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Growth of a platform business model as an entrepreneurial ecosystem and its effects on regional development

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ABSTRACT

This paper analyses the dynamics of platform business models as an entrepreneurial ecosystem and its effects on regional development. Here, we seek to answer the following research questions: (1) What effects do platform business models have on regional development? (2) What factors and structures affect the dynamics of platform business models? (3) How can we describe the dynamics of platform business models in app stores and hotel-booking industries? To answer these questions, the authors first analysed two platform entrepreneurial ecosystems in the smartphone app store industry (Google Play's Android market and Apple's App Store) and two ecosystems in the hotel-booking industry (Hotels.com and Booking.com). Second, we analysed the effects of platforms as entrepreneurial ecosystems on the regional development of Daegu Metropolitan City. We used in-depth interview methods with a semi-structured questionnaire, system dynamics (SD) simulation, a literature review, and a statistical analysis as research methods. The results of these analyses yielded the following findings. First, platform business models as economic ecosystems motivate a change of regional development from focused areas to multiple areas, from a hierarchical structure of firms to a network of diverse firms, and from scope and scale economy-based firms leading regional development to creative economy-based firms leading regional development. Second, we identified three category factors that were important in a platform ecosystem, and built up and simulated causal and SD models of these factors. Third, we found that the dynamics of platform ecosystems differ from platform to platform because the openness of platforms produces different effects on firms according to the industry to which they belong.

KEYWORDS

Platform business model; economic ecosystem; regional innovation system; open business model; regional development

1. Introduction

1.1. Research questions

Nowadays, we cannot not escape the effects of platform business models such as Android store, Appstore, Hotels.com, and Booking.com in normal life. These kinds of platform

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business models not only change individual economic lives but also regional innovation systems (RISs).

The purpose of this paper is to analyse the dynamics of platform business models and their effects on regional development. As such, we seek to answer the following research questions:

(1) What factors and structures affect the dynamics of platform business models?
(2) How can we describe the dynamics of platform business models in app stores and hotel-booking industries?
(3) What effects do a platform business model have on regional development?

1.2. Research scope and method

The authors analysed two platforms – Google Play (Android market) and Apple's App Store – in the smartphone app store platform business model industry. We also analysed two firms – Hotels.com and Booking.com – in the hotel-booking platform business model industry. These two representative smartphone app store platforms, and two hotel reservation platforms are major platforms in the industries to which they belong. So, these platforms are selected to analyse the effects of platform business models on regional development.

This study used interview methods, brainstorming, literature reviews, simulation, and statistical analysis together. Based on the interview and literature review, causal loops, simulation models of target platform models, of Daegu and Seoul were developed. The simulation models were facilitated by brainstorming and interviews, which were subsequently validated. Additionally, we analysed the effects of platform business models on Daegu regional development by in-depth interviews, literature reviews, and brainstorming by the co-authors. Appendix 1 shows the in-depth interview list and the semi-structured questionnaire used in this study. We used an Analytic Hierarchy Process method to measure the degree of openness of supplier and user. In addition to this, we also used intensive brainstorming among the co-authors who have worked in software industry, and used hotels mainly in Daegu and Seoul, Korea. From interview and brainstorming, we give a high openness value of 0.9, medium openness 0.1, and low openness 0.1 according to a2 Vensim system dynamics (SD) program toolkit. And a statistical analysis to identify the effects of platforms on regional development was added.

2. Literature review and research framework

2.1. Literature review

2.1.1. Open innovation and business model platform

The question of whether providing a new technology to secondary developers stimulates innovation is central to public policy and firm strategies in many high-tech industries (Boudreau, 2007). However, there is scant systematic evidence on this situation, wherein a kind of platform for open innovation (OI) or supplier innovation exists (Chesbrough, 2003a, 2003b; Lyons, Coronado Mondragon, Piller, & Poler, 2012). Platforms provide architectures to combine internal and external innovations in ways that create

value throughout the chain of activities that deliver useful technology to the market (Chesbrough, 2003a). In addition, within the networked world, firms are recognizing the power of the Internet as a platform that can co-create value with customers (Sawhney, Verona, & Prandelli, 2005).

Many high-tech industries offer products or services that can be described as systems of interdependent components built around or on top of 'platforms' (Gawer & Henderson, 2007). Because of this, the behaviour of platform owners towards other firms in the ecosystem has been subject to much scrutiny. There are two fundamentally distinct approaches to the opening of a technology platform and the different kinds of impact they have on innovation (Boudreau, 2010). One kind of impact is granting access to a platform, thereby opening up markets for complementary components around the platform. The other is giving up control over the platform. When a technological system continues to innovate after it has been opened, a new trade-off, which might be referred to as 'diversity versus control', will occur (West, 2003). Indeed, drawing on external knowledge has been one of the more persuasive arguments to open up innovation to the outside (Chesbrough, 2003; von Hippel, 2005).

Leading platform owners have strongly focused on attracting and tying external complementary firms to their platforms (Jeon, Kim, & Koh, 2015). As such, these complementary firms apply to several distinct types of control mechanisms along with their external innovation process, including the following: (a) market regulative control, (b) co-regulative control, (c) restrictive control, (d) sanction control, (e) motivational control and (f) informative control (Scholten & Scholten, 2012). These control mechanisms can be applied at dedicated phases of the platform-based innovation process to steer external complementary innovation efforts on top of the platform. Basically, platform innovation can drive the growth of an enterprise (Meyer & Mugge, 2001). Several software (SW) platforms, such as smartphone app stores or hotel-booking platforms, drive innovation and transform industries (Evans, Hagiu, & Schmalensee, 2006).

We also looked into previous studies with regard to hotel-booking platforms. One study characterized online reviews for small and medium hotels in Portugal. This paper collected and analysed 1500 online reviews for 50 small and medium hotels. It found several key factors that appear in online reviews about hotels (Chaves, Gomes, & Pedron, 2012). One case study of the online hotel market claimed that online travel agents (OTAs), such as Booking.com, play an important role in building hotel reputation. Moreover, these OTAs encourage hoteliers to exert effort for the quality of their service. This shows that the information supplied by past guests through OTAs generates a price premium for hotels with good reputations. The information gleaned from customer reviews is of great interest to both companies and consumers because it is usually presented in the form of unstructured free text. As such, automatically extracting and rating user opinions about a product is a challenging task (de Albornoz, Plaza, Gervás, & Díaz, 2011). The electronic distribution of room information, prices, and availability has changed the channels that people use to reserve hotel rooms, from travel agents and hotel chains' call centres to using online booking platforms (Carroll & Siguaw, 2003; Tso & Law, 2005).

