

The relationship between open innovation, entrepreneurship, and introduction of new business models in Korean and Indonesian information technology enterprises

JinHyo Joseph Yun · Irene Muffikh Nadhiroh · Woo Young Jung

Received: 1 October 2013 / Accepted: 10 November 2013
© Korean Social Science Research Council 2013

Abstract This case study sought to identify the relationships that can exist between open innovation, entrepreneurship, and the introduction of new business models at the enterprise level. Eleven Korean enterprises and five Indonesian enterprises were chosen, to obtain minimum research generality. While the number of enterprises is not great, it provides enough samples to determine the concrete relationships among these factors. The article starts by pointing out the general relationship between entrepreneurship, open innovation, and the introduction of a new business model. It examines two different contexts: the difference between the Seoul and Daegu regional innovation systems, and the difference between the Indonesian and Korean national innovation systems.

Keywords Open innovation · Entrepreneurship · New business model · National innovation system · Regional innovation system

Introduction

As a university education becomes more common and patent systems and patent property rights expand, the knowledge produced in the world is increasing exponentially. The distribution of knowledge and technology is growing rapidly not only in enterprises but also among individuals, regions, and countries because of the propagation of the Internet,

J. J. Yun (✉) · W. Y. Jung
Department of IT Convergence, Daegu Gyeongbuk Institute of Science and Technology, 50-1 Sang-Ri,
Hyeonpung-Myeonpung-Myeon, Dalseong-Gun, Taegu 711-873, South Korea
e-mail: jhyyun@gmail.com; jhyun@dgist.ac.kr

W. Y. Jung
e-mail: wyjung@dgist.ac.kr

I. M. Nadhiroh
Centre for Science and Technology Development Studies, Indonesian Institute of Science,
Widya Graha LIPI, 8th Floor Gatot Subroto Kav. Wo, South Jakarta 12710, Indonesia
e-mail: irene001@lipi.go.id

the increasing use of smart devices, and the increase in visual communication. As the amount of knowledge and its distribution speed rapidly increase, the knowledge and technology that can be accessed in the world by an individual in an enterprise has far surpassed the level that can be obtained by self-development within the enterprise. Under these conditions, open innovation in enterprises increases rapidly. Open innovation involves the opportunity to commercialize both external and internal ideas (Chesbrough 2003), as useful knowledge resides external to enterprises for appropriation and leverage (Hughes and Wareham 2010).

Open innovation has been shown to be practiced by small and medium-sized enterprises (SMEs) as well as large enterprises in various industries (Lichtenthaler 2008). Open innovation is essential for SMEs that cannot afford their own research and development or that lack the expertise to develop their own products (Yun and Mohan 2012). Especially in sectors where the market changes rapidly and technology advances quickly, SMEs depend on various forms of open innovation, such as user innovation or demand heterogeneity, rather than innovation based on their own research and development (Yong and Park 2010). Smaller enterprises are taking an increasingly prominent role in the contemporary innovation landscape (Varande et al. 2008). Thus, analyzing the open innovations of SMEs in rapidly changing technology environments can enhance understanding of the enterprises' technology-based activities.

Research questions

This study focused on information technology (IT) SMEs to answer the following research questions.

What kind of concrete relationship can exist between open innovation, entrepreneurship, and business model at the enterprise level? The study first investigated whether a concrete relationship exists between the role and function of entrepreneurship in IT SMEs as it relates to rapidly changing market environments, subsequent changes in open innovation by the enterprises, and the resulting introduction of a new business model.

*Are there any differences in these three factors between the Seoul and Daegu regional innovation systems (RISs)?*¹ Differences between RISs can lead to differences in the amount of knowledge within an RIS and its distribution speed, and ultimately cause a difference in the open innovation of enterprises. In this study, differences in the characteristics of open innovation were qualitatively identified based on case studies of the Seoul and Daegu RISs. In this way, a more direct open innovation strategy for SMEs can be suggested at the enterprise level based on differences in the RISs.

Are there any differences in these three factors between national innovation systems (NISs)? This question was explored through a case-centered comparison between Korean and Indonesian enterprises. These study questions were set up to identify differences in the open innovations of individual enterprises based on differences in NISs, rather than to establish a theory for generalization.

¹ RIS is a set of interacting private and public interests, formal institutions and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use and dissemination of knowledge (Doloreux 2003).

Research method and scope

Normally, the research methods used for studying the open innovation of SMEs are statistical analysis, based on surveys and individual case analysis. Statistical analysis based on surveys divides open innovation channels of SMEs into two categories: (1) technology exploitation, based on venture building outward industrial property licensing, and employee involvement; and (2) technology exploration, based on customer involvement, external networking, external participation, outsourcing research and development (R&D), and inward industrial property licensing. It then analyzes surveys to identify the difference between manufacturing and service industries (Varande et al. 2008). In addition, many studies, such as a recent study on SME innovation strategy (Lecocq and Demil 2006), a study on informal collaboration in open source software development (Henkel 2006), and a study on SME strategies for searching for external knowledge (Laursen and Salter 2006), analyze the open innovation of SMEs in depth and breadth using a survey method. This method is useful for establishing a theory or generalizing a phenomenon, but has limited usefulness for identifying the characteristics of open innovation by individual SMEs.

Other research methods used to study SME innovation are useful for obtaining perspective. Many are case studies where certain characteristics of SMEs are deduced by interviewing many SME staff members, implicitly or explicitly, using a semistructured questionnaire or checklist for interviews (Massa and Testa 2008). Another case study analyzed the role of technology in the process of changing the basic policy of individual enterprises to an open innovation strategy, although that was for just a single enterprise, Procter and Gamble. The case study was conducted based on an interview template, with members of many departments as the subjects (Dodgson et al. 2006).

Our study followed the latter method. We made a checklist (shown in the “[Appendix](#)”) for an interview to investigate the specific circumstances of open innovation, entrepreneurship, and new business model introduction of IT SMEs. And we used the analytic hierarchy process (AHP) method to decide the degrees of the three factors at each enterprise.

