

MMRC
DISCUSSION PAPER SERIES

No. 492

Architecture of Interfirm Collaboration and Global Competitive
Advantage: Findings from the Mobile Handset Industry


Hee Kyung Na

Adjunct Professor, Kyungpook National University

Young Won Park

Faculty of Economics, Graduate School of Humanities and Social Sciences,
Saitama University, Manufacturing Management Research Center
Graduate School of Economics, The University of Tokyo

November, 2016

 MONOZUKURI 東京大学ものづくり経営研究センター
Manufacturing Management Research Center (MMRC)

Discussion papers are in draft form distributed for purposes of comment and discussion. Contact the author for permission when reproducing or citing any part of this paper. Copyright is held by the author.

<http://merc.e.u-tokyo.ac.jp/mmrc/dp/index.html>

Architecture of Interfirm Collaboration and Global Competitive Advantage : Findings from the Mobile Handset Industry

Hee Kyung Na

Adjunct Professor, Kyungpook National University

E-mail: hkna@knu.ac.kr

Young Won Park

Faculty of Economics, Graduate School of Humanities and Social Sciences, Saitama University

Manufacturing Management Research Center

Graduate School of Economics, The University of Tokyo

E-mail: ywparkjp@gmail.com

Abstract: This paper explores the heterogeneity of interfirm relations and its influence on the domestic and global performance. By magnifying the magnitude of relational ties between a supplier and a buyer, the study identifies multiple types of interfirm architecture (integral, quasi-integral, modular, quasi-modular) and the mechanisms of the connection between the domestic and global competitive advantage. The findings show that, in the tightly coupled collaborative architecture, securing a certain degree of autonomy is helpful for the suppliers to influence the buyers' technological and product trajectories of the domestic market to be synchronized with the global trend and thereby increasing chances to create and capture more value both in and out of the home country. And the loosely coupled architecture facilitates the firms to experiment to find a strategy to better fit both in the domestic and foreign markets. By simultaneously considering the existing two major parameters (structure and tie strength) of the interfirm relations and developing a combined framework of the collaborative architecture, this study advances our understanding on under what conditions firms are more likely to better perform within and beyond the domestic boundary.

Key Words: interfirm relations, collaborative architecture, multinational enterprise (MNE), comparative value chain structure, domestic and global value creation and capture

1. Introduction

Modern enterprises cannot complete a whole process of product development and distribution in-house (Baldwin and Clark, 2000; Sturgeon, 2002; Jacobides, 2005; Chesbrough et al., 2006). In a series of value chain, firms are linked to various entities and interact in diverse ways (Pisano, 1991; Gawer and Cusumano, 2002; Iansiti and Levien, 2004; Teece, 2007). In management literature, researchers from multiple lines of studies have tried to uncover the mechanics of interfirm collaborations and its influence on the performance (Dyer and Singh, 1998; Gulati et al., 2000; Adner and Kapoor, 2010).

Regarding the features of collaborative relations, prior research has largely focused on two aspects: structure and strength (magnitude) of the interfirm ties (Granovetter, 1973; Ahuja, 2000; Iansiti and Levien, 2004). So far, studies have analyzed the above mentioned parameters (structure and tie strength) respectively. Yet, in order to systematically understand the logics of interfirm collaboration, it is needed to incorporate the two factors in a more combined framework.

In particular, for multinational enterprises (MNEs) that operate both domestically and globally, it has been a critical challenge to organize effective interfirm ties to create and capture value in and out of the home country. Jacobides and Kudina (2013) argue that firms in different countries establish heterogeneous value chain structure and this *comparative value chain structure* is related to the global performance of MNEs. Regarding this issue, Porter (1986; 1990) claims that although operations of MNEs are getting highly globalized, they compete in the foreign market based upon the foundation of capabilities, which were formed in the home country.

As pointed out earlier, interfirm connections of these firms are extremely diverse. And the answers/clues we can acquire on the question of how MNEs simultaneously obtain competitive advantage in the domestic and foreign markets are still limited. Therefore, this study aims at further exploring the following two interrelated research questions on the basis of the prior studies: (1) how the architectures of interfirm relations are heterogeneous in terms of structure and strength between collaborators, and (2) what type of relations are more effective for them to attain higher domestic and international competitive edge and why.

Drawing on a longitudinal case study on the mobile phone industry, this paper unveils that the tightness of interfirm relations should be separately measured along each stage of value chain and the comparative degree is tightness should be considered. For instance, it was observed that a supplier and a buyer were tightly connected in one stage (e.g., the product planning and development) and loosely-coupled in other stage (e.g., product sales) of the value chain. Or, in other case, although two relations should be regarded as a tight relationship within the conventional dichotomic framework (strong or weak tie), the degree of their collaboration can be different (i.e., extremely tight and moderately tight).

Thus, in this study, I magnify the detailed picture of interfirm collaborations by specifying the two features of relations and combining them to better reflect the reality. By doing so, this study contributes to offer more advanced framework on the interfirm relation and advance our understanding on the firms' domestic and global performance based upon the newly proposed framework.

The remainder of this paper is organized as follows. In the subsequent section, I review what we have learned and have yet to learn on the research questions of this study. In the section 3, comparative analysis on the mobile phone industry is provided. The paper demonstrates how the architectural differences of interfirm relation affect the long-term performance of the firms domestically and globally. Finally, I conclude by discussing and summarizing the findings and present the areas for future research.

2. Literature Review

(Existing Literature on the Interfirm Collaboration and Performance)

In examining interfirm relations, architectural perspective is useful in that it helps us to grasp the contours and framework within which firms interact (Jacobides et al., 2006; Takeishi and Fujimoto, 2003; Fjeldstad et al., 2012). As explained earlier, the existing studies have paid attention to the two aspects in analyzing the architecture of interfirm relations: structure and tie strength. As for the structure of the interfirm relations, initial studies had examined networks of firms by dividing them into two types: centralized or decentralized networks (Langlois and Robertson, 1992; Saxenian, 1994).