Studies on smartphone app store platforms were also reviewed. Application distribution platforms or app stores, such as Google Play or Apple's App Store, allow developers and users to submit feedback to downloaded applications in the form of ratings and

reviews. An earlier study investigated how and when users provide feedback, inspected the feedback content, and analysed its impact on the user community by analysing over one million reviews from Apple's App Store (Pagano & Maalej, 2013). SW vendors lack the perspective to develop SW within a SW ecosystem. The inability to function in a SW ecosystem has already led to the demise of many SW vendors, leading to loss of competition, intellectual property, and, eventually, jobs in the SW industry (Jansen, Finkelstein, & Brinkkemper, 2009). Mobile application stores have revolutionized SW and content delivery, in that these stores focus on applications, building around them an ecosystem of developers and consumers (Cuadrado & Dueñas, 2012). The Apple App Store disallows platform customizability, and applications that overlap with existing functions are rejected. At the other end of the spectrum, the Android store-based platform functions (e.g. keyboard, authentication) can be replaced by market applications. Recent years have witnessed incredible popularity and adoption of smartphones and mobile devices, accompanied by a large amount and a wide variety of feature-rich smartphone applications (Zhou, Zhou, Jiang, & Ning, 2012). For example, a number of third-party alternative marketplaces have also been created to host thousands of apps (e.g. to meet regional or localization needs). Even though some portion of the mobile app explosion can be understood by SW reuse in the Android mobile app market along two dimensions – reuse by inheritance and class reuse – a more significant portion should come from the platform attribute (Ruiz, Nagappan, Adams, & Hassan, 2012).

Studies on causal loop and SD of open innovation were last reviewed. The causal loop of the national innovation system (NIS) was developed and applied to analyse effects of OI policy on the NIS (Yun, Won, Hwang, Kang, & Kim, 2015). This study used the simulation results of OI policy to the NIS to build up the Cambodian NIS. Another study proposed a dynamic model of an OI economy system that includes OI sub-economy, closed innovation sub-economy, and social innovation sub-economy (Yun, 2015). The existence of a causal loop and well-operating dynamic relations among three sub-economies were pointed out as the key factors for conquering the growth limits of capitalism in this research. Another research analysed the relationship between technology, business model (BM), and market in autonomous car and intelligent robot industries (Yun, Won, Jeong, et al., 2016). The causal loop between technology, BM, and market including other additional factors was proven by a network analysis of patent citations and references, intensive interviews, and literature reviews in autonomous car and intelligent robot industries in this study.

2.1.2. The role of open business model platform in RIS

It is misleading to talk about innovation 'systems' as 'ecosystems' (Mazzucato, 2015). An ecosystem hence can be defined as a network of interconnected organizations, connected to a focal firm or platform, which incorporates both production and use of side participants and creates and appropriates new value through innovation (Autio & Thomas, 2014). So, open business model (OBM) platform is a kind of entrepreneurial ecosystem. An innovation system is multi-sectoral or multi-clustered (Chesbrough, 2006).

Strange attractors motivate regional innovation in special conditions. For example, if regional path dependence leads to path interaction and new path creation, business or organizational innovation at the micro scale and regional industrial innovation at the macro scale occurs (Cooke, 2013, 2016). By the way, a regional development platform

is a kind of tool for regional innovation policy and strategy (Harmaakorpi, 2006). Several regional innovation platforms such as Bayern Innovative, EcoPlus, Marche were analysed as an adjacent possible innovation pathway (Cooke, 2013). OBM platform in RIS is a kind of strange attractor because OBM platform makes path interaction and new path creation among all joiners of platforms even though it is a software (SW) platform (Yun, Won, & Park, 2016).

RIS has three important components such as financing in the configuration of an RIS, the systemic dimensions of learning and innovation, and productive culture as the institutional setting (Cooke, Uranga, & Etxebarria, 1997). An OBM platform belongs to one of three important components of RIS, the systemic dimensions of learning and innovation.

Constructed advantage based on RISs that transceive over long distances as well as through regional networks is becoming the model of choice for achieving accomplished regional economic development (Cooke & Leydesdorff, 2006). An OBM platform is a kind of constructed advantage.

2.2. Research framework

This work builds on the research framework shown in Figure 1. Platform firms generally have a supplier platform, a customer platform, and industrial characteristics. A supplier platform opens (what/who?) to a supplier wherein the supplier and platform firm interact to innovate at such point. Thus, a supplier platform triggers supplier-based OI or supplier OI (Gassmann, 2006; Gassmann, Enkel, & Chesbrough, 2010). Articulated and global customer platforms open up their BM to other firms (Kodama & Shibata, 2015; Patra & Krishna, 2015). As such, customer platforms are similar to OBMs (Chesbrough, 2010, 2012, 2013). OBMs allow ideas to travel from invention to commercialization through at least two different companies and not just through a hosting company. There are several platforms that have different characteristics in accordance with the industry it

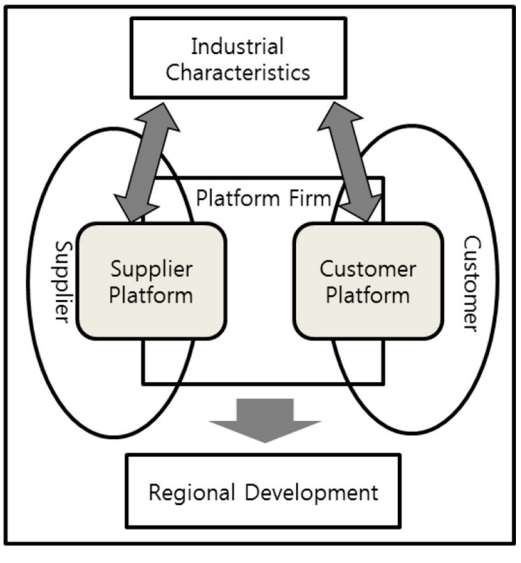

Figure 1. Research framework: structure of platform firm.

belongs to (Carroll & Siguaw, 2003; Cuadrado & Dueñas, 2012; Pagano & Maalej, 2013; Yacouel & Fleischer, 2012).

From the research framework, we built basic components for the dynamic models of a hotel-booking platform and a smartphone app store platform: the supplier platform, which is a kind of supplier OI platform with openness from low to high levels; the customer platform, which is a kind of OBM platform with openness from low to high levels; and industrial characteristics, which should be concretely found in the industry. Last, we will look into the effects of supplier and customer platforms on regional development.

3. Analysing platforms

3.1. Causal relations of smartphone app store platform and hotel reservation platform

First, we looked into Apple's App Store and the Android market case of the 'supplier side' OI/closed innovation (CI) decision from intensive interviews (Appendix 1) and literature reviews such as Pagano and Maalej (2013) and Yacouel and Fleischer (2012). Apple's App Store and Google Play's Android market have the same level of openness to users, but they have different levels of openness to the supplier (Pagano & Maalej, 2013). Apple has an advantage in the quality of apps, but a disadvantage in the number of apps. On the contrary, Android has a disadvantage in the quality of apps, but an advantage in the number of apps (Table 1).

If a firm chooses OI, the combined impact of the 'advantage in the number of app' and the 'disadvantage in quality of app' to the 'overall value of platform' can differ in accordance with the size of the 'coefficient'. If the coefficient (i.e. impact) of the 'openness to suppliers' to the 'number of suppliers' is greater than that (i.e. impact) to the 'percentage of verified suppliers', OI will be superior to CI. However, if the relative coefficient size (i.e. impact) is adverse, CI will be superior to OI.