Studying a quickly changing industry is good for this type of research because it makes the relationships among the three factors more obvious in the short term. By further analyzing a specific industry or sector (in this case, the IT sector), the possibilities of identifying concrete and meaningful relationships are also increased. Eleven enterprises in Korea and five in Indonesia were selected to obtain minimum research generality, since research resources were limited. Korea has a top-tier IT industry, while Indonesia’s is rapidly growing. Even though 16 enterprises from two countries do not make a large sample, the number of enterprises was enough to find out the concrete relationship between open innovation, entrepreneurship, and business model introduction.

Five of the Korean enterprises were in Seoul, and six were in Daegu. The enterprises were randomly chosen. If interviews were not possible, additional random sampling was done. One additional enterprise was selected from Daegu for analysis to build up a balance in total size and in ratio of hardware and software between the Seoul and Daegu RISs. In one case, an operating division of a mid-sized enterprise in Seoul was included in the analysis and considered to be an independent SME, because the division was actually an independent enterprise and had significant enterprise activities as an IT SME. One of the Seoul enterprises has its headquarters in Busan but most of its enterprise activities take place in Seoul, so it was included as a Seoul enterprise. Five Indonesian enterprises in the capital (Jakarta) and Bandung, a region with a strong IT presence, were included in the

analysis. These enterprises are similar to the enterprises in Seoul and Daegu in total size and hardware and software ratio.

All interviews were conducted between May and September 2011. The Korean research team interviewed the Korean enterprises, and the Indonesian team interviewed the Indonesian enterprises. With a single semistructured questionnaire, a consensus on significance, interpretation, and summary of interview results was formed among the research teams. The study results were compared and analyzed through a series of discussions after the interviews.

Literature review and research design

Literature review

The relationship between open innovation and introduction of a new business model

Innovative performance resulting from an enterprise's open innovation can be categorized in three types: turnover relating to products new to the world market, to products new to the enterprise, and to significantly improved products (Laursen and Salter 2006). Open innovation channels—such as cooperation among Chinese SMEs, cooperation with intermediary institutions, and cooperation with research organizations—have been shown to have positive effects on innovation performance, such as the annual turnover of new products or the innovation index (Zeng et al. 2009). Similarly, collaboration with partners in the value chain (customers or suppliers) provides a strong base for the incremental improvement of existing products and services, whereas collaboration with academic institutions increases the ability of enterprises to drive radical new product development, because of access to new technologies (Parida et al. 2012). With the exception of analyses of individual open innovation cases, most open innovation studies, like the cases above, analyze how much the results of open innovation affected the introduction of new products, which are typically reflected as sales or the proportion of sales.

This study paid attention to how new products of previous studies were specified as the measurable target of open innovation, and systematized them as the introduction of a new business model, indicated by new products and new services. In other words, the measures of performance of open innovation identified in this study through the interviews were the presence, degree, and frequency of new business model introduction, and the qualitative aspects of new product introduction.

The relationship between entrepreneurship and open innovation

The entrepreneurship fuzzy set has three dimensions in the market sector: organization creation, economic innovation, and profit-seeking (Hornaday 1992). Of these, organization creation and economic innovation are associated with the organizational behavioral characteristics of enterprises related to open innovation. SME entrepreneurs have strong viewpoints about innovation, including that “innovation is anything that makes money; innovation comes from everyone; and innovation sources are everywhere” (Massa and Testa 2008, p. 409). SMEs tend to consider strict rules to be obstacles to innovation, and focus on the importance of research centers and universities and intermediaries that mediate technology and ideas. Schumpeterian entrepreneurs monitor developments in technologies, products, and methods at home and abroad and contemplate how profitable it

would be to adapt or improve existing goods or methods or produce them less expensively (Phelps and Zoega 2009).

Conceiving of new products and new methods against the background of existing technologies and the accessible stock of past products and methods is generally the contribution of entrepreneurs (Hayek 1978). In addition, this entrepreneurial orientation has moderating effects on the market orientation-performance linkage, according to evidence from Chinese small enterprises (Li et al. 2008). Open and networked innovation that is triggered by a creator with visionary leadership, such as entrepreneurship, is a process of exploration and exploitation without any distinction in how the types and structures of networks evolve and interact in the process (Harryson 2008).

As shown in the previous studies, entrepreneurship plays an important role in promoting open innovation. In fact, the distinctive appearance of entrepreneurship stimulates the system, equipment, and enterprise culture, laying the groundwork for the induction of a larger degree of open innovation. Therefore, this study focused on identifying the relationship between entrepreneurship and open innovation, the degree of relation, and its characteristics, at the level of individual enterprises, through case study interviews.

The relationship between cluster, regional innovation system, national innovation system, and open innovation

An appealing attribute of clusters is that they can provide positive externalities to agglomerated enterprises because they are interconnected, and would theoretically encourage information and collaboration flows among members (Silvestre and Dalcol 2009; Marceau 1994). Within a cluster, the intensity of information and communication is observed through face-to-face contacts and the interactions of people and enterprises (Batheld et al. 2004).

However, because there is a severe asymmetry among clusters, depending upon their makeup and location, some locations or clusters in any industry or sector have more knowledge than others (Malmberg 2003). For example, the difference in production, distribution, and consumption among growing clusters may lead to a difference among specific enterprises, such as Samsung display Ltd and Chimei display Ltd among Korean and Taiwan thin-film-transistor liquid-crystal display(TFT LCD) clusters (Yun et al. 2010). Differences between RISs and clusters cause an unequal distribution of knowledge within the economic system and lead to a difference in regional knowledge capabilities and open innovation between an RIS and a cluster (Cooke 2005). A study that analyzed the Silicon Valley–Hsinchu Connection demonstrated that as a new cluster became affiliated with the Silicon Valley through the construction of a Taiwanese technical community there, the new cluster became successful because of an increase in the mobility of knowledge and capital (Saxenian and Hsu 2005). Another study found that, according to its regional innovation or regional embeddedness, the mode of knowledge sourcing of an enterprise can be changed (Kramer and Diez 2011).

