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How latecomers innovate through technology modularization: Evidence from China's Shanzhai industry

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How local latecomer firms catch-up on technological innovation has been an important and well-researched topic. Inspired by the success of China's Shanzhai mobile phone business, we propose a new path for latecomers to such strategic catch-up. Initially, technological development and profit seeking lead to technology modularization and value chain evolution. Specifically, some firms in possession of better technologies refocus their business on the design and production of chipsets and software, while others with other advantages such as market information reallocate their effort in cosmetic design, differentiation, or marketing. These local firms that used to be electronics suppliers to major original equipment manufacturers (OEMs) gradually transform themselves into module designers and producers, causing the value chain to evolve from a vertical and OEM-centric system to a horizontal, project-oriented and loosely cooperative network. Modularization and the evolution of value chain significantly lower the technological threshold of entering the mobile phone business, promote disruptive innovations, and accelerate latecomers' accumulation of knowledge and technology.

Keywords: modularity; disruptive innovation; local firms; mobile phone firms; emerging economies

1. Introduction

There has been a good array of research on how local latecomer firms in emerging economies innovate and catch-up to well established firms in developed economies (Ahn, Kim, & Lee, 2005; Cho & Lee, 2003; Kim, 1997; Kim & Lee, 2002; Lee & Lim, 2001; Liu & Wu, 2011). Two approaches dominate the previous research on this topic. The first breaks down the local firms' organizational learning process into multiple stages and examines how they in each stage learn from others and develop their own innovation capabilities (Kim, 1997; Liu, 2008; Xie & Wu, 2003; Zhai, Shi, & Gregory, 2007). The other separates local firms into different groups based on industrial characteristics or the technological regime of the industry (Winter, 1984), and then matches their distinct characteristics and different paths to upgrades (Kim & Lee, 2002; Lee & Lim, 2001).

While most of these studies focus on the matching amongst strategies, growth stages, and the accumulation of technological capabilities, few have explored the potential significance of technological modularization and subsequent evolution of industrial

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value chain to local firms' catch-up efforts. Through a study of China's Shanzhai mobile phone business, we offer a new theoretical angle and evidence that technological modularization propels local disruptive innovations.

First, modularity enables local firms to break the technological barrier to technology-intensive industries. The complexity of technological innovation often suffocates a latecomer's product development and delays their product introduction (Baldwin & Clark, 2000; Langlois, 2002). However, the modularization of product development as a result of economic development and profit-seeking behavior separates a product into multiple modules, significantly reducing the difficulty of developing individual modules. By sourcing readily available modules from developers, local firms can focus on disruptive innovations to design and assemble products that fit local needs or niche markets such as markets at the bottom of the pyramid (Prahalad & Hammond, 2002).

Secondly, the existing literature has proposed that, because modularity reduces the complexity of innovation, it increases the speed of innovation (Baldwin & Clark, 2000). We agree to this point but also attribute the acceleration partly to the fact that the industrial value chain evolves to accommodate the modularization of product development. Specifically, because of modularization, firms that used to be part suppliers may turn themselves into module developers. These module developers form loose cooperation to complete the design of a final product, creating a horizontal and project-oriented value chain that is significantly different from the conventional model of in-house vertical product development system. We argue that this horizontal value chain facilitates the commercialization of modules hence accelerates the speed of disruptive innovations.

The evidence from China's Shanzhai cluster/segment is robust to explain the relationship between modularization and disruptive innovations for three reasons. First, Shanzhai firms in nature are latecomers that emerged around 2001. Located in the Pearl River Delta area, one of China's industrial bases and export hubs, many of the Shanzhai firms were originally electronics suppliers, making toys or simple consumer goods, prior to becoming Shanzhai phone producers. Secondly, the Shanzhai segment has since been undergoing modularization of technology development and the subsequent evolution of the value chain. Lastly, the Shanzhai business has been largely a success story.

Our qualitative investigation confirms the proposed positive effect of industrial modularization on local firms' innovation efforts. The detail of our study unfolds as follows: Section 2 provides the research background; Section 3 is the methodology of the study; Section 4 proposes the theoretical model of disruptive innovation based on modularity and evolution of the industrial value chain; Section 5 explores the strategic transformation of Shanzhai mobile phone firms; and Section 6 addresses a conclusion and suggests policy implications.