And successive studies have specified each type of interfirm relations. For instance, Greve et al. (2013) further examined two heterogeneous types of centralized network and found how they perform in terms of innovation and risk management (i.e., hub and spoke type network of Samsung and integrated type of Sony). By zooming in structural dissimilarities of networks and their influence on the collaborative outcome, studies have tried to understand diversity of relational structure and logics behind diverged competitive outcome (performance) (Powell et al., 1996; Greve et al., 2014).

Firms collaborate with a variety of entities: supplier, customer, competitor, research organization, and so forth (Tsai, 2009). With respect to the collaborating partner, scholars started to consider *who conducts which part of a value chain* (e.g., distribution of tasks by collaborators), what kind of role the firms play in the directly and indirectly linked environment and how their relative power is distributed and exerted (e.g., hub or niche/ platform provider or user) (Gawer and Cusumano, 2002; Iansiti and Levien, 2004; Teece, 2007; Boudreau, 2010).

The structure of interfirm ties matters in understanding the rationale behind the simultaneous high domestic-international performance. For instance, as Jacobides and Kudina (2013) argue that if a firm's value chain structure in the home country is similar to that of a foreign country, it is easier for the firm to expand to the foreign market. As Jacobides (2008) and Jacobides and Kudina (2013) argue, it is necessary for us to examine heterogeneous structure of value chain in different nations in order to grasp their performance out of the home country. However, our knowledge on the structural heterogeneity of interfirm relations in different countries is still far from sufficient.

Secondly, another significant factor is collaborative magnitude (coupling strength) between firms. With respect to this aspect, multiple streams of studies including supply chain management, network and business ecosystem studies offer us a theoretical foundation for further discussion. For example, in network theory, Granovetter (1973) uncovered the benefits of weak ties such as collection of broader and more diverse information with less resource redundancy. And, in business ecosystem studies, loosely connected collaboration was considered to facilitate firms' lightweight resource investment into a specific partner and help them to minimize the risk of being overly dependent on a single partner (hub firm) (Iansiti and Levien, 2004; Eisenmann et al., 2009; Boudreau, 2010).

On the other hand, in a tightly-coupled interfirm relation, firms get to develop highly specific internal assets for the collaborator because firms are required to optimize their resources to the operation of a specific collaborator (Iansiti and Levien, 2004). Under this setting, once a supplier is committed to a certain partner, the cost of switching to others becomes very high. Also, the tight-relationship renders the firms more vulnerable to significant changes in technology and business models by making them locked in a certain technological or strategic direction (Henderson and Clark, 1990; Christensen, 1997).

Despite these demerits, tightly-connected structure is more likely to be efficient in operations because firms closely arrange the activities of collaborators to a shared objective so that they can implement a more efficient division of labour by avoiding duplication of efforts among them. As Teece (1986) demonstrates in the argument of co-specialization, mutually adapted firms tend to yield superior value in combination.

With respect to the tightness of interfirm relations, Burt (2001) claims an intriguing view that the two tie strengths (i.e., weak and tight) are not necessarily conflicting. According to Burt (2001), they are both necessary to attain higher performance: a network that possesses strongly connected ties within it and weakly connected ties outside it was the most ideal because by composing the network in that way firms could exploit the efficiency of tight collaboration within the network and increase the possibility to leverage the benefits of exploring diverse knowledge of loose collaboration outside the network.

As explained so far, although prior literature has sought to seek diverse aspects of interfirm relations and its connection with the performance of firms, the theoretical clue we possess at the moment is still blurred. In examining the research questions of this study, many puzzles still remain. For instance, although prior studies divide the collaborative strength into tight or weak, the actual strength of collaborative relations exists at some point in between the two extremes (high to low).

And thus it is in fact natural to consider the following aspects in detail such as how strong or weak relations are, where (which stage) in the value chain is strongly or weakly connected, how they are built, how value chain structure is dissimilar in different countries, and how national heterogeneities affect the firms' operation within and beyond the home country boundary. Pursuing these questions, our theoretical framework and constructs are still underdeveloped.

Therefore, in this study, I zoom in the fuzzy picture with the two combined tools (structure and strength of the interfirm relations), and try to answer the following questions: how interfirm collaborations are architecturally different, specifically where are they different, where in the value chain do firms make it tight or loose and how it is related to their odds to capture more value in the domestic and global markets than competitors. In addressing these questions, the mobile phone industry helps us to get useful insights.

3. Case Study

Methodology

This is an explorative case. Case-based exploratory methods are best suited for examining new and poorly understood phenomena (Eisenhardt, 1989). As shown in Table 1, firms from Japan disappeared after the early 2000s and newcomers from Korea and China emerged in the top group. During the research process to explore various possible reasons that caused the performance gap between those national groups of firms, it was identified that the heterogeneous architecture of interfirm collaboration was a major factor.

Insert Table 1 about here

In this industry, exploring fundamental reason to cause the divergent fate of these 3 groups of firms has been a longtime inquiry. This study is part of such endeavor as well. The analysis is based on primary and secondary data. First of all, in order to uncover underlying logic between the comparative interfirm architecture and its influence on the domestic and global performance, the semi-structured interviews were conducted at the network operators, handset manufacturers, hardware/software suppliers, independent design houses, industry associations, and research institutes in Japan, Korea, and China during the period of 2006 and

2015.

Respondents were asked to describe the technical, commercial and managerial aspects in detail and the interviews lasted about two hours each time on average. Throughout the research process, the primary and secondary data were supplemented with each other iteratively to validate the discovered logics. The main sources of secondary data were industry journals, technological reports and corporate archives. Through a series of data analysis, I confirmed validity of the framework and the key sub-constructs suggested in the framework of this study (e.g., (quasi-)integral/(quasi-)modular collaborative architecture).

Comparative Analysis of Three Interfirm Relations

Enabling Mechanism of the Competitive Advantage in the Domestic and Global Markets

Insert Figure 1 about here

Figure 1 presents the framework of how national competitive advantage is created and transferred from home country to overseas in the mobile handset industry. In this industry, the superiority in the home country does not directly guarantee the global competitiveness of related firms (Funk, 2002; Marukawa, 2009; Marukawa and Yasumoto, 2010). Therefore, the performance of firms is divided into two phases: domestic and international markets.