In other words, there is a difference in mobility and existence of knowledge among regions beyond the boundaries of countries. Meanwhile, differences between NISs, which would include “all important economic, social, political, organizational, institutional, and other factors that influence the development, diffusion, and use of innovation,” combined with differences among sectors, lead to a difference in the amount of knowledge, as well as the distribution or circulation speed of knowledge and information, and the commercialization pattern of knowledge between countries surrounding a specific sector (Lundvall 1992, p. 78). The reason is that differences between innovation systems, such as NISs,

reflect differences in innovative capacity (Freeman 1987). Another study suggested that, according to different nations' RISs, there will be differences in the intangible assets which act as drivers of innovation (Kramer et al. 2011). Those intangible assets are the amounts, speeds, or contents of knowledge.

The previous studies have shown that differences between RISs, clusters, and NISs cause differences in the amount of knowledge, and its distribution speed, within the relevant innovation system, and so induce an overall difference among the enterprises within the innovation system. Differences between the Seoul and Daegu RISs are presumed to cause a difference in the overall open innovation activities among the enterprises in the two systems. Also, differences between the Korean and Indonesian NISs lead to differences in the innovative capacity of the enterprises within the two systems, and ultimately to differences in open innovation among those enterprises.

Research design

Research framework

The research framework (Fig. 1) was based on the studies mentioned above. The qualitative characteristics of the relation between entrepreneurship and open innovation for each enterprise were ascertained through semistructured interviews, and were estimated based on this. In addition, the open innovation level of each enterprise was estimated qualitatively through semistructured interviews. Finally, as effects of open innovation, the concrete, quantitative, and qualitative characteristics of new business model introduction were estimated qualitatively through semistructured interviews and the levels were estimated. This research framework qualitatively estimates substantial relationships between entrepreneurship, open innovation, and new business model introduction at the level of each enterprise; at the same time, it can estimate the level of relation between them qualitatively. Through this model, the qualitative difference in open innovation of the enterprises located in RISs and NISs can be estimated conservatively and concretely. In addition, the level of difference can be compared qualitatively.

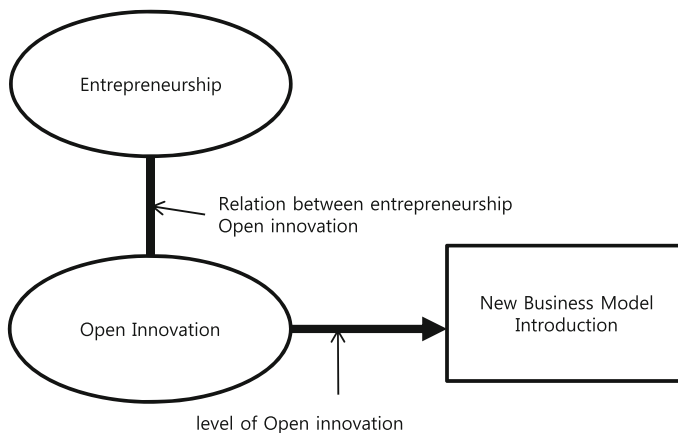
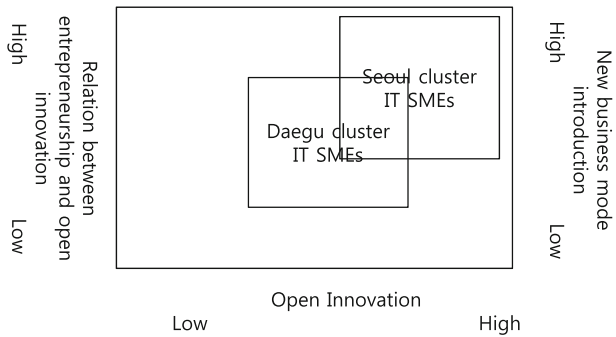


Fig. 1 Research framework

Fig. 2 Research model 1: differences between Seoul and Daegu SMEs



Research models

In research model 1, the difference in open innovation between enterprises in the Daegu and Seoul RISs was hypothetically set up as shown in Fig. 2. Through case studies, the differences between RISs, such as in model 1, were explored in detail at the level of individual enterprises. This research model shows that the enterprises of the Seoul RIS consistently show bigger levels in the relation between entrepreneurship and open innovation, level of open innovation, and level of new business model introduction than the enterprises of the Daegu RIS. Evidence for this research model was traced by case studies of IT enterprises in both RISs.

Research model 2 (Fig. 3) presumes that the level of open innovation will differ in three aspects among IT SMEs in the Korean and Indonesian NISs, with the qualitative differences among individual enterprises exhibiting a consistent pattern overall in the difference between Korean and Indonesian enterprises. It also presumes that the qualitative differences and characteristics identified in individual enterprises through the semistructured interviews will show a consistent pattern. Evidence for this research model was traced by case studies of IT enterprises in both NISs.

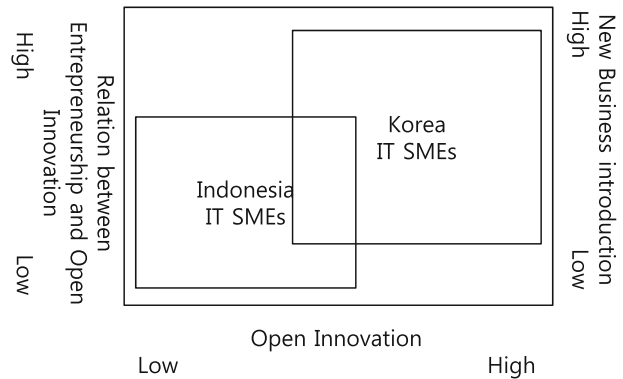
Differences between enterprises in the Seoul and Daegu regional innovation systems

Relationship between entrepreneurship and open innovation

Entrepreneurs in two enterprises in the Seoul RIS (enterprises A and D) and two enterprises in the Daegu RIS (enterprises G and J) established systems for open innovation, such as the three-channel system or recruiting people from a target area. In other enterprises in the Seoul RIS and one enterprise in Daegu, open innovation was actively triggered by entrepreneurs. Some entrepreneurs organized an open innovation system. Others triggered open innovation activity, while still others did not encourage open innovation. The open innovation of the Seoul RIS is higher than that of the Daegu RIS; see Table 1.