2. Research background

2.1. Research context

The word "Shanzhai" originally means "mountain village" where outlaws live on illegal trades and use it as an act of rebellion against the emperor in the medieval period (Shi & Rong, 2010). Nowadays, it refers to the practice of business imitation in Cantonese, but in Mandarin it also means a region where people follow a different set of social behavioral rules. This word is increasingly used to denote a field of imitation in the industrial value chain that small firms use as a business strategy. Therefore, those small firms practicing imitation in the mobile phone industry are called Shanzhai firms, and

their products called Shanzhai mobile phones. Shanzhai mobile phone producers imitate the functions and styles of the mainstream phone producers like Motorola and Nokia earlier and Apple and Samsung later, but they also have their own brands and trade-marks. Their small sizes restrict their investment in research and development (R&D), and most of them tend to borrow ideas or imitate product designs from major players.

The history of “Shanzhai” mobile phone dates back to 2001 (Hu, 2009), when many counterfeit products that copied international mainstream mobile phones were on sale in Shenzhen and Guangzhou in southern China. However, the practice of counterfeiting, copycatting, and cloning has attracted significant criticism and opposition. Fortunately in 2003, MediaTek Inc. (MTK), a Taiwanese electronic chip producer, started to supply legitimate and good-quality multifunctional chipsets, making it technologically possible for Shanzhai firms to abandon counterfeiting and develop mobile phones independently. Later in the smartphone era, the availability of other modularized technologies such as the open-source Android system also enables Shanzhai firms to advance with industry leaders. According to the statistics conducted by CCID Consulting¹, the sales volume of Shanzhai mobile phones reached 150 million units in 2007 (CCID, 2007). Some Shanzhai firms have expanded to international markets such as the Indian market and Middle Eastern markets.

2.2. Theoretic background

2.2.1. Disruptive innovation

The term “disruptive technology” was first introduced by Bower and Christensen (1995) and refined by Christensen (1997). Christensen and Raynor (2003) preferred the concept of “disruptive innovation” to that of “disruptive technology”. They suggested that few technologies are intrinsically disruptive or sustaining in nature, but the innovation strategies associated with technologies enable technologies to have disruptive impacts on leading established firms.

Disruptive innovations are often the outcome of new product innovations that deviate radically from an existing technological trajectory by incorporating a package of different performance attributes to the product (Christensen & Bower, 1996; Henderson & Clark, 1990; Teece, 1986). They are novel in that they significantly depart from existing alternatives and are shaped by new cognitive frames that need to be deployed to make sense of the innovation. Firms practicing disruptive innovation introduce products performing differently to those arising from conventional technologies.

Driven by the demand for low-cost alternatives and tight budgets, China’s Shanzhai phone makers naturally develop disruptive innovations to target the low-end market. Equipped with inferior technologies, Shanzhai mobile phones are designed to perform basic functions that satisfy most needs of the low-end users, instead of providing a rich package of functions that increases the price tag. As Shanzhai firms continue to accumulate technology and capital, disruptive innovations continue to flow out of the pipeline to tackle various market segments.

2.2.2. Modularity

Modularity is a way of breaking down and managing a complex system (Baldwin & Clark, 2000; Ethiraj & Levinthal, 2004; Sanchez & Mahoney, 1996; Simon, 1962; Ulrich & Eppinger, 1999). In a complex technological system, not only are there many

technological organs, but also the functions of organs are interdependent (Simon, 1962). Through the modularization of technology, highly interactive components are integrated into a module, so a complex system can be broken down into several relatively independent modules with reduced and standardized interactions and the degree of system complexity can be lowered substantially (Schilling & Steensma, 2001). This allows firms to decompose and understand complex products. Then innovations to modules can be made, and new ways to combine modules can be developed to create novel complex products.

For latecomers, a mobile phone would be a relatively complex product to produce without the modularization of mobile phone technologies. With modularization of the process of mobile phone manufacture, R&D is also modularized. Some relatively technologically advanced firms specialize in developing core technologies such as mobile phone chipsets, and latecomer firms with good sense of market pulse focus on developing mainboards and other parts of the phone. By combining self-developed disruptive technologies and outsourced chipsets, Shanzhai firms can introduce their products extremely quickly.

2.2.3. *Latecomers' growth models*

There have been studies of the growth models of local firms in developing countries. From a detailed case study of three firms, Zhai et al. (2007) proposed a growth model with four stages including penetration, accumulation, evolution, and adaption to describe how latecomers in emerging economies evolve. In a Korean industrial investigation, Kim (1997) proposed the model of technological leapfrogging from "imitation to innovation", which diverges from the A-U growth model (Utterback & Abernathy, 1975) that innovations begin with product innovation and then move to process innovation in developed economies. Kim (1997) argued that latecomers' innovation proceeds from process innovation to product innovation, including copying, creative imitation, and innovation.