Recently, at Apple's App Store, we observed talented app providers who stay in the App Store and leave the Android market. The causal relations are as follows. If the quality of app in Apple's App Store increases, the number of verified transactions (i.e. paid app) increases. And, sales and investment of Apple's App Store increase. In this case, it means that CI may be superior. So, the coefficient (i.e. impact) of 'openness to supplier' to 'percentage of verified suppliers' is greater than the 'number of suppliers'.

Next, we looked into Hotels.com and Booking.com's case of the 'user side' OBM/half-open business model (HBM)/closed business model (CBM) decision. Hotels.com and Booking.com have the same level of openness to the supplier, but they have different levels of openness to the customer (Yacouel & Fleischer, 2012).

Table 1. Supplier side of app store platform business models.

App store	Apple: closed innovation (CI)	Advantage in quality of app	CI → Openness to Suppliers ↓ → Percentage of Verified Suppliers ↑ → Quality of App↑
		Disadvantage in the number of apps	CI → Openness to Suppliers ↓ → Number of Supplier ↓ → number of Apps ↓
	Android: OI	Disadvantage in quality of app	OI → Percentage of Verified Suppliers ↓ → Quality of App ↓
		Advantage in the number of apps	OI → Openness to Suppliers ↑→ Number of Supplier ↑→ number of Apps ↑

Table 2. User side of hotel-booking service platform business models.

Hotel booking	Booking.com: OBM	Advantage in the number of user	OBM → Openness to Customer ↑ → Number of User ↑ → Overall Value of Platform ↑
		Disadvantage in revenue collectability	OBM → Openness to Customer↑ → Revenue Collectability↓ → Sales of Platform↓ → Investment on Platform ↓ → System Quality ↓ → Overall Value of Platform ↓
	Hotels.com: HBM	Disadvantage in the number of user	HBM → Openness to Customer ↓ → Number of User ↓ → Overall Value of Platform ↓
		Advantage in revenue collectability	HBM→Openness to Customer↓→ Revenue Collectability ↑→ Sales of Platform↑ → Investment on Platform ↑ → System Quality ↑ → Overall Value of Platform↑

At this, 'revenue collectivity' means 'the platform's abilities, or possibilities, of actually receiving transaction fee from customers and suppliers'. And, we propose that 'more openness to customer' means that the platform has 'less direct control' on the contacts and transactions between customers and suppliers.

If a firm chooses to adopt OBM, 'Openness to Customer' will be greater than HBM or CBM. Greater 'Openness to Customer' means that the platform has less direct control on the contacts and transactions between suppliers and customers. Because of less control on the transactions between suppliers and customers, 'revenue collectability', that is the possibilities of actually receiving transaction fee from customers and suppliers, will be less with OBM. But with OBM, 'Number of Customers' will increase because the platform will be under less control, and autonomous contacts between suppliers and customers will increase. Thus, the advantage of OBM is having more number of users than HBM/CBM, and the disadvantage of OBM is having less revenue collectability.

In the case that a firm chooses OBM, the combined impact of 'advantage in number of users' and 'disadvantage in revenue collectability' to 'overall value of platform' can differ in accordance with the size of the 'coefficient', as in Table 2. If the coefficient (i.e. impact) of 'openness to customer' to 'number of users' is greater than (i.e. impact) 'revenue collectability', the OBM will be superior to HBM/CBM. However, if the relative coefficient size (i.e. impact) is adverse, HBM/CBM will be superior to OBM. Recently, at Hotels.com, we observed a decreasing number of users of Hotels.com and an increasing number of users of Booking.com, as well as that the overall value of the platform of Hotels.com decreases. In this case, it means that the coefficient (i.e. impact) of 'openness to customer' to 'number of users' is greater than 'revenue collectability'.

3.2. Causal loop modelling of platform

According to the hotel-booking platform or smartphone app store platform, the basic causal relationship models of BM and OI platform dynamics can have five parts such as a decision, a supplier, a user, revenue, and platform as in Figure 2.

The decision part includes the following: (a) OI/closed innovation (CI) decision, (b) OBM/HBM/CBM decision, (c) openness to suppliers and (d) openness to customer (user).

On the other hand, the supplier part includes the following: (a) amounts of supplier, (b) percentage of verified supplier, (c) amounts of app and service and (d) quality of app and service.

Meanwhile, the user part only includes the (a) number of users.

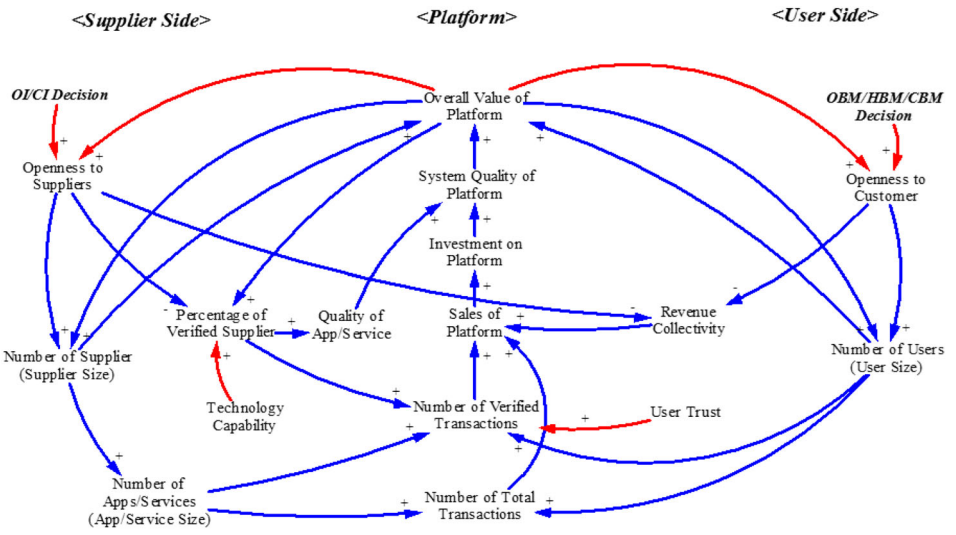

Figure 2. Causal loop modelling of BM and OI platform dynamics.

The revenue part has (a) revenue collectability, (b) amounts of total transaction, (c) amounts of verified transaction and (d) sales of platform.

The platform part has (a) system quality of platform, (b) investment into platform and (c) overall value of platform.

And, like two industries, there will be a balancing loop (BL) in (a) 'open to supplier' and 'percentage-verified suppliers' and (b) 'open to supplier', 'open to user' and 'revenue collectability'. This means that OI and OBM can have a BL in these two parts. OI and OBM are not always the best answer, and they vary based on the situation.

We see here that (1) the OI/CI decision is about the openness to the supplier side, while (2) the OBM/HBM/CBM decision is about the openness to the customer (user) side. OI has perspectives on supplier innovation (Brem & Tidd, 2012). BM is about openness to the customers because BM performs two important functions: it creates value, and it captures a portion of that value (Chesbrough, 2013). The left part of the causal model is a supplier side that includes (a) OI/CI decision, (b) openness to suppliers, (c) amounts of supplier, (d) percentage of verified supplier, (e) amounts of app and services and (f) quality of app and services.