In the research, it was identified that the characteristics of domestic firms is determined by the interactive influence between the architecture of interfirm relations and national conditions. National conditions include six factors pointed out in the Porter(1990)'s diamond model such as factor conditions, demand conditions, related and supporting industries, and firm strategy and rivalry, and the two indirect variables (i.e., government role and the chance of unexpected occurrences). Also, technological aspects (continuity) affect the formation of characteristics of domestic enterprises.

With the combined influence of these three factors, performance of firms in the domestic market is drawn. Technological continuity (similarity) matters when domestic firms expand overseas as well. For instance, if technologies are continuous between the domestic and foreign countries, it will be easier for firms to conduct product development for the foreign market. Also, if technologies are similar between generations, it will be easier for firms to exploit their previously accumulated capabilities and knowledge. Finally, through competition with foreign contenders born in other countries, the global performance is determined in the international marketplace.

By introducing the architectural concept into the interfirm relations as a major factor, the framework specifies how firms are inter-connected and co-evolve by shaping strategy, culture, and resource allocation pattern in and out of the home market collectively over time. In the following section, I describe how heterogeneous architectures of the interfirm relations affect the process of creating domestic and international competitive advantage in Japan, China and Korea.

Heterogeneous Architecture of Interfirm Collaboration

Insert Figure 2 about here

In the mobile industry, similarity of firms to compose their interfirm connections was observed among the firms headquartered in the same country. Most importantly, the way operators and handset makers (two main players in the industry) collaborate was highly homogeneous among firms born in the same home country. In a process to deliver final product (mobile phone) to end-users, these two collaborators (operators and handset manufacturers) engage in the two major stages of the value chain: (a) product planning and development and (b) sales (distribution and marketing). In the tasks of (a) and (b), collaborative strength between them locates in a certain level in between the two extremes from high to low as shown in Figure 2. Based upon their degree of collaborative tightness in (a) and (b) in the value chain, it is possible to classify the architecture of interfirm relations into four different types (See Figure 3).

Insert Figure 3 about here

- (1) ***Integral***: The firms tightly collaborate in the operation (a) and (b).
- (2) ***Quasi-integral***: The firms tightly collaborate in (a), but less tightly collaborate in (b).
- (3) ***Modular***: The firms loosely collaborate in the operation (a) and (b).
- (4) ***Quasi-modular***: The firms loosely collaborate in (a), but tightly collaborate in (b).

Integral collaborative architecture (Japan)

The leadership of network operators is extremely strong in the whole process of value chain (a) and (b). The handset makers develop mobile phones as OEM subcontractors by following orders from the operators. Each operator is tightly connected to a certain group of handset manufacturers. The operators not only purchase the terminals from the handset vendors but also distribute the handsets through their own stores. In the operators' store, the handsets are sold by being bundled with the operators' service and end-users are required to subscribe to network service of a specific operator in order to purchase the mobile phone. In Japan, the handset vendors tend to build an exclusive long-term relationship with a particular operator.

Quasi-Integral collaborative architecture (Korea)

The relationship between operators and handset manufacturers are similar to that of Japan in (a) yet distinct in (b). The Korean operators also purvey the handsets from the manufacturers, and sell a part of handsets to end-users by bundling with their network service. Similarly, the operators wield a relatively strong power and reflect their opinions on the product planning and development process. Yet, in Korea, the handset makers distribute a part of terminals through their own channels along with the operators' own stores. The portion of sales between the operator and handset vendor's channels has been approximately 80%:20%. However, in comparison with the exclusive relationship between the operators and handset makers, the Korean phone makers build rather loose relationship by offering their handsets to all operators.

Modular collaborative architecture (China)

Network service and handset are being sold separately. The handset makers are highly independent from the influence of the network operators in the all stages of value chain (a) and (b). Generally, the handset manufacturers develop their cell phones without a specified guidance of the operators. Only 10 to 20% of the terminals are jointly developed in cooperation with the operators. Regarding the sales of handsets, the amount of terminals distributed by the operators was about 30% in 2G. The remaining handsets were sold by independent retailers. At present, the portion of handsets distributed by the operators is still relatively low. Thus, the relationship of firms is loosely connected in China.

Collaborative Architecture and Global performance

Insert Figure 4 about here

In the integral architecture of collaborative relations, the Japanese operators took a strong leadership in the all stages of value chain. The product planning is based on suggestions by the operators. They plan the roadmap of their services and decide what kinds of functions should be included in each model. The handset makers take the responsibility until they hand over the ordered handsets to the operator. After the operator purchases the handsets from the makers, they sell the mobile phones to end-users in their directly owned stores.

The operators gain profits from new services. Therefore, the Japanese operators required the phone makers to focus on continuously developing technologically advanced functions such as internet browser, email (1999), camera (2000), music download (2002), electronic payment (2004), digital TV broadcasting (2005) incessantly. By following technological/product roadmap of the operators, the makers have mainly released state of the art high-end models and built a strong technology-oriented R&D routine and organizational culture in the domestic market. In Japan, the focus of makers was laid on addressing the operators' technological requirements.

The tight relationship with the domestic operator had multi-faceted impacts on the performance of makers in and outside of Japan. In terms of technological aspects, the Japanese handset manufacturers were apparently years ahead in a series of innovations. This was possible because the operators orchestrated the vectors of handset makers and component/platform providers in a direction that their capabilities could be effectively integrated as a whole. Also, since the operators guaranteed its handset manufacturers a certain level of sales, the handset makers were able to focus on carrying out the orders/guidance given by the operator in the domestic market.

On the other hand, there were downside effects as well. Although the tight relations at home were advantageous in creating innovation, it made the handset manufacturers locked in a specific pathway of technological and product evolution determined by the operator. Historically, the Japanese handset makers have customized many of their components and software to optimize the system and satisfied the detailed needs of operators. As developers described the Japanese mobile phone as *handmade*, the makers used many proprietary components only for the domestic market.