From this, the researchers found that the open innovation strategy of an enterprise is directly dependent on entrepreneurship. If the entrepreneurship level of an enterprise is not high—for example, if the CEO does not have a positive attitude toward change, risk, or introducing a new business model—then open innovation in the enterprise is passive and no open-innovation-related system is organized, as was the case with enterprise K. However, if the entrepreneurship level of an enterprise is high—if the CEO has a positive

Fig. 3 Research model 2: differences between Korean and Indonesian SMEs



attitude toward change, risk, or introducing a new business model—then the open innovation of the enterprise is positive, and an open innovation system is often organized in the enterprise, as occurred in a particularly energetic way in enterprise A.

Level and characteristics of open innovation

As shown in Table 2, enterprises A, B, and E in the Seoul RIS and enterprise G in the Daegu RIS have open innovation channels to a university or national laboratory, through a supply enterprise, or from the customer sector they belong to. These enterprises have diverse open innovation channels and receive qualitatively different knowledge from these channels. Enterprises C and D in the Seoul RIS and enterprises F, J, and K in the Daegu RIS have open innovation channels mainly to a university or national laboratory, supply enterprises, or their own sector. These enterprises received a lot of knowledge from these channels but did not have serious differences between them. More than half of the Seoul RIS enterprises have active open innovation channels to customers.

From this, we found three levels of open innovation: low (which mainly has a university or national laboratory as the open innovation channel, such as enterprise H and I), middle (which has a university in addition to the enterprises' own sector or competing enterprises as open innovation channels, such as enterprises C, D, K, J, and K) and high (which has a university, the enterprise's own sector, and customers as open innovation channels, such as enterprises A, B, E, and G).

Introduction of new business models

As shown in Table 3, enterprises A and D in the Seoul RIS, and enterprises G and H in the Daegu RIS have expanded existing business models and at least partially evolved to a qualitatively different business model. Enterprises B, C, and E in the Seoul RIS and enterprise H in the Daegu RIS expanded their own business models widely. More than half of the Seoul enterprises had expanded their business models in quantity and quality.

From this, we identified three levels of new business model introduction: low (adhering to an existing business model without trying to change or enlarge it, such as enterprises F, I, and K), middle (enlarging a business model quantitatively, such as enterprises B, C, E, and H), and high (enlarging a business model quantitatively and evolving it qualitatively, such as enterprises A, D, G, and J).

Table 1 Relationship between entrepreneurship and open innovation in two Korean regional innovation systems

Enterprise	Characteristics	Level ^a
Seoul		
A	Three-channels open innovation system, building connections with university and national laboratories, markets, and related firms, by the CEO, marketing director, and research director	5
B	CEO and enterprise treat customers and suppliers as sources of new knowledge	3
C	Open to customer of the enterprise, tries to realize a new idea from internal or external sources on the spot	3
D	Recruiting people from target business fields and building up a system that promotes open innovation	4
E	Recruiting people in a new target sector and letting them invite new ideas from customers and people in related sectors	3
Daegu		
F	Applying ideas based on the CEO's experience to develop new products	2
G	Building a system that adds new business models based on customers' or parts suppliers' experiences and knowledge, and enlarging existing business models continually based on customers' ideas	4
H	Product enlargements based on requirements or proposals from customers in the same sector	3
I	Restricting ideas or knowledge introduced by customers or associated enterprises because of limited internal capabilities or negative attitudes	2
J	Building up the open enterprise part of the enterprise and organizing several open systems that introduce new ideas for new products from customers or related agencies	4
K	Developing internal R&D capabilities and letting internal agents develop new products	2

^a Lierkert five values were used like as very low (1), low (2), normal (3), high (4), and very high (5). However, these Lierkert values were used as subsidiary to analytic hierarchy process (APH) method.

Comparison of Seoul and Daegu regional innovation systems

The result of the comparative analysis of the Seoul and Daegu RISs can be seen in Fig. 4. Because it is similar to the figure for research model 1, it can be said that research model 1 is confirmed. In other words, IT SMEs in the Seoul RIS are at a higher level than IT SMEs in the Daegu RIS. Overall, the level of relationship between entrepreneurship and open innovation, and the level of open innovation itself, are higher in the Seoul RIS, and this ultimately leads to the introduction of more diverse and active new business models there. Nonetheless, enterprise G in the Daegu RIS shows a higher level than the average for Seoul enterprises in all aspects, including the level of relationship between entrepreneurship and open innovation, level of open innovation, and level of new business model introduction. In contrast, enterprise C in the Seoul RIS has similar levels to enterprises in the Daegu RIS for all three categories.