Meanwhile, the right part of the causal model is the user side that includes (a) OBM/HBM/CBM decision, (b) openness to customer, (c) amounts of user (user size) and (d) revenue collectability. The middle part of the causal model is the platform side that includes (a) amounts of total transactions, (b) amounts of verified transactions, (c) sales of platform, (d) investment into platform, (e) system quality of platform and (f) overall value of platform.

If we assume the aforementioned, where a platform has greater overall value, there is a great tendency to open to suppliers and customers. This tendency can arise from (1) its confidence from its success as well as from (2) its intention to grow more and dominate the entire industry or market. With such a tendency and greater overall value, the platform will have more openness to suppliers and customers. Thus, we can have meaningful reinforcing loops (RLs) and BLs, as shown in causal model in Figure 2.

If we look into the loops of the causal model from the supplier side, there are two different kinds of loops such as RLs and BLs. One is RLs such as R1 and R2 in (Table 3). These loops increase the advantage of OI, and motivate faster system growth. The other is BLs such as B1 and B2 in Table 3. These loops increase the disadvantage of OI by damaging supplier quality. For example, a lot of apps which were provided by suppliers at the Android stores have very low qualities. So, many customers decline to pay money to buy Android apps.

If we look into the loops from the user side, there are also two different loops, RLs and BLs. The one in RLs such as R3 and R4 in Table 3. These loops increase the advantage of the OBM and motivate faster system growth. The other is a BL such as B3 in Table 3. This loop increases the disadvantage of OBM, and damages revenue collectability. For example, increase of free apps at Android store motivates decrease in providing high-quality apps to customers.

And, the industry's characteristics are included in the platform. As a platform, hardware, SW, and service will have different industry characteristics: (a) hardware: (1) car, (2) computer and so on; (b) SW: (1) OS, (2) app market and so on and (c) service: (1) hotel reservation, (2) trip reservation, (3) air ticket reservation and so on.

In particular, through intensive interviews, which are shown in Appendix 1, we anticipate that the importance of 'technological capability' and 'user trust' will be different in accordance with the industry characteristics, including confirmation in the smartphone app store and hotel reservation platforms of the Korean market. 'Technological capability' influences the 'supply side' and 'quality of platform', and thus it will be more important in the hardware industry. In this industry, technology takes more time to develop and is harder to copy. 'User trust' influences 'user side' and 'sales of platform', and thus it will be more important in the service industry. In the service industry, quality cannot be directly observed until a user uses it. As such, the other user's experience and the user's trust from using it will be more important than anything else.

We can see the relation between technology capability and platform industry in Figure 2. Technological capability is an important factor that influences a percentage of the verified supplier and, eventually, the overall value of the platform. With more technological

Table 3. Major RLs and BLs in revised causal model.

Supplier side	R L	(R1) Openness to Supplier ↑ → Number of Supplier↑ → Overall Value of Platform ↑ → Openness to Supplier ↑
		(R2) Openness to Supplier↑ → Number of Supplier↑ → Number of Apps/Services↑ → Number of Total Transactions↑ → Sales of Platform↑ → Investment into Platform ↑ → System Quality of Platform ↑ → Overall Value of Platform↑ → Openness to Supplier ↑
	B L	(B1) Openness to Supplier↑ → Percentage of Verified Suppliers ↓ → Quality of App/Service ↓ → System Quality of Platform ↓ → Overall Value of Platform ↓ → Openness to Supplier ↓
		(B2) Openness to Supplier↑ → Percentage of Verified Suppliers ↓ → Number of Verified Transactions↓ → Sales of Platform↓ → Investment on Platform ↓ → System Quality of Platform ↓ → Overall Value of Platform ↓ → Openness to Supplier ↓
User side	R L	(R3) Openness to Customer↑ → Number of Users ↑ → Overall Value of Platform ↑ → Openness to Customer ↑
		(R4) Openness to Customer↑ → Number of Users ↑ → Number of Total Transactions↑ → Sales of Platform↑ → Investment on Platform ↑ → System Quality of Platform ↑ → Overall Value of Platform↑ → Openness to Customer ↑
	B L	(B3) Openness to Customer↑ → Revenue Collectability ↓ → Sales of Platform↓ → Investment on Platform ↓ → System Quality of Platform ↓ → Overall Value of Platform ↓ → Openness to Customer ↓

capability, a platform can technologically and deeply support more suppliers. By this, the percentage of verified suppliers will increase. And, the quality of app and service will increase. Finally, it will increase the overall value of platform. Moreover, it will be more important in 'hardware' than 'SW' and 'service', because in hardware, it takes more time to build such technological capability and is harder to copy. The sequencing of the importance of technological capability among industries is as follows:

Hardware > SW (App Market etc.) > Service (Hotel Reservation etc.). It was confirmed with the Korean market through intensive interviews, which are shown in Appendix 1.

And we can see the relation between user trust and its influence on the platform in Figure 2. User trust is an important factor that influences the 'amounts of verified transaction' and platform sales. With more user trust, the more wiliness a user will have to buy a more verified transaction that requires more payment. By this, sales of platform will increase. And in the end, the overall value of the platform increases. User trust will be more important for services than SW and hardware. This is because in hardware, quality can be observed more easily than SW and service. In service, a user cannot directly observe the quality before he/she uses it. As such, the trust and opinion of another user are more important over anything else. The sequencing of the importance of user trust among industries is as follows: Service > SW > Hardware. It was also confirmed within the Korean market through intensive interviews (Appendix 1).

4. Simulation of platform business models.

4.1. Openness to supplier, and user in Daegu

First, we compare the supplier's openness rate and the customers' openness rate in the industry within the Korean market, which is mainly from Daegu and Seoul, as shown in Table 4.

Apple acknowledges the passive iOS modification of developers, but only for essential aspects, while Google opens the Android OS source to app developers and considerably acknowledges the free right to modify it. As such, the supplier's OI level is 0.5 for Apple, while it is 0.9 for Google.

Apple receives all the rewards for apps and subsequently delivers them to developers with the commission deducted. As such, the customer's OI is only 0.5. On the other hand, most Android apps are provided for free, and most of the rewards for app development are directly transferred to the app developers by allowing in-app purchase and other similar features. Thus, the OBM, that is, customer OI level, is 0.9.

Second, we compare the suppliers' openness rate and the customers' openness rate in the hotel reservation platform within the Korea market, as shown in Table 5. Hotels.com allows hotels (customers) to develop a system, including its own reservation system, while

Table 4. Openness of app store platforms in Daegu.

Platform firm	Supplier openness rate	Customers' oneness rate
Apple's App Store	Middle (0.5) (iOS codes are half-opened to App development firms. Six interviewee firms agreed without exception.)	Middle (0.5) (All iOS paying apps are paid to Apple and transferred to app development firms. Six interviewee firms have the same opinion.)
Google Play (Android market)	High (0.9) (Android codes are open enough to app development firms. Six interviewee firms agreed without exception.)	High (0.9) (Most Android apps are free apps or have an app payment system that offers apps through some payment app policy similar to Apple's App Store.)

Table 5. Openness of hotel reservation platforms in Daegu and Seoul.