Under this circumstance, the Japanese makers had to re-develop hardware and software almost from scratch for the global market. The problem was that many of manufacturers did not possess much resources left to conduct the additional R&D for the overseas market separately because they had already consumed much of their assets in addressing the needs of the domestic operator. As managers recalled in the interviews, they did not possess much financial resources left for the additional large-scale R&D and capability building after they deducted the domestic R&D cost from the compensation they received from the operators.

In the mid-1990s, the Japanese makers tried to expand to foreign market. The major makers such as Panasonic (Matsushita at present), NEC, Mitsubishi, and Toshiba started to establish

manufacturing facilities in Europe and China, and purvey GSM handsets overseas. However, despite the efforts to adapt to the foreign environment, most of them ended up withdrawing from those Europe and China: Toshiba and Panasonic in 2005, Mitsubishi and NEC in 2006. Why did this happen? The reason of failure outside was fundamentally related to their way of collaborating at home.

Let's take a look at their experience in China as an example. When the Japanese makers entered China market, they confronted greatly heterogeneous environment. For instance, in Japan, each maker released a few models every six months. As an OEM subcontractor, the makers did not have to figure out user needs proactively, distribute their products, and dispose unsold inventory by themselves. However, in China, the abilities in these multiple stages of value chain were required.

Different from the relatively stable Japanese market, China market was highly diverse, trendy, and competitive. The handset vendors in China fiercely competed with their own brands and released several dozens of models every year at an extremely fast speed. As a separate entity from the operators, the makers needed abilities in product planning, sales, brand establishment and promotion in China. It was by no means easy for the Japanese handset makers because they were not given enough opportunities to accumulate experiences in those activities in the home country. Even NEC, who most aggressively and ambitiously poured financial resources into China, gave up operation and withdrew from the market after all.

In developing mobile phones for the foreign consumers, the Japanese makers focused on technological aspects as they have done in Japan. As had been in Japan, the firms have thought that their technologically advanced products will naturally open up the market. Therefore, the makers developed the mobile phones based on the existing R&D routine and business model built in the domestic market without enough major adjustment to customize their products for the taste of foreign consumers.

Regarding their foreign operation, the Japanese executives emphasized that they overinvested in technology and underinvested in sales and brand building as they did in the domestic market. This example of the Japanese case ineptly shows that the architecture of collaborative (interfirm) relations significantly affects the R&D routine, resource allocation pattern, strategic formation and implementation of firms. In fact, it is ironic to observe the low capabilities in marketing and distribution of the Japanese makers because most of them were all major consumer electronics companies that are superior of those activities (i.e., sales and distribution) in the product value chain.

Next, the Korean example shows that maintaining appropriate level of autonomy for suppliers in forming collaborative structure is beneficial. In Korea, the handset makers distributed and marketed their cell phones to the end-users directly. By selling a part of products through their own channels, the makers (e.g., Samsung and LG) were motivated to build a strong brand and appeal it to the end-customers in order to sell more products by themselves.

From the mid-1990s, the Korean phone manufacturers fiercely competed to differentiate their mobile phone brands at home. Since they were allowed to market and circulate their products in the downstream stages of the value chain under the less tight collaborative relations with the operators, the Korean handset makers became more and more sensitive to the voice of end-users and focused on excavating hidden end-user needs very actively.

Technologically, Korea has first commercialized cdma standard. Since the technology was immature at the beginning, the domestic market played a role as a test bed for this novel technology. At the very beginning, Samsung and LG developed terminals for the global market based upon the end-user demands and information acquired in Korea. They exploited the experiences accumulated through trial and error with the Korean end-users for the foreign models. In the late 1990s, the makers started to go overseas. During the early stage of cdma introduction, Korea was approximately six months to one year ahead of the global trend, and it helped them to export pre-tested technologies and products at home to overseas. By doing so, cdma technology was being diffused gradually in the foreign countries.

After the mid-2000s, the necessity to address heterogeneous needs of foreign consumers significantly increased. Through the longtime interactions with both the operators and end-users, the Korean manufacturers have accumulated capabilities in product planning, developing, marketing, and distributing with technology- and end-user oriented operational routine and corporate culture. When they tried to search for user needs and customize the handsets to satisfy the taste of foreign end-users, the experiences under the less-tightly coupled collaborative architectural conditions in Korea was helpful to adapt to the foreign countries.

In the upstream of the value chain, the Korean firms have a similar process to that of Japan. The operators determine the roadmap of their services and the makers develop the handsets which enables their services effectively. However, the difference between them is that, in Korea, the handset makers are more actively engaged in building their own product/technological strategy. And as they accumulated experiences across borders, the influence of the handset makers' product strategy became stronger. In the collaboration process, the manufacturers tried to adjust the strategic choice of the domestic operators and suggest the product and technological directions to the operators so that the domestic evolutionary path can be synchronized with the major global trend.

The Korean makers brought products succeeded outside back to Korea as well. Over time, this interplay of products and technologies between the domestic and foreign markets became more frequent and prevalent when they released products. In the Korean firms, resources were deployed by keeping pace with the international technical and market trends. This can be observed in their product release. So far, Samsung and LG have released many globalized models that were sold more than ten million units in Korea and/or foreign countries simultaneously (e.g., a part of example of the successful models sold both domestically and globally are SGH-T100, E700, D500, D900, E250 for Samsung, KV5900, KE970, KG270, KP100, SU910 for LG).

Of course, the Korean makers added minor adjustment to better address the demands of each foreign region but the same models released in multiple foreign countries shared almost identical functionalities and basic concepts. By simultaneously reflecting the needs of domestic and foreign end-customers and mixing them in a balanced manner, the Korean makers were able to reduce the gap between the domestic and foreign boundaries in terms of the evolutionary process of technologies and products. Since the relative size of the Korean firms are small compared to the rivals, it was helpful for them to run the business more efficiently.

What is worth contemplating is that this was originated from the less-tightly coupled quasi-integral architecture of Korean firms. If they did not have the chance to access to the sales (downstream) stage of the value chain in the first place, they would not have the motivation and negotiating power to influence the direction of the domestic operator in a way that they could synchronize their product/technological strategies with the global evolution. This implies that the collaborators' adequate level of autonomy facilitates them to transfer the competitive advantage created at home to abroad more effectively. And regarding the method to secure the autonomy between the firms, the Korean case offers a meaningful hint.