The differences in these three aspects between RISs were identified based on five cases in one RIS and six cases in the other. In other words, the differences in level of relationship between entrepreneurship and open innovation, level of open innovation, and level of new business model introduction cannot be generalized, but the realistic qualitative differences can be seen through case analysis. This can be interpreted to mean that, between Daegu and

Table 2 The level and characteristics of open innovation

Enterprise	Characteristics	Level
Seoul		
A	Exploration of ideas from customers by the marketing director, ideas from their own sectors with technological advantages by the R&D director, and ideas from the university and national laboratory by the CEO	5
B	Enlarging knowledge channels from attending university, through supply enterprises and existing or potential customers	5
C	Involvement of all business processes with obtaining new ideas, knowledge, technology, and know-how	3
	Introducing new ideas into the enterprise through networks within their own sector, such as Seoul mobile entrepreneurs association or new mobile contents association, and from the national research laboratory and university	
D	Three- to four-step process that introduces new ideas into the enterprise from several targeted businesses	3
E	Exploration of knowledge or technology in their own sector by the R&D director (who is from Samsung), from customers by the CEO (who is from the marketing area), and by the new marketing director, whose main job is to target any sector	4
Daegu		
F	Obtaining ideas by networking with the national laboratory and the local university, but not having an official structure for exploring ideas from outside	3
G	Continually seeking new ideas from advertising customers, firms from different sectors, and universities, and doing weekly correlation analysis on new ideas	4
	Building up internal efforts to fully explore new ideas that are different from the main business, such as on/offline linked advertisements or offline shopping mall connected with online advertisement based	
H	No external idea procurement system or system that reflects the various demands and expectations of the surroundings	2
	New ideas produced by internal engineers who have more than five years of experience	
I	Following up ideas from supply enterprises only; no active introduction of ideas from surroundings	2
J	Exploring ideas from a university and from a related agency, such as a hospital or medical center, but no system for obtaining knowledge	3
K	Obtaining new ideas from a university but not systematically	3
	Developing new software(S/W) products from interaction between an internal idea and an idea developed experimentally	

Table 3 Introduction of new business models

Enterprise	Characteristics	Level
Seoul		
A	Continually expanding and evolving in response to market needs with existing middle-ware competitiveness as its core, such as license fees from set-top box sales or profit from sales of internet protocol television (IP TV) solutions	5
B	Expanding business models through IP TV platform or web platform	3
C	Expansion from consulting to development and sales	3
D	Accumulating collective intelligence-based business model experience, such as user related restraint contents and location information, and applying these business models to collective intelligence business model consulting and similar business model development	4
E	Becoming successful in adding various new business models and contents through internal and external open innovation channels, such as open market service with transaction fees in addition to 180 live channels, 100 high-definition television (HDTV) channels, 110,000 video on demand (VOD) services, 127 two-way TV application programs, and broadcast platform license fees	3
Daegu		
F	Adding new business as an extension of existing product contents, such as various mobile learning management systems, or redeveloping existing PC content into new content appropriate for smart devices in education markets	2
G	Expanding an existing factory automation system or transitioning based on it	4
H	Expanding from business model, such as portal advertisement through online shopping mall, offline advertisement, online advertisement based on online shopping mall, own IT contents business, to corporate enterprise resource planning (ERP) system production, corporate inventory management system, and online and mobile design contents	3
I	Expanding the business model from the core, such as disaster management system to a neighboring area, including police property management system or fire prevention system	2
J	Limited business model, such as sales of health care analysis S/W package that was delivered by supplier, and small consulting business in the same area	4
K	Expanding and evolving from ERP-centered enterprise solution to health care IT products such as dementia prevention cognitive rehabilitation equipment, Ox meter, vital sign monitoring system, and patient fall monitoring system	2
	Internal technology-driven business strategy could not internalize new business model by introducing or expanding new content-centered business model	

Seoul enterprises, the difference in the level of new business model introduction results from the difference in the level of open innovation and the level of relationship between entrepreneurship and open innovation. If the differences between the level of open innovation and the level of relationship between entrepreneurship and open innovation can be addressed, then the introduction of new creative business models for Daegu IT enterprises can be invigorated and the creation of a globally competitive Daegu-based business model can be expected.

In addition, considering the differences between enterprises, it appears that CEOs with engineering backgrounds exhibit weak relationships between entrepreneurship and open innovation, and a low level of open innovation, leading to unsuccessful new business model introduction. For clearer understanding of this feature, additional case studies or statistical analyses are required for generalization.

In this study, differences between the RISs of Daegu and Seoul can be directly confirmed by the case analysis of IT SMEs. It can be said that the capital, Seoul—where universities and population are concentrated—has more IT-related knowledge and information, for which the distribution speed exceeds that of Daegu. These facts allow for the conclusion that open innovation activities in Seoul IT SMEs are at a higher level than those in Daegu. In other words, an enterprise's open innovation strategy should be changed based on the amount of knowledge and the distribution speeds of its RIS. However, regardless of the regional differences in each case, if the CEO's entrepreneurship is vigorous, then an enterprise can have a more open attitude and more diverse new business models can be introduced.

Differences between enterprises in the Indonesian and Korean national innovation systems

Relationship between entrepreneurship and open innovation

Indonesia's five IT enterprise CEOs are engineers (Table 4). In this case, when CEOs try to develop new ideas by themselves, such as in enterprise B, the relationship between entrepreneurship and open innovation is very low. However, if CEOs try to let their engineers develop new ideas, such as in enterprises a, c, and e, then the relationship between entrepreneurship and open innovation is higher. Enterprise c tries to invite and implement unusual ideas from outside the enterprise or from the gaming community.

The new ideas in most of the Indonesian IT SMEs under study were introduced by an engineer-CEO or by employees from an internal engineering department, except in enterprise c. This means that these Indonesian IT SMEs use a closed innovation strategy as directed by the engineer-CEO.

Level and characteristics of open innovation

As shown in Table 5, some Indonesian IT enterprises (such as enterprises b and c) generate new ideas internally, while others (such as enterprises a and d) obtain new ideas or technology from university or engineering research laboratories. Enterprise e tries to obtain new ideas from the Korean sectors, and it belongs to enterprises B, C, E, and H as shown in Table 3.

Most of the Indonesian IT enterprises that were interviewed have internal or limited open innovation channels and activities.