Platform firm	Supplier openness rate	Customers' oneness rate
Hotels.com	High (0.9) (Hotels.com codes are fully open to connected hotels. Four big interviewee hotels agreed without exception.)	Middle (0.5) (Hotel fees are paid at Hotels.com and transferred to hotels. Six interviewee hotels agreed.)
Booking.com	Low (0.1) (Booking.com codes are not open to connected hotels. Four big interviewee hotels agreed without exception.)	High (0.9) (All hotel fees are directly paid to hotels and recently some portion is transferred to Booking.com by hotels. Six interviewee hotels agreed.)

Booking.com does not. Thus, the supplier's OI is 0.9 for Hotels.com, while it is 0.1 for Booking.com (Table 5).

Hotels.com receives the hotel lodging charge payment and then transfers it to the hotels with the commission deducted, while Booking.com lets hotels receive the payment and have them pay the commission themselves. As such, the openness of their OBM, that is, customer OI, is 0.5 for the former and 0.9 for the latter.

4.2. Simulation of platform business models of Daegu

The SD model in Figure 3 follows the causal model of platforms in Figure 2. The numeric formulae for this SD model are given in Appendix 2, which is based on logical rationality of causal loop diagrams.

4.2.1. Simulation of smartphone app store platform

4.2.1.1. Industrial characteristic of smartphone app store platforms of Daegu. First, both application platform business models are most affected by suitable app development capabilities among various factors. It is believed that Apple's App Store requires a higher technology capability than Android given that Apple uses Objective C and takes two to three weeks of preliminary assessment for uploading the apps to the platform in the Korea Daegu market. There are relatively many Android app Java-based developers and little preliminary assessment to upload applications, especially in Daegu. As such, the Android platform requires lower technological capability than the Apple platform. In Daegu, Korea, it is common for Android developers to develop Apple apps as hybrid ones, reflecting that the Apple platform requires a higher technological capability.

Second, the trust of users on the technical level of applications is the key as regards to the consumption of paid applications. For instance, users have a high trust on the technical

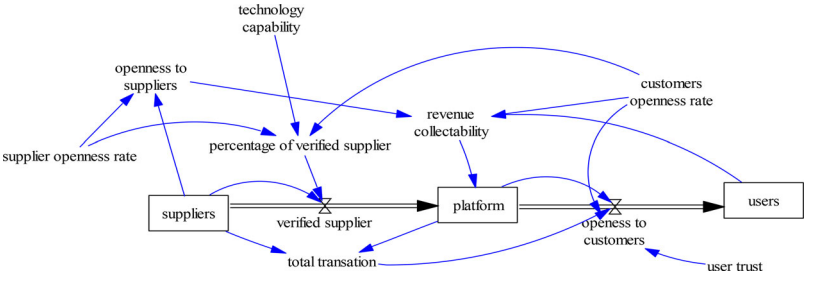

Figure 3. SD model of platform causal loop.

level of paid applications from Apple's App Store, and thus their paid applications are widely consumed. On the other hand, Android app stores have low user trust on the technical level of applications, and hence the consumption of free applications prevails. Therefore, the technical level of an app store platform business model has the key role in deciding the capability and revenue of engaged businesses.

4.2.1.2. Simulation of modern condition of app industry of Daegu, Korea. Based on the focused interview, which is shown in Appendix 1, the technological capability level of the Apple app platform business model is high (0.9) in the Korea Daegu market, while it is still 0.5 for Android, even though it has significantly caught up. In a simulation that took this situation into consideration, the revenue collectability was higher in Apple than in Android, as shown in Figure 4(a). Therefore, the results of the simulation model have practical feasibility in consideration of the industrial characteristics.

4.2.1.3. Simulation of additional condition of app industry of Daegu, Korea. The above is a simulation wherein the Android platform business directly receives the revenue made by the applications or takes more of the app sales revenue (for paid ones) and then transfers 80% of it to the developers later in order to reduce the customer OI rate of Android. The customer's openness rate of Android Platform was accordingly reduced from 0.9 to 0.7 for another simulation. The results show that the Android app store may take over Apple's App Store for revenue collectability (see Figure 4(b)).

Thus, a business strategy to reduce some of the openness of the Android's OBM will lead to the increased profit of platform businesses in Daegu, Korea. It is important to highlight the strategy that the Google Play platform recently considered and tried or practically reinforced the limitations with regard to in-app purchases. This new attempt will be revealed as a result of additional simulation.

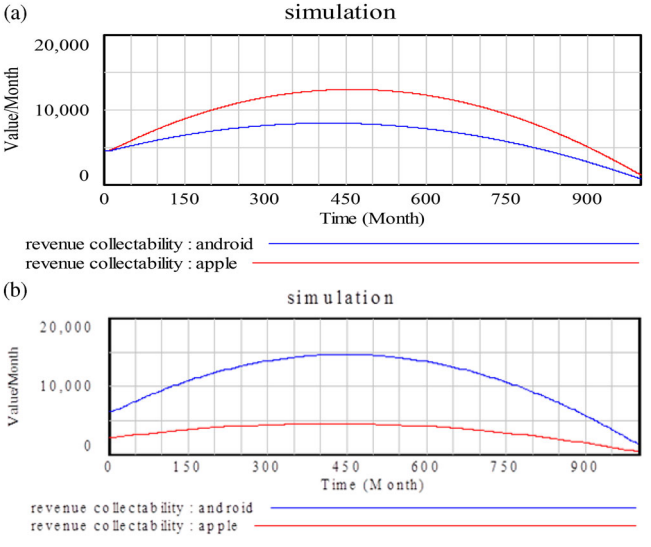

Figure 4. (a) Simulation results of modern conditions in app industry. (b) Simulation results of additional condition in app industry.

4.2.2. Simulation of hotel reservation platform

4.2.2.1. Industrial characteristic of hotel reservation platform of Daegu and Seoul. First, it is more likely for well-known and reputable hotels to be reserved through hotel reservation platforms. Seoul-based hotels are more well known because they have a high domestic and overseas access through the platforms than hotels in Daegu. That is, Seoul-based hotels are more well known than Daegu-based hotels, and hence they have a higher likelihood of being booked through the platforms. Starting in Asia, Hotels.com has introduced Korean hotels to its domestic and overseas users.

Second, those hotel reservation platforms that create many well-known promotions to users have a higher user trust because their hotels are recognized more easily. Hotels.com is making more advertisements and reinforcing promotion, including one free night for those who reserve over 10 nights. Hotels.com is retaining users for longer periods through improved trust.

By examining the industrial characteristic elements of both hotel reservation platform business models, it can be seen that higher user trust leads to more users. In fact, Hotels.com has a higher openness level of supplier OI, as it directly receives room charges and then transfers the revenue to hotels with the commission deducted. As such, customer OI is somewhat low, which is a very hotel-friendly characteristic. Hotels may reduce the risk of cancelled reservations because the platform business receives the room charge in advance. Moreover, it is very convenient for the hotel that the platform takes all the required actions and calculations and simply transfers the payment with the commission deducted. Also, the SW system of the platform is open and well-connected to the accommodation system of hotels, which results in a higher level of convenience.