The collaborative architecture in the Chinese context helps us to enlarge a picture of modularized interfirm relations. In the modular architecture, firms conduct their activities in a more independent level (See Figure 4). Since handset makers do not develop most of products by the close guidance and support of the operators, overall innovation performance becomes lower than that of the integral/quasi-integral architecture. In practice, the Chinese handset manufacturers have produced low/mid-end mobile phones compared to the Japanese and Korean makers.

On the other hand, modular architecture is advantageous in facilitating diversity. From 1999, China has had the largest number of cell phone makers with various backgrounds: for instance, in 2003, the major makers were from electronics (e.g., TCL, Konka, Haier, Panda, Amoisonic, Daxian, Soutec, Hisense), telecommunications equipment (e.g., ZTE, Huawei, Datang, Capitel, Jinpeng, Putian), and pager (e.g., Bird, Eastcom) industries. Until now, many handset makers have emerged and disappeared in the market. In 2013, there were still over 50 local handset manufacturers in China.

In this loosely-coupled interfirm architecture, mobile phone makers are relatively flexible in choosing their own product and technological pathways. For this reason, the Chinese local handset vendors released quite a number of terminals in the domestic market. Surprisingly enough, the number of mobile phones being sold in China was almost 1500 models in 2006 (Marukawa, 2009). If we consider that the total number of mobile phones released in Japan and Korea yearly was approximately 80 models in each country, it is obvious that the modular interfirm architecture facilitates the firms' flexibility to create high product diversity at home.

In term of the operation in the foreign country, modular architecture create an environment for the participating firms to experiment their product and technological strategies more freely

in and outside the home country as a country level. From the early 2000s, multiple Chinese handset makers started exporting their mobile phones abroad. Through a series of market competition with the diverse rivals within and beyond the home country –although not large number of makers- several Chinese high-performers (e.g., ZTE and Huawei) turned out to be able to build a value network that better serves both the domestic and global markets by purveying low/mid-end acceptable quality handsets with competitive price overseas.

At a country level, this architecture let diverse handset vendors more freely try their own strategies without a huge constraint of the operators’ technological and product trajectories. This explorative process to find a global high-performer among diverse manufacturers cannot easily take place in the integral/quasi-integral architectures because, in those environments, handset providers are required to get an approval of the operator, and thus the number of firms is naturally limited in the more tightly-connected structure of interfirm architecture. If a country has a small population of firms, the probability to nurture high-performers decreases as well.

The analysis of these three heterogeneous interfirm architecture shows that the mechanisms of superior performance within and beyond the home country vary depending on both strength and structure of the interfirm relations.

4. Discussions and Conclusion

This study explores how the heterogeneous architecture of interfirm relations affects the performance of firms in and out of the home country. The comparative case study of the mobile handset industry unveils that by combining the two conventional aspects (collaborative strength and structure) in examining interfirm relations, we can identify four different types of architecture (integral, quasi-integral, modular and quasi-modular). Also, this study further considered relative strength of collaborative relations in multiple stages of value chain such as (a) product planning and development and (b) sales.

Insert Table 2 about here

The findings can be summarized as follows (See Table 2). As demonstrated in the case, the handset makers in each country showed highly similar strategic pathway in R&D routine and corporate culture in the domestic and global markets. And with respect to the successful performance of firms, multiple patterns were observed in different architectural types. When the suppliers (handset makers) had a tight relationship with the buyers (operators), relatively loose relationship between them (quasi-integral architecture) is more likely to be beneficial.

The Korean case described the characteristics of this architectural type. In Korea, suppliers (handset makers) were allowed to engage in marketing and distribution. Being allowed to establish end-customer interface as a supplier in the downstream of the value chain can help suppliers to cultivate end-user centric operations and management routine. This is particularly essential when firms expand to foreign country because they need this ability in a circumstance that they need more proactive engagement in the product development process outside.

Also, if suppliers are able to build their own distribution channel, they are more likely to build a relatively stronger bargaining power toward the collaborators (buyers). In Korea, as the handset manufacturers accumulated experiences with the end-users in and out of the home country, the influence of the handset makers' product strategy became more important to both of the collaborators. Thus, in the collaboration process, the manufacturers were able to adjust the technological directions of the operators so that the domestic evolutionary path can be synchronized with the major global trend. Reducing the gap between the home and foreign markets is critical for firms to effectively perform across borders.

As described in the Korean case, the product and technological strategy for the domestic and foreign markets co-evolved over time and, under this circumstance, the Korean handset makers have released many models that are being sold in the domestic and foreign market simultaneously. Under this environment, firms can more effectively exploit their limited resource within and across borders. Although it may look like a small difference, the competitive result of firms in this industry clearly showed that it causes a huge difference in the course of fierce global expansion in the long run.

In case of loosely-connected modular architecture, the mechanism of creating global competitive advantage shows other logic. Since firms are less interdependent in this architectural setting, diverse firms are more likely to emerge in the market because of the low level of interdependency. In China, firms can experiment their own products and technological strategies that fit in both domestic and foreign settings more flexibly. As described in the Chinese case, the modular architecture played a role to nurture a growing number of effectively performing handset makers (e.g., Huawei, ZTE, and more recently Lenovo) in and outside China among many makers born in China.

Concerning the divergent performance of firms, others might consider different factors such as government policy and technological standard. In the global competitive process, those factors also affected to the competitive landscape of the industry to a certain degree. However, each factor alone cannot fully explain competitive consequences of this industry. For example, in terms of the government support, the telecommunications industry has been a strategically important sector for all three countries and they all have aggressively tried to boost the competitiveness of associated firms domestically and globally. In terms of the national support and technical capability, Japan was by no means in inferior conditions when rivals from Korea and China joined the industry.

As for standard battle, it is a fact that Japan was isolated in 2G with their endemic PDC standard. Regarding this issue, some might think that it was the standard that caused the failure of Japanese firms. However, if it was the technological standard that triggered their market failure, the Japanese firms would have recovered the low international performance from 3G because after they failed in diffusing the 2G standard (PDC) globally, Japan chose more broadly adopted 3G standard (e.g., W-CDMA and cdma2000) in the global market earlier than most of competing countries: W-CDMA from 2001 by NTTdocomo and cdma2000 from 2002 by KDDIau. However, even after they launched the 3G earlier than others, their performance out of Japan continued to get worse.