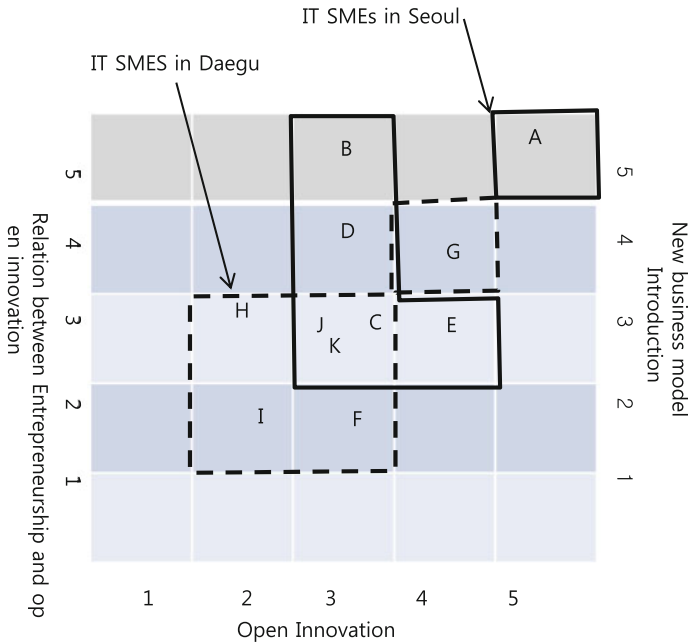


Fig. 4 Comparative analysis of Daegu and Seoul IT SMEs

Introduction of new business models

As shown in Table 6, Indonesian IT enterprises had focused business models, except enterprise d, which enlarged its business model quantitatively, much like Korean enterprises B, C, E, and H. Enterprises a, c, and e enlarged their original business model to a limited degree.

From this, we could conclude that any enterprise with closed innovation cannot enlarge its business model quantitatively or evolve its business model qualitatively. However, this does not exclude the possibility of closed innovation by the enterprise itself.

Comparison of Indonesian and Korean information technology enterprises

When comparing Indonesian IT SMEs to those of Korea, it is most of all apparent that the levels of relationship between entrepreneurship and open innovation, open innovation, and introduction of new business models are all lower in Indonesia. The level of IT SMEs in Indonesia is low overall—except for some, like enterprise E, which has open innovation activities for the acquisition of new ideas and maintains internal and external systems. Except for enterprise D, entrepreneurs themselves showed little openness toward external ideas and little direct interest in building and maintaining an open system. Even considering that the IT enterprises of Indonesia are in their initial stages, the new business model aspect of these enterprises is insufficiently activated, with a few exceptions. It is concluded that the new business model aspect remains at the stage of a supply-oriented limited product business model in Indonesia’s IT sector (Fig. 5).

However, the IT SMEs of Indonesia are basically promoting a closed innovation strategy centered on technical innovations. They are expanding technology through

Table 4 Relationship between entrepreneurship and open innovation in the Indonesian national innovation system

Enterprise	Characteristics	Level
a	The CEO builds knowledge in the enterprise through his knowledge as an engineer, eye for the market, and networking with professors in a regional university IT department	2
b	The three founders with engineering backgrounds noted the importance of education as a realistic solution for Indonesia and, having started with mathematics and physics, are expanding to diverse education contents to enlarge the market	1
c	Five students who like games founded this enterprise in Bandung. Each student introduced creative ideas to developing a new business model	2
d	Eighteen founding members who are from the information bio technology (IBT) gaming society in 2007 tried to invite and implement unusual ideas from outside and maintain an open approach to ideas from the gaming community	3
e	Four co-founders promote an IT-based business system and recruit top IT engineers in Indonesia to generate ideas and knowledge	2

Table 5 Level and characteristics of open innovation in the Indonesian national innovation system

Enterprise	Characteristics	Level
a	Deep relationship with excellent IT engineering university; introducing new employees and new technology from that university	2
b	Continuing internal business expansion process based on new knowledge or ideas that arise in the process of systematically assessing the related community	1
c	Founders majored in electrical engineering and graphic engineering and developed interactive games.	1
d	Initial acquisition of external ideas by hiring people from research laboratories throughout the country who enjoy and have ideas about games	2
e	Hiring excellent staff and, by allowing them to develop themselves and freely pursue their hobbies, maximizing their creativity Accepting and accumulating new ideas and technology while remaining open to voices from the enterprise's sectors	3

research collaboration with universities or research centers and other outside enterprises within a limited range. Because the IT sector has not yet fully developed or matured, it is concluded that the enterprises in Indonesia have not reached the stage of creative open innovation that is based on demand, expectations, and ideas from customers.

All five enterprises in Indonesia were founded by engineers—unlike in Korea, where many IT SMEs do not have engineers as founders or CEOs. Even if this was not the case, by securing senior executives from the management or marketing sectors, the Korean enterprises tend to promote a market-oriented open innovation strategy and management. Engineer-oriented Indonesian enterprises are promoting technology-push-based business management, which is also internally based on engineers. Therefore, their diverse market and external open innovation idea procurement and new business model introduction still seem somewhat insufficient.

This is a characteristic image of IT SMEs which is appearing during the developing stages of the Indonesian IT sector. The engineer-oriented establishment and technology-

Table 6 Introduction of a new business model

Enterprise	Characteristics	Level
a	Increasingly sophisticated business model built around chip production Reaching a new stage of new business development by combining chip and communication-related functions	2
b	Adhering to education content that is qualitatively the same as the starting point	1
c	Developing interactive 3D games with excellent internal capacity but limited market response	2
d	Expansion from a flash game, which is the core product, to a board game, using internal R&D and networking with the sector	3
e	From solution capability to radar S/W, business expanded by government and outside requirement	2