On the other hand, Booking.com has a somewhat low openness of supplier OI. As such, the platform's SW system is rarely open to hotels, while the users only make reservations through the platform and pay upon arrival, making it a very user-friendly system. It is convenient for users to register at the site and subsequently pay the charge. Therefore, users increasingly prefer the Booking.com platform as they become familiar with it. The increase of Booking.com usage in Seoul, Gangbuk, Gangnam, and Daegu is a proof of this. However, the customer trust improvement of Hotels.com, through promotion, has an effect on user retention. As such, the users are maintained and even the number of users increases as Hotels.com reinforces promotion. Therefore, the customer's trust of Hotels.com is very high (0.9), while Booking.com is relatively low (0.5) because the platform is not sufficiently known in Daegu-based or small hotels (see Appendix 1).

4.2.2.2. Simulation of modern conditions of hotel reservation platforms in Daegu and Seoul. Figure 5 shows the simulation results wherein Hotels.com would have long been chased by Booking.com after a certain time and then taken over by it. This situation is far more feasible in the Seoul market soon, and in the Daegu market, a little late.

4.2.2.3. Simulation of additional conditions of hotel reservation platform of Daegu and Seoul. As shown in Figure 6, if customer OI is reinforced to the same level as Booking.com (0.9), Hotels.com would maintain its superiority for a considerable period. At present, in the Korea Seoul major market and small Daegu market, Hotels.com is introducing a new sales strategy to substantially reduce the commission if existing or new hotel customers, who renew or make new contracts, decide to receive a room charge upon the users'

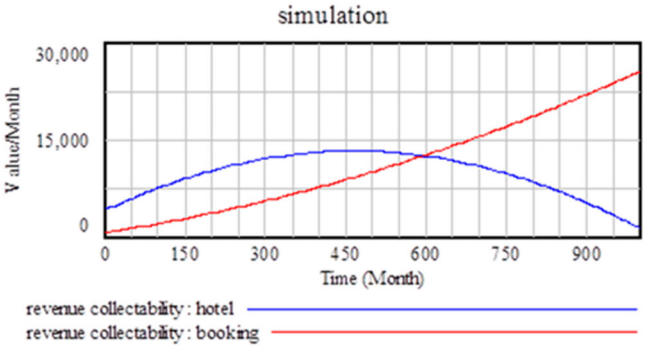

Figure 5. Simulation results of modern conditions of hotel reservation industry.

arrival at the hotels. The new sales strategy of Hotel.com matches the additional simulation results of this research.

5. Regional development

5.1. Expanding and changing of Daegu SW cluster by emerging of smartphone app platforms

App Store or Android store performed a role as a strange attractor that displays 'revealed relatedness' rather than obvious relatedness in the Daegu SW innovation ecosystem. App Store and Android store motivated a huge increase of SW firms in diverse levels, and changed the structure of the Daegu SW innovation ecosystem.

First, SW firms in Daegu changed from Daegu Digital Industry Promotion Agency (DIP) Cluster-based one pole congestion to congestion of diverse poles-based cluster such as DIP, Dong-Daegu Venture Valley, SuSeung Alpa City, SungSeu Advanced Industry Cluster, 3rd Government United SW Centre, and Techno Police + National Industry Cluster, as in Figure 7. This means that the SW cluster of Daegu based on one pole has been changed to a zone based on several poles (Figure 7). App Store and Android store, which are OBM platforms, motivated the emergence of several SW districts with diverse target industries such as smart locking system, smart Internet of Things (IoT), and smart activating.

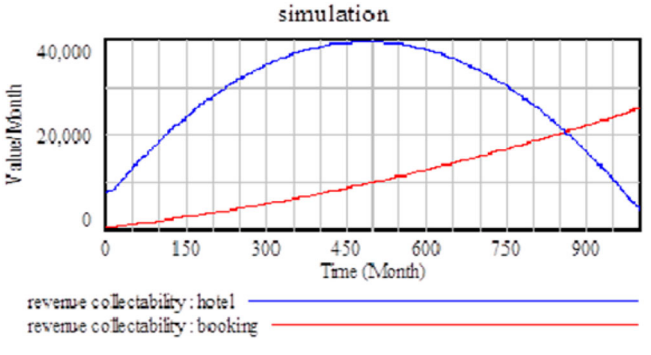

Figure 6. Additional simulation in the hotel reservation platform within the Korean market.

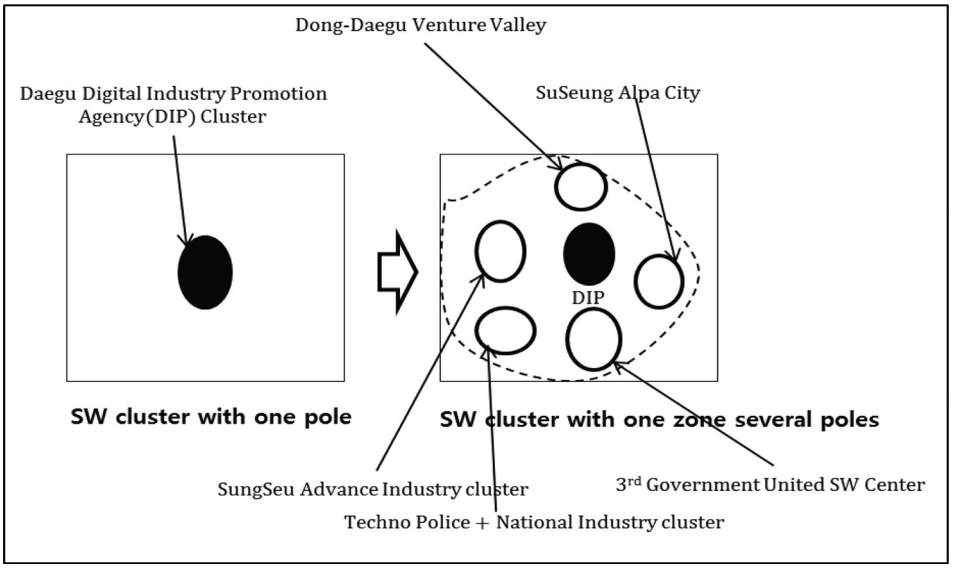

Figure 7. Changing of Daegu SW cluster.