Similarly, when Korea chose cdma technology, there was no guarantee that the cdma will smoothly spread as a standard in the global market. This means that successful standard establishment requires successful domestic and global supply of handsets and services. Not all standards spread without effective handset development and sales in the global market. Thus, technological factor alone does not explain the longitudinal performance gap of firms born in the three countries comprehensively and fundamentally.

This study contributes to advance our knowledge on interfirm division of labour. Above all, the study classifies architecture of interfirm relations into diverse forms by disentangling the stages of value chain and considering relative tightness of collaborative relations. As demonstrated in the case, the question of *who undertakes which stage of the operations under what level of collaborative tightness* should be considered in a more systematic framework. Although prior studies have discussed this issue, research did not specify heterogeneous effects depending on the more detailed typology as suggested in the theoretical framework of this study.

Second, prior research considers the coupling strength in a dichotomic manner (tight or loose) or did not consider the heterogeneous impact of each stage of the value chain. In this sense, this study complements prior arguments by further exploring and enlarging the relative tightness of collaborative strength and structure. This is imperative because it helps us better understand how the performance is affected by it.

For managers and policy makers, this study offers insightful messages. By magnifying collaborative strength between firms and tracing the interplay among them in terms of technological and product evolution, we can grasp how resources are accumulated and allocated across borders. In particular, this study shows that firms embedded in a certain national architecture create specific capabilities. For decades, within the given architectural structure, firms develop value network and inter/intra-organizational routine. In a favorable condition, it can be a source of inimitability for the firms. However, if the circumstance changes, it can become a threat as well.

As Hannan and Freeman (1984) argue, firms within a certain environment get to self-reinforce their routine and create rigidity over time. As described in the Japanese case, if the direction of firms' technological and product pathway does not coincide with the global trend,

it becomes too risky for the associated firms operating under the tight relationship. In that case, allowing firms a little more flexibility in the value chain might be beneficial. In practice, Japan realized the constraints of their integral architecture and tried to alter the industrial structure and practices by introducing policies but it seems quite difficult for them to reframe it. Indeed, it is a very challenging process.

This study has many limitations. To begin with, the paper delineated limited examples from a single industry. In order to generalize the insights of this study, the research has to be extended and compared in a broader industrial context by incorporating cases from other industries and examples of more incumbent leaders (e.g., Nokia, Motorola) and a new challenger (e.g., Apple). Next, although this study tried to consider the relative magnitude of relations, it could not measure it as continuous figures. I would like to leave those works for my future research.

In our intellectual journey to map out the competitive advantage of firms, the concept of interfirm collaborative architecture is surely an indispensable clue. Since we are currently in the midst of theory building and accumulation through the lens of architectural perspective, there is still a considerable gap between the literature and reality. This paper is a part of such endeavor to approach one step closer to the reality.

References

- Adner R. Kapoor R. (2010) Value Creation in Innovation Ecosystems: How the structure of Technological Interdependence Affects Firm Performance in New Technology Generations. *Strategic Management Journal* 31: 306-333.
- Ahuja, G. (2000) Collaboration networks, structural holes, and innovation: a longitudinal study. *Administrative Science Quarterly*, 45: 425-455.
- Baldwin, C. Y., Clark, K. B. (2000) *Design rules: the power of modularity*. Cambridge, MA: MIT Press.
- Boudreau, K. (2010) Open platform strategies and innovation: Granting access vs. developing control, *Management Science*, 56(10): 1849-1872.
- Burt, R.S. (2001) Structural holes versus network closure as social capital, *Social capital*; Burt, R.S. (eds) *Theory and research*, Aldine publisher: 31-56.
- Chesbrough, H., Vanhaverbeke, W., West, J. (2006) *Open Innovation: Researching a new paradigm*, Oxford University Press, New York.
- Christensen, C. M. (1997) *The innovators dilemma: When new technologies cause great firms to fail*. Harvard Business School Press, Boston, Massachusetts.
- Dyer, J. and H. Singh (1998) "The relational view: Cooperative strategy and sources of interorganizational competitive advantage," *Academy of Management Review*, 23, pp. 660-679.
- Eisenhardt, K. M. (1989) Building theories from case study research. *Academy of Management Review*, 14: 532-550.
- Eisenmann, T.R., Parker, G. Van Alstyne, M. W. (2009) Opening platforms: How, when and why?, Chapter 6 *Platforms, markets, and innovation* (2006) 131-162.
- Fjeldstad, O.D., Snow, C.C., Miles, R.E. (2012) The architecture of collaboration, *Strategic Management Journal*, 33: 734-750.
- Funk, J. L. (2002) *Global competition between and within standards*. Palgrave Macmillan.
- Gawer A, Cusumano M. (2002) *Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation*. Harvard Business School Press: Boston, MA.
- Granovetter, M.S. (1973) The strength of weak ties, *American journal of Sociology*, 78: 1360-1380.
- Greve, H., Rowley, T. shipilov, A. (2014) *The Network advantage: How to Unlock Value from Your Alliances and Partnerships*, Wiley/Jossey-Bass.