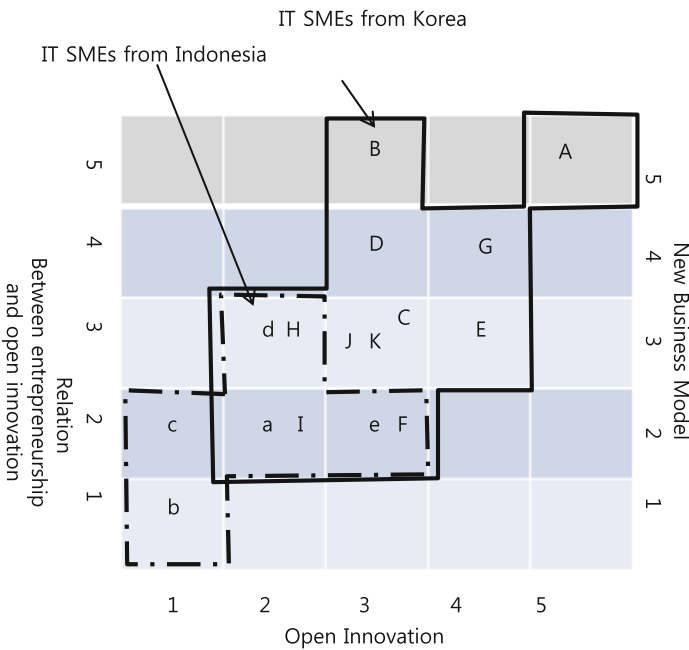


Fig. 5 Comparative analysis of Indonesian and Korean IT SMEs

push-oriented management strategy appear in association with a lack of funding, initial markets, and marketing capacity. However, considering Indonesia’s large domestic market, a capable engineer-centered establishment and technology-driven enterprise development strategy can be expected to establish a foothold for rapid IT SME growth and expansion into world markets in the future.

Unlike in Indonesian IT SMEs, the level of open innovation in Korean IT SMEs is fairly high. In that situation, various levels of open innovation have become a source for procuring new business models. Above all, entrepreneurship that is open to new markets is considered to be very important to the expansion of open innovation. Therefore, Korean IT

SMEs at their current stage are considered to be in a situation where the frequent introduction of new business strategies determines an enterprise's competitiveness by various channels, and ways of open innovation with more open entrepreneurship serve as their base.

Conclusion

Key findings

The open innovation strategy of an enterprise is directly dependent on entrepreneurship. If an enterprise's entrepreneurship level is not high, its open innovation is passive and open innovation-related systems will not be organized. However, if its entrepreneurship is high, then its open innovation is positive, and open innovation systems will be organized in it.

Open innovation has three levels: low, where university or national laboratories are the main open innovation channels; middle, which also includes the enterprise's technology sector or competing enterprises as open innovation channels; and high, which includes the university, the technology sector, and customers as open innovation channels.

There are three levels of new business model introduction: low, in which an enterprise adheres to its existing business model and does not try to change or enlarge it; middle, in which an enterprise enlarges its business model; and high, in which an enterprise enlarges its business model quantitatively and evolves it qualitatively.

Differences in the level of relationship between entrepreneurship and open innovation, level of open innovation, and level of new business model introduction are largely based on differences between RISs, although the limitations of such differences can be overcome by entrepreneurship with an open attitude.

Enterprises based on a closed innovation strategy obtain ideas or technology mainly from a CEO who has an engineering background or internal engineering or R&D staff, not from marketing or outside networking. Therefore, the larger portion of CEOs of closed-innovation-strategy-based enterprises comes from engineering or technology backgrounds.

Finally, we found that enterprises in a low-level NIS more often accept a closed innovation strategy than enterprises in a high-level NIS. However, we could not confirm this as a conclusion or identify a reason, and cannot generalize it. The situation of the NIS influences the open innovation strategy of enterprises that belong to it, but the open innovation strategies of enterprises can also differ from those of other enterprises belonging to the NIS. We could not generalize a conclusion based on our 16-enterprise case study. In addition, the closed innovation strategy can be the better choice in a low-level NIS. This should be studied further.

Implications

This case study was based on semistructured interviews and a qualitative comparison of enterprises. The study focused on 16 cases and presents results that are reasonable and have specific implications to a certain extent. However, there is a limit to the generalization of the study results. It was not the goal of this study to generalize the difference in the level of relationship between entrepreneurship and open innovation, the level of open innovation, and the level of new business model introduction between RISs.

However, by clearly identifying concrete differences in the three aspects of open innovation among regions, especially the differences in each case, this study tried to

replace a superficial discussion of open innovation with elements relevant to an enterprise's survival, strategy, and development. Open innovation activities that proceed in significantly different forms by region, lead to an enterprise's introduction of a new business model and determine the long-term survival of the enterprise.

In a knowledge-based economy, the open innovation strategy of an enterprise determines the enterprise's present and future development. Therefore, a systematic analysis of specific open innovation strategies is directly related to the survival of the enterprise, and is required more than ever.

To determine the relationship between entrepreneurship and open innovation, the level of open innovation, with concrete measures and systems, and open innovation leading to an enterprise's new business model, it is necessary to collect more data on the open innovation activities of a larger number of enterprises.

By accumulating case analyses of enterprises' open innovation activities, it will become possible to propose a new system and method of industry–university–institute collaboration, at the level of open innovation strategy, for enterprises in a knowledge-based economy. In addition, through large-scale multifaceted open innovation case analysis studies, enterprises can accumulate concrete ideas for open innovation strategies, methods of entrepreneurial approach for open innovation improvement, and new business model introduction strategies, to help them escape from be caught by other firms easily.

Acknowledgments This study was supported by the Daegu Gyeongbuk Institute of Science and Technology (DGIST) R&D Program of the Ministry of Education, Science and Technology of Korea (12-IT-01).

Appendix: Interview checklist

Background

- Type of enterprise—market, size, competence, and products.
- Organizational structure and context.
- Innovation problems and challenges being faced.

Entrepreneurship

- Building up the new enterprise.
- Treating the risks which the enterprise meets during its growth.
- Attitude to changing of business model.
- Attitude to new environment.

Open innovation

- Response to new ideas or knowledge.
- Network to which the enterprise belongs.
- Collaboration with customers.
- Collaboration with universities.
- Collaboration with research institutes.
- Collaboration with suppliers or other enterprises in the industry.
- Connection with knowledge agencies including the government and consulting firms.

