharing), context (transmission protocols), grammar (interpreting experiences through shared experiences), and rules (code of conduct). The fact that the entities involved in revitalizing local communities are restricted by this platform does in fact build incentives to establish trust and cooperation between the entities.

It is believed that these studies by Kokuryo (2006a, 2006b, 2011) and Kokuryo and Platform Design Lab. (2011) expand on his prior research into interaction-type PF theory in platform product theory (Kokuryo, 1995, 1999) and applies the idea that platforms are designable artifacts (Kokuryo, 2011) to platforms in the community. In fact, Kokuryo and Platform Design Lab. (2011) notes the following five points as the key variables for designing a platform: (1) designing the communication patterns, (2) designing roles, (3) designing incentives, (4) designing a mechanism to develop psychological conditions that are necessary for enabling collaboration among people, and (5) management of the internal changes of participants. They state that it is effective to consider these variables from various perspectives to design a well-balanced platform. Certainly, parts of the design concepts of platforms in business and platforms in the community overlap. However, designing and building a community platform requires an awareness of the social context in which the platform will be embedded (Kokuryo, 2011), for example, relationships of trust in the local community and relationships with existing local communities. The examination of a field of research that could be termed “social platform theory,” for expanding on platform product theory by incorporating consideration of the contributing factors peculiar to community platforms, could

probably be a subject of study for platform theory in the future. It may be useful to incorporate a policy studies type approach as a part of the social platform theory research, such as a policy study, for example, of community science theory (Kaneko, 1999; Kaneko, Tamamura, and Miyagaki, 2009) and volunteer and non-profit organization (NPO) theory (Tao and Kawano, 2004).

5. Conclusion

In this paper, we confirmed the genealogy of platform theory research in the field of business studies and the front line of research for each of the following three streams: (1) platform technology theory/platform components theory, (2) platform products theory: layer-type platform theory, and (3) platform products theory: interaction-type platform theory (Figure 3).

In terms of platform technology theory/platform components one, we confirmed that although this theory originated with automobile product development research, platform strategy/management has subsequently been developed by targeting product development in a broad range of fields. Moreover, in terms of platform technologies, we indicated that research has been conducted in the context of technology strategy. Although layer-type platform theory has its genesis in the discussions put forward by Deguchi (1993), research such as research of platform leadership (Gawer and Cusumano, 2002) and ecosystem theory (Iansiti and Levien, 2004) was central to the genealogy of this theory. Interaction-type platform theory was made up of two main streams: the research by Kokuryo (1995, 1999) and others into platform business and the series of discussions by Eisenmann and Hagiu on two-sided platform strategies influenced by developments in economic science theory in recent years.

With regard to the outlook for the abovementioned streams of research, this paper suggested the fusion of L-PF theory and I-PF theory in platform products theory and the development of social platform theory as examples of the two directions for the development of the platform theory. The requirement of this paper was to present a clear awareness of the schools of thought in previous research and to explore the research challenges peculiar to platform theory by independently studying the platforms that were the subject of the research. We hope that, towards that end, this paper will be useful in “structuring and classifying the streams of the prior research.”

Types of Platform Theories	Types of Studies	Key Literature
Platform Technology Theory/ Platform Components Theory	Platform commonalization in automobile product development	Wheelwright and Sasser (1989); Wheelwright and Clark (1992); Meyer and Utterback (1993); Nobeoka (1996); Meyer and Lehnerd (1997)
	Platform strategy management in product development (Meyer's research group)	Meyer and Lopez (1995); Meyer and Zack (1996); Meyer and Seliger (1998); Meyer (1997); Meyer and DeTore (1999)
	Platform strategy management in product development (other than the Meyer's research group)	Eisenhardt and Tabrizi (1995); Taitkonda (1999); McGrath (2000); Muffatto and Roveda (2000); Krishnan and Gupta (2001); Funk (2002); McCormack and Verganti (2003); Nobeoka (2006)
	Platform technology	Nobeoka (2002, 2006); Marukawa, Yasumoto, Imai and Shiu (2007); Sakakibara (2005); Kouyama (2006)
Platform Products Theory: Layer-type Platform (L-PF) theory	Network externalities (related to L-PF theory)	Katz and Shapiro (1985, 1986, 1994); Shapiro and Varian (1999); Rohlfs (2003); Negoro and Kato (2008)
	Layer-type products and services, platform industries	Deguchi (1993, 1995, 1996, 2005); Yoda (1998); Suetatsu (2002); Negoro and Tsutsumi (2004)
	Platform leadership	Gawer and Cusumano (2002, 2004, 2008); Cusumano (2004); Negoro and Kato (2006)
	Ecosystem theory (related to L-PF theory)	Moore (1993, 1996); Iansiti and Levien (2004a, 2004b); Adner (2006); Iansiti (2008)
Platform Products Theory: Interaction-type Platform (I-PF) theory	Platform businesses	Konsynski, Warbelow and Kokuryo (1989); Rayport and Sviokla (1994); Written and edited by Imai and Kokuryo (1994); Kokuryo (1995, 1999); Negoro and Kimura (1999, 2000)
	Two-sided markets theory (influenced by two-sided platform strategy research)	Rochet and Tirole (2003, 2006); Caillaud and Jullien (2003); Evans and Schmalensee (2010)
	Two-sided platform strategy	Eisenmann, Parker and Van Alstyne (2006, 2011); Evans, Hagiu, and Schmalensee (2006); Hagiu (2006); Eisenmann (2007); Hagiu (2008); Hagiu and Yoffie (2009)
	Strategy of Parallel Platforms	Negoro, Kamaike, and Shimizu (2011)

Source: Created by the authors

Figure 3 Main Studies and Genealogy of Platform Theory in the Field of Business Studies

Acknowledgments

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