- Gulati, R., Nohria, N., & Zaheer, A. (2000) Strategic networks. *Strategic Management Journal*, 21(Special Issue): 203-215.
- Hannan, M.T., Freeman, J. (1984) Structural inertia and organizational change, *American Sociological Review*, 49(2): 149-164.
- Henderson, R.M. & Clark, K.B. (1990) Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly* 35(1): 9–30.
- Iansiti M, Levien R. (2004) *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation and Sustainability*. Harvard Business School Press: Boston, MA.
- Jacobides, M.G. (2005) Industry Change through Vertical Disintegration: How and Why Markets emerged in Mortgage Banking. *Academy of Management Journal* 48(3): 465-498.
- Jacobides, M.G. (2008) Playing football in a soccer field: Value chain structures, institutional modularity and success in foreign expansion, *Managerial and Decision Economics*, 29: 257-276.
- Jacobides, M. G., Knudsen, T., Augier, M. (2006) Benefiting from innovation: Value creation, value appropriation and the role of industry architectures. *Research Policy*, 35(8), 1200-1221.
- Jacobides, M. G., Kudina, A. (2013) How industry architectures shape firm success when expanding in emerging economies, *Global Strategy Journal*, 3(2): 150-170.
- Langlois, R.N., Robertson, P.L. (1992) Networks and innovation in a modular system: Lessons from the microcomputer and stereo component industries, *Research Policy*, 21(4): 297-313.
- Marukawa, T. (2009) Why Japanese multinationals failed in the Chinese mobile phone market: A comparative study of new product development in Japan and China, *Asia Pacific Business Review*, 15: 411-431.
- Marukawa, T., Yasumoto, M. (2010) *The evolution of Mobile Phone Industry: Why Japan Has Been Isolated in the World*, Yuhikaku, Tokyo. (in Japanese)
- Pisano, G. P. (1991) The governance of innovation: Vertical integration and collaborative arrangements in the biotechnology industry, *Research Policy*, 20: 237-249.
- Porter, M. (1986) *Competition in Global Industries*. : Boston: Harvard Business Press.
- Porter, M. (1990) *The Competitive Advantage of Nations*. New York: The Free Press.

- Powell, W.W., Kenneth, K., Smith-Doerr, L. (1996) Interorganizational collaboration and the locus of innovation: Networks of learning in Biotechnology, *Administrative Science Quarterly*, 41(1): 116-145.
- Sturgeon, T. J. (2002) Modular production networks: a new american model of industrial organization. *Industrial and Corporate Change*, 11(3), 451–496.
- Saxenian, A. (1994) *Regional advantage: culture and competition in Silicon Valley and route 128*. Harvard University Press: Cambridge, MA.
- Takeishi, A., Fujimoto, T. (2003) Modularization in the car industry: Interlinked multiple hierarchies of product, production and supplier system. In Prencipe, A.; Davies, A.; Hobday, M. (eds) *The business of systems integration*, Oxford: Oxford University Press, 2003, pp. 254-279 .
- Tsai, K.H. (2009) Collaborative networks and product innovation performance: Toward a contingency perspective, *Research Policy*, 38: 765-778.
- Teece, D.J. (1986) Profiting from technological innovation, *Research Policy*, 15:285-305.
- Teece, D.J. (2007) Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance, *Strategic Management Journal*, 28: 1319-1350.
- Wernerfelt, B. (1984) A resource-based view of the firm, *Strategic Management journal*, 5: 171-180.

Table 1 Global market share of handset manufacturers by ranking

	1985	1990	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
1	Moto	Moto	Moto	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Nokia	Sam	Sam
2	NEC	Pana	Nokia	Moto	Moto	Moto	Moto	Moto	Moto	Moto	Moto	Moto	Sam	Sam	Sam	Sam	Sam	Sam	Nokia	Nokia
3	Oki	Nokia	Eric	Eric	Eric	Eric	Siemens	Sam	Sam	Sam	Sam	Sam	Moto	LG	LG	LG	Apple	Apple	Apple	
4	Nokia	Mitsu	Pana	Pana	Siemens	Siemens	Sam	Siemens	Siemens	Siemens	LG	Sony Eri	Sony Eri	Moto	Sony Eri	ZTE	LG	ZTE	ZTE	
5	Pana	Toshi	NEC	Alcatel	Pana	Pana	Eric	Sony Eri	Sony Eri	LG	Sony Eri	LG	LG	Sony Eri	Moto	Apple	ZTE	LG	LG	

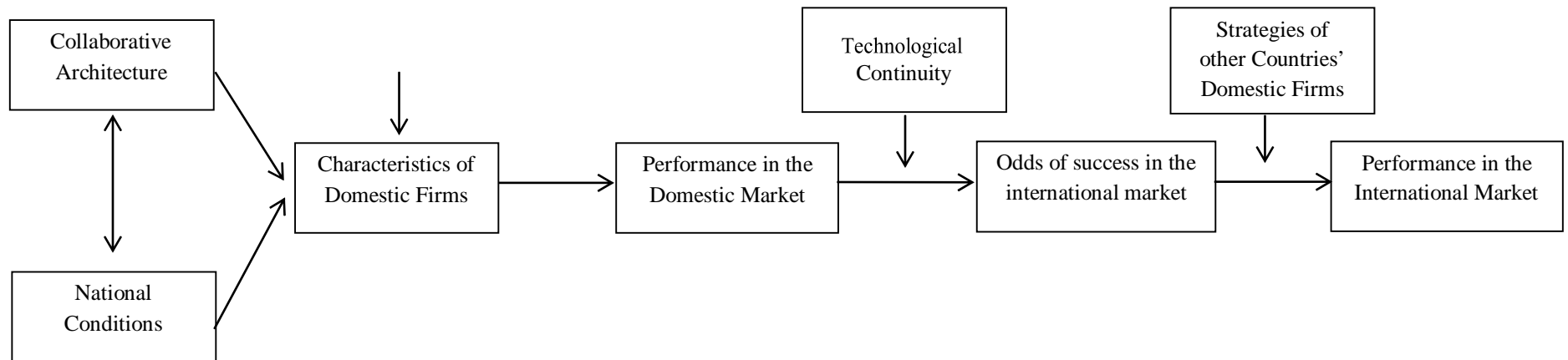
Source: Gartner, Strategy analytics, IDC Worldwide Quarterly.