These theoretical models marginally explained the phenomenon of China's Shanzhai mobile phone business in the sense that they also begin with imitation and then proceed to the process of catching-up with competitors' technologies. A key difference between the Korean industries and the Shanzhai mobile phone industry lies in that the Shanzhai business arises spontaneously without active government involvement, while many Korean technological leapfrogging firms received ample government support. Based on our observation of Shanzhai firms, this paper will utilize the accumulated knowledge from previous studies to elaborate on the strategic transformation of Shanzhai mobile phone firms.

3. Methodology

3.1. *Case selection*

We conducted a case study of five firms: three Shanzhai firms and two large leading firms. Table 1 shows the major information of the five cases. The names of the companies are disguised to ensure confidentiality. Following factors are considered in selecting these companies. First, we selected Shanzhai firms that took charge of the final development and manufacturing project management, and they were responsible for the coordination of the whole industrial value chain. Because these Shanzhai firms were in the key position in the industrial value chain (which will be explained in the following

Table 1. Details of interview.

Interviewed firms (details of firms interviewed are anonymised)	Scale	Main product	Interviewee	Duration of interview
Firm A	More than 100 employees	Branded mobile phone	R&D manager	About 1.5 h
Firm B	More than 500 employees	Branded mobile phone	R&D manager	About 1.5 h
Firm C	About 20 employees	Shanzhai mobile phone	Business owner	About 2 h
Firm D	About 10 employees	Shanzhai mobile phone	Business owner	About 2 h
Firm E	Less than 10 employees	Shanzhai mobile phone	Business owner	About 2 h

section), we could learn more details of the operation of the industrial value chain through interviewing them. We also interviewed two leading firms that developed brand mobile phones. Therefore, we could compare Shanzhai firms' business models with leading firms' business models, and summarize the differences between the two. Second, all the firms interviewed were in the Shenzhen area of southern China. The reason was that Shanzhai mobile phone firms are mainly located in the special economic zones in southern China where firms face lower taxes and less regulation. Shanzhai mobile phone firms in Shenzhen are the majority of Shanzhai firms in China. Cases from the same areas could also minimize the extraneous variation caused by different areas. Third, the firms interviewed had been in business for more than two years, which would ensure that they provide us with enough information for case analysis.

3.2. Data collection

Data in this study were collected from both interviews and archives. We conducted in-depth interviews with senior R&D managers or business owners of mobile phone firms. The managers who were interviewed have been working in the firm for more than one year, which ensures that they can provide accurate information about the firm's process of developing mobile phones. Each interview with Shanzhai firms lasted about 2 h, and each interview with large firms lasted about 1.5 h. Some of them were interviewed again via telephone for confirmation. We also collected available archive data. Industrial reports and internal documents were collected. We took multiple trips to the largest mobile phone marketplace in China, Huaqiang bei electronic product market in the city of Shenzhen, to personally observe the business practice and culture there. We even purchased some samples of the Shanzhai phones in the market for comparison to gain first-hand experience.

3.3. Data analysis

Typical content analysis method was utilized to code data from various sources (Strauss, 1987). We created five categories based on the data coding. These categories are (1)

technological modularity, (2) evolution of industrial value chain, (3) innovation process, (4) disruptive innovation, and (5) strategic transformation.

Then we used the method of analytic induction (Glaser & Strauss, 1967; Yan & Gray, 1994) to analyze data and proposed hypothetical explanation of phenomena. In the process of analytic induction (Gressey, 1953; Yan & Gray, 1994), we iterated data with proposed theory, compared the data from different sources, and in the end, we suggested a theoretical pattern that fitted data from all cases. First, we defined the phenomenon that we tried to explain. Second, a tentative theoretical explanation of that phenomenon was suggested. Third, one case was studied to check whether the hypothesis fitted the facts in the case. Fourth, if the tentative theoretical explanation did not fit the data from the case, either the theoretical explanation was reformulated or the phenomenon to be explained was re-defined. Last, the procedure was continued until a theoretical explanation emerged that could be applied to all cases. As suggested by prior studies (Eisenhardt, 1989; Yan & Gray, 1994), the comparative case method is appropriate in case studies.

4. Technological modularity, evolution of the industrial value chain and disruptive innovation

4.1. Technological modularity and the evolution of mobile phone industrial value chain

A typical high-tech product integrates a large number of technologies that interact with each other in a complex way. The embedded complexity creates a need for firms to simplify the management of the product and development of new technologies. Modularity is one such idea that separates a product into multiple modules. Through the design and manufacturing of individual modules, firms can reduce the technological requirement while increase the cost effectiveness of R&D budget (Schilling & Steensma, 2001).

The conventional product development is done mostly in-house by OEMs. Several reasons back up such practice. Firstly, brand manufacturers have the necessary resources