Second, the structure of Daegu SW clusters changed from a hierarchical structure to a network structure. As App Store and Android Store appeared, many small and diverse SW firms appeared in Daegu, and the structure of SW cluster changed from a hierarchal structure to a network structure, as in Figure 8. Emerging diversity of SW firms and sectors in Daegu caused the hierarchal structure of the SW cluster not to operate efficiently, and induced SW firms and sectors to increase networking in the Daegu SW cluster. The

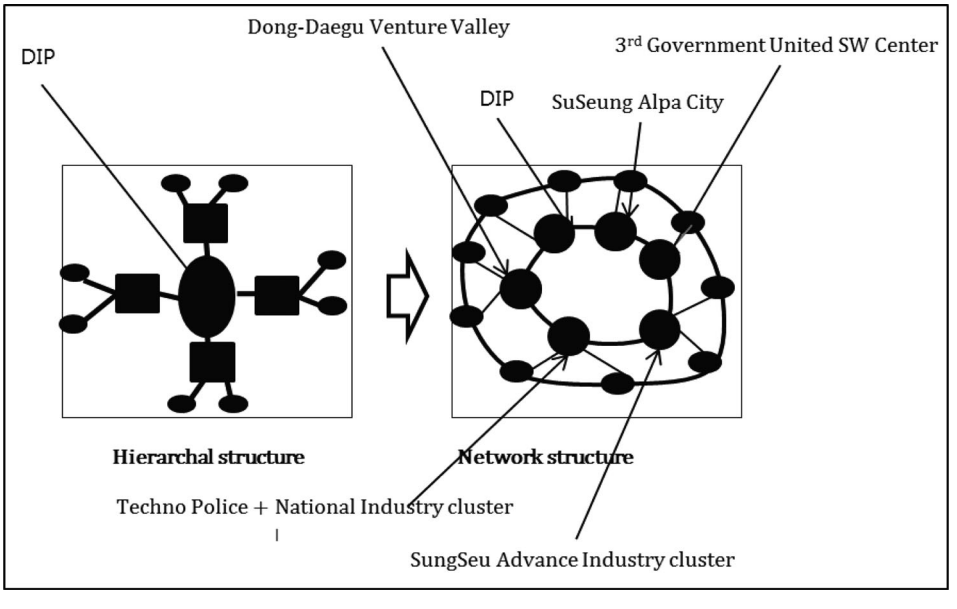

Figure 8. Change of the structure of Daegu SW cluster.

networking structure of the cluster motivates quick changes of firms according to the market, global trends, and newly emerging industry requirements.

The change of structure of the Daegu SW Cluster triggered several functions. First, Smart content sectors such as Contents Korea Lab, Mobile Game Centre, and IT Fusion sports contents centre are appearing. Second, an SW fusion technology support centre, medium-sized firm cluster, and SW developer Welfare Centre are appearing. Third, ICT park and Media Hub are appearing. Fourth, a Daily Health Care Confirmation Zone, local government-connected living lab, and IoT complex support centre are under construction.

But there were also the effects of BL in Daegu SW cluster. DIP, which was the core institute of Daegu SW cluster, is in a dangerous situation right now. DIP is in dissolving situation by the changing of Daegu SW cluster as in Figure 8.

5.2. Expanding and changing hotels in Daegu

Booking.com and Hotels.com also played the role of a strange attractor in the Daegu hotel industry. Booking.com and Hotels.com motivated a sudden increase of hotel use from domestic and foreign consumers. The transition of the amounts of hotel is triggering a change in the structure of the hotel industry in Daegu.

According to Table 6, small hotels including guesthouses with a history of less than five years are appearing diversely as D group. The number of hotels which belong to D group is

Table 6. Hotels of Daegu (example) searched by Booking.com.

Category	Hotel lists	Numbers and characteristics
A group: Big hotels having more than 10-year history	Novotel Embessed Hotel Hotel Inter Bulgo Daegu Hotel Inter Bulgo Exco	3 Hotels having more than 200 beds that mainly invite customers by traditional promotions.
B group: Big hotels having less than 5-year history	Hotel Nostel Midus Hotel Redidence R Hotel W Motel Charra Hotel	5 Despite being big hotels, they try to invite customers through Book.com or Hotels.com.
C group: Small hotels having more than 5-year history	ApSan Business Hotel I+ Motel, Motel AER NaNa Motel, Look Motel Talk Motel, Pink Motel	7 Traditional love hotels that invite customers through traditional practices
D group: Small hotels having less than 5-year history	Good Stay Guest House Daoun House GongGam HanHok Guest House Top Hotel, HaNi Guest House The Style Guest House Glenz Guest House Causal House SoNo Good Stay Hero Tel, Gallery House The HanOk and Spa GongKam DonsungRo Guest House February Hotel ApSan February Hotel HangGum Pan Guest House, BeSta Hostel	16 Several diverse culture-based small hotels including guesthouse are emerging. They are actively using OBM platforms such as Booking.com or Hotels.com.

Source: 27 May 2016 Booking.com hotels in Daegu.

16. D group hotels mainly use Booking.com because they need user openness most of all. For D group hotels, user openness is very important because they do not have enough marketing source. So, the number of hotels of this group searched by Hotels.com on the same day was 13 as in Table 6.

In addition, big hotels having a history of under five years in B group are appearing together in Daegu. The number of hotels which belong to B group is 5. B group hotels mainly use Hotels.com because they want to build up platform connections between theirs and Hotels.com. So, hotels of this group searched by Booking.com on the same day was seven as in Table 6.

These two categories of hotels are using OBM platforms such as Booking.com or Hotels.com more actively than big hotels having a history of more than 10 years or small hotels having a history of more than 5 years.

The structure of Hotels in Daegu has changed dynamically. Most importantly, three different hotel categories appeared as Hotels.com and Booking.com grew. Major hotels normally did not use platforms. In cases where they did use them, they focused on Hotels.-com. Creative small hotels focused on Booking.com and used Hotels.com less.

Hotels in Daegu showed three different trends, as in Figure 9, such as globalization of major hotel groups, diverse business hotel emerging, and emerging of creative small hotels by entrepreneurs. These three trends have relations with OBM platforms. Big hotels in Daegu try to globalize through Hotels.com and Booking.com. Diverse business hotels also try to conquer weak location situations by a price advantage made possible by the OBM platform. Small creative hotels can easily invite customers from Seoul and foreign

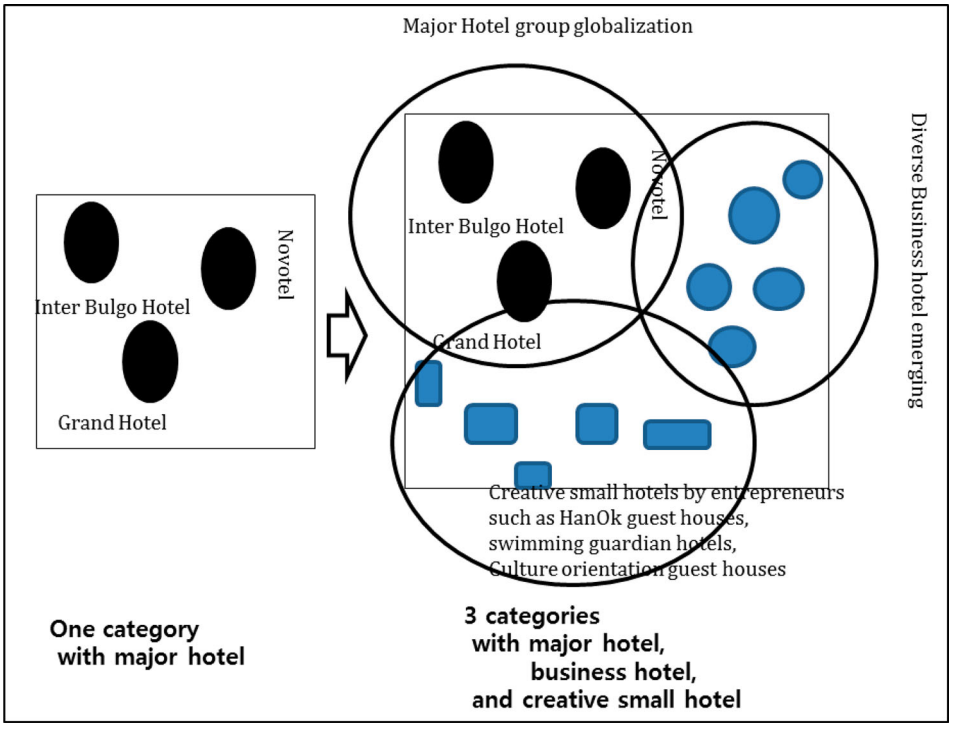

Figure 9. New trends of hotels in Daegu.

country customers without any additional marketing cost through Hotels.com and Booking.com.