Note: Moto (Motorola), Eric (Ericsson), Pana (Panasonic), Mitsu (Mitsubishi), Toshi (Toshiba) Sam (Samsung), SonyEricsson (SonyEri)

Table 2 Heterogeneous architecture of interfirm relation in the mobile phone industry

Interfirm Architecture	Integral	Quasi-integral	Modular
Nation	Japan	Korea	China
Characteristic of architecture	tightly-coupled in (a)product planning and development, and (b)sales (whole stages of value chain)	tightly-coupled in (a)product planning and development, and less tightly coupled (b)sales (more autonomy in the downstream)	loosely coupled in (a)product planning and development, and (b)sales (autonomous in the whole stahe)
Collaborative (coupling) strength	Collaborator(buyer)-dependent	less collaborator-dependent, more autonomy	independent from collaborator, large autonomy
Focus of management	technological requirements by collaborator	technological requirements by collaborators and customer needs by end-user	flexible choice of technological options and search for customer needs
Organizational culture of suppliers (handset makers)	technology-centered, B2B-oriented	technology- and user-centered, B2B and B2C-oriented	user-oriented, B2C-oriented
Benefit of the interfirm architecture	efficient in orchestrated innovation	efficient in orchestrated innovation, excavation of end-user demand	high niche creation (emergence of diverse firms) Flexibility
Challenges of Suppliers (handset makers)	overly buyer-dependent (risky if buyer's technological path does not lead or co-evolve with the global trend), relation-specific assets, difficult to adapt to foreign buyers and end-users	an ability requited to manage (balance) bargaining power toward buyer, balance the domestic and foreign customer demand	differentiate from other makers (natural selection), overcome low efficiency in innovation

Figure 1 Mechanism of the competitive advantage in the domestic and international marketplace



Note: The national conditions incorporate factors in Porter (1990)'s diamond model.

Figure 2 Heterogeneous collaborative (coupling) strength in the two stages of mobile phone value chain

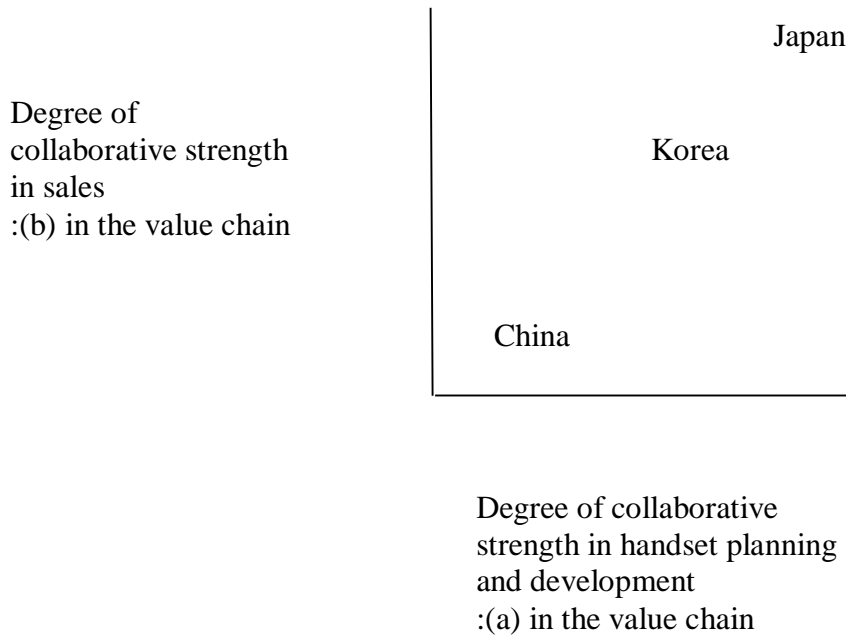


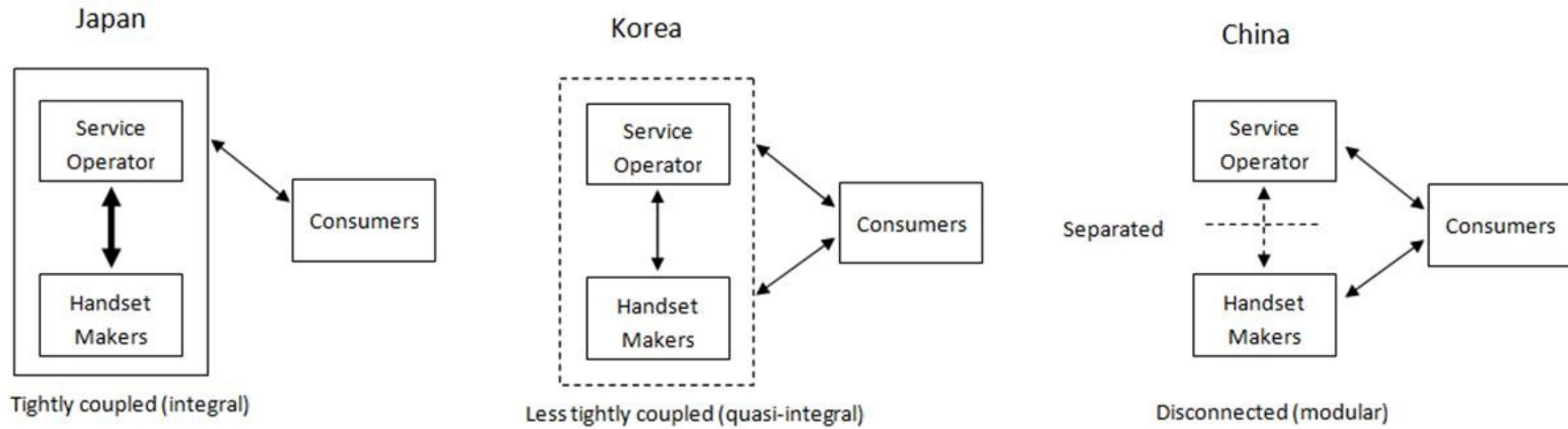
Figure 3 Taxonomy of collaborative architecture

(b) Degree of collaborative tightness in product sales

		Low	High
(a) Degree of collaborative tightness in product planning and development	High	Quasi-Integral	Integral
	Low	Modular	Quasi-Modular

Note: Precisely the degree of collaborative strength between supplier and buyer in (a) and (b) can be regarded as a continuum. However simplifying the model is helpful for offering analytic convenience and stimulating further discussion.

Figure 4 Heterogeneous collaborative architectures of the mobile handset business ecosystems in Japan, Korea, and China



Note: the thickness of the arrows indicates the degree of coupling strength between the entities. And the dotted line shows the loosely coupled relationship.