New business model introduction

- Enterprise's history of changing business models.
- Structure of the business model.
- Revenue structure according to the business model.
- Concrete changes in the business model from last year to this year to next year.

References

- Batheld, H., Malmberg, A., & Maskell, P. (2004). Cluster and knowledge: Local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, 28, 31–56.
- Chesbrough, H. (2003). The era of open innovation. *Sloan Management Review*, 44(33), 35–41.
- Cooke, R. (2005). Regional knowledge capabilities and open innovation: Regional innovation systems and clusters in the asymmetric knowledge economy. In S. Breschi & F. Malerba (Eds.), *Clusters, networks, and innovation* (pp. 80–112). Oxford: Oxford University Press.
- Dodgson, M., Gann, D., & Salter, A. (2006). The role of technology in the shift towards open innovation: The case of Procter & Gamble. *R&D Management*, 36(3), 27–35.
- Doloreux, D. (2003). Regional innovation systems in the periphery: The case of the Beauce in Quebec (Canada). *International Journal of Innovation Management*, 24, 243–263.
- Freeman, C. (1987). *Technology policy and economic performance: Lessons from Japan*. London: Pinter.
- Harryson, S. (2008). Entrepreneurship through relationships—Navigating from creativity to commercialisation. *R&D Management*, 38(3), 290–310.
- Hayek, F. A. (1978). Competition as a discovery procedure. In F. A. Hayek (Ed.), *New studies in philosophy, politics, economics and the history of ideas* (pp. 179–190). London: Routledge.
- Henkel, J. (2006). Selective revealing in open innovation processes: The case of embedded Linux. *Research Policy*, 35(7), 935–969.
- Hornaday, R. W. (1992). Thinking about entrepreneurship: A fuzzy set approach. *Journal of Small Business Management*, 30(4), 12–23.
- Hughes, B., & Wareham, J. (2010). Knowledge arbitrage in global pharma: A synthetic view of absorptive capacity and open innovation. *R&D Management*, 40(3), 324–343.
- Kramer, J.-P., & Diez, J. (2011). Catching the local buzz by embedding? Empirical insights on the regional embeddedness of multinational enterprises in Germany and the UK. *Regional Studies*, 15(2), 1–15.
- Kramer, J.-P., Marinelli, E., Iammarino, S., & Diez, J. (2011). Intangible assets as drivers of innovation: Empirical evidence on multinational enterprises in German and UK regional systems of innovation. *Technovation*, 31, 447–458.
- Laursen, K., & Salter, A. (2006). Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms. *Strategic Management Journal*, 27(2), 131–150.
- Lecocq, X., & Demil, B. (2006). Strategizing industry structure: The case of open systems in a low-tech industry. *Strategic Management Journal*, 27(9), 891–898.
- Li, Y., Zhao, Y., Tan, J., & Liu, Y. (2008). Moderating effects of entrepreneurial orientation on market orientation-performance linkage: Evidence from Chinese small firms. *Journal of Small Business Management*, 46(1), 113–133.
- Lichtenthaler, U. (2008). Open innovation in practice: An analysis of strategic approaches to technology transactions. *IEEE Transactions on Engineering Management*, 55(1), 148–157.
- Lundvall, B.-A. (1992). *National system of innovation: Towards a theory of innovation and interactive learning*. London: Pinter.
- Malmberg, A. (2003). Beyond the cluster-local milieus and global connections. In J. Peck & W. Weung (Eds.), *Remaking the global economy: Economic-geographical perspectives* (pp. 256–275). Thousand Oaks: Sage.
- Marceau, J. (1994). Clusters, chains and complexities: Three approaches to innovation with a public policy perspective. In M. Dogson & R. Rothwell (Eds.), *The handbook of industrial innovation* (pp. 145–171). Cheltenham: Edward Elgar.
- Massa, S., & Testa, S. (2008). Innovation and SMEs: Misaligned perspectives and goals among entrepreneurs, academics, and policy makers. *Technovation*, 28, 393–407.
- Parida, V., Westerberg, M., & Frishammar, J. (2012). Inbound open innovation activities in high-tech SMEs: The impact on innovation performance. *Journal of Small Business Management*, 50(2), 283–309.

- Phelps, E., & Zoega, G. (2009). Entrepreneurship, culture and openness. In D. B. Audretsch, R. Litan, & R. Strom (Eds.), *Entrepreneurship and openness: Theory and evidence* (pp. 101–121). Northampton: Edward Elgar.
- Saxenian, A., & Hsu, J.-Y. (2005). The silicon valley–hsinchu connection: Technical communities and industrial upgrading. In S. Breschi & F. Malerba (Eds.), *Clusters, networks, and innovation* (pp. 230–255). Oxford: Oxford University Press.
- Silvestre, B. D., & Dalcol, P. R. (2009). Geographical proximity and innovation: Evidences from the Campos Basin oil & gas industrial agglomeration. *Technovation*, 29, 546–561.
- Varande, V. V., Jong, J. P., Vanhaverbeke, W., & Rochemont, M. D. (2008). Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, 29, 423–437.
- Yong, S. S., & Park, K. D. (2010). The role of demand heterogeneity in product innovation strategy. *Korean Social Science Journal*, 37(2), 27–42.
- Yun, J. J., & Mohan, A. V. (2012). Exploring open innovation approaches adopted by small and medium firms in emerging/growth industries: Case studies from Daegu-Gyeongbuk region of South Korea. *International Journal of Technology, Policy and Management*, 12(1), 1–19.
- Yun, J. J., Park, S., Lim, D., & Hahm, S. (2010). Emergence of east Asian TFT-LCD clusters: A comparative analysis of the Samsung cluster in South Korea and the Chimei cluster in Taiwan. *Asian Journal of Technology Innovation*, 18(1), 201–228.
- Zeng, S., Xie, X., & Tam, C. (2009). Relationship between cooperation networks and innovation performance of SMEs. *Technovation*, 30, 181–194.