But there were also the effects of BL in Daegu hotel industry. Inter Bulgo Hotel, which was the number one hotel of Daegu, is in a dangerous situation right now. The ownership of Inter Bulgo Hotel was changed in 2015 DIP by the new trends of Daegu hotel industry as in Figure 9.

6. Conclusion

6.1. Summary

First, both app store platforms and hotel reservation platforms have the characteristics of a platform business, even though they show some differences in supplier OI and customer OI. Second, the platform business has very strong dynamics for a certain period if both suppliers and customers have open platforms, which are connected through the casual loop of a feedback loop. That is, strong dynamics can lead to a difference in revenue collectability if some elements are changed in the additional simulation. In particular, the App Store platform should concentrate on the reduced customer OI rate of the Android market in the future. On the other hand, the hotel reservation platform should focus on a strategic change of Hotels.com with regard to payment upon arrival.

Third, the platform business has changed the sectorial innovation system of the SW industry and hotel industry. Platforms made dynamic changes in cluster structure and functions of the SW industry and hotel industry of Daegu.

6.2. Implications

First, dynamic change of RISs or clusters can be motivated by an OBM platform. OBM platforms have powerful feedback loops that motivate dynamic development of RISs.

Second, there can be multiple platforms with different characteristics and levels, from the suppliers to the customers. That is, a single business can develop a BM with several platforms. Thus, the practice or analysis of a platform business must simultaneously take into account the characteristics, level, and number of platforms. So, when we introduce new policy or strategy for target platform business models in any RIS, we should keep in mind multiple platforms.

Third, the platform business should focus on quick and dynamic changes through the dynamics' structure. That is, the platform business requires an enterprise strategy that considers the structure and conditions of dynamic change over time, as well as the results, instead of taking a static approach. So, when we introduce new policy or strategy for target platform business models in any RIS, we should focus on dynamics.

6.3. Limitations and additional research goals

First, this research analysed two limited businesses, app stores and hotel reservation platforms for the Korea Daegu and Seoul market, and their effects on the Daegu SW industry, and Daegu hotel industry. Additional and comprehensive follow-up research is necessary to have sufficient and major players of such industries within the massive global market.

Second, difference of the effects of platform business on RIS is according to the difference of platform. Maybe different platforms will trigger different effects on target RIS.

Third, different platform businesses are recently and explosively emerging all over the world. So, it is necessary to understand the difference in major elements of the platform business according to industry as well as effects on RISs and clusters.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendices

Appendix 1. Interview lists and half-structured questionnaire

(1) Interview lists

Industry	Interview date	Firm	Interviewee	Firm location	Home page
App development firms	2015.05.06	Busang Systems	Song JuneWoo	Daegu	www.busang-sysems.com
	2015.05.13	Neuron Works	Sin Sun	Daegu	www.facebook.com/heyyosunny
	2015.05.13	AR Media Works	Mun SukHyeon	Daegu	www.armedia.co.kr
	2015.05.13	Talk Talk Golf	Lee BaeHee	Daegu	www.talktalkgolf.com
	2015.05.14	Fusion Soft	You JongWon	Daegu	www.fusionsoft.co.kr
	2015.05.17	Whale Soft	Kim MinSu	Daegu	www.whalesoft.co.kr
Hotels	2015.04.29	Daegu Grand Hotel	Choi JunGeun	Daegu	www.daegugrand.co.kr
	2015.05.14	New Daegu Hotel	Cheai JaeYoung Jung SeoungHaw	Daegu	www.taeguhotel.co.kr
	2015.05.15	Young Dong Hotel	No YeunJong	Seoul	www.youngdonghotel.co.kr
	2015.05.15	Hotel Inter-Burgo	Han GiSu	Seoul	www.ibhote.com
	2015.05.18	GongGam Guest House	Kim YoungHee	Daegu	blog.naver.com/empathy215
	2015.05.19	IBIS Seoul Myeongdong	Ryu HeJung Kim YoungHen	Seoul	www.ibis.com/Myeong-Dong

(2) Half-structured questionnaire

Hotel interview

- Introduce to us the booking channels, situation, and volumes of your hotel.
- Explain to us your usage of Hotels.com and Booking.com.
- Explain to us the openness of Hotels.com and Booking.com's system.
  - o How freely can you use the system codes of Hotels.com and Booking.com to connect with your own hotel system or to custom it for your own usage?
- Explain to us the relations of Hotels.com, your hotel and the customer.

- Explain to us the relations of Booking.com, your hotel, and the customer.
- Explain to us the changing trends of total booking, usage of Hotels.com, and usage of Booking.-com in your hotel.
- Explain to us the special characteristics, strengths, and weaknesses of Hotels.com.
- Explain to us the special characteristics, strengths, and weaknesses of Booking.com.
- What is your opinion on the future of Hotels.com and Booking.com?
- What is the effect of this business model on clusters?

App development firm interview

- Introduce to us your firm's development history of Google Android apps and Apple apps.
- Explain to us your history, situation, and ability of developing free and paid Apple apps.
- Explain to us your history, situation, and ability of developing free and paid Android apps.
- What special characteristics, strengths, and weaknesses did you find when you developed and uploaded your Apple app?
- What special characteristics, strengths, and weaknesses did you find when you developed and uploaded your Android app?
- Did you see any changing trends in Apple's App Store and Google Play's system and policy?
- What is your opinion on the future of Apple's App Store and Google Play?
- What is the effect of this business model on clusters?

Appendix 2. Numeric formulae for modelling

(1) Supplier = suppliers/verified supplier, Initial Value 100
(2) Platform = RANDOM NORMAL(10, 10000, INTEGER(verified supplier + revenue collectability), openness to customers, 100), Initial Value 100
(3) Users = openness to customers, Initial Value 100
(4) Openness to suppliers = (SMOOTH (suppliers, 10)) * supplier openness rate
(5) Percentage of verified supplier = IF THEN ELSE(supplier openness rate * (1 + technology capability) − customers openness rate $\geq$ 0, −10, 10)
(6) Verified supplier = DELAY3(percentage of verified supplier * suppliers, 3)
(7) Revenue collectability = SMOOTH(openness to suppliers * users * customers openness rate, 10)
(8) Openness to customers = platform * customers openness rate * (1 + user trust)/total transaction
(9) Total transaction = suppliers + platform
(10) User trust = 0.1
(11) Technology capability = 1
(12) Supplier openness rate = low 0.1, middle 0.5, high 0.9
(13) Customers openness rate = low 0.1, middle 0.5, high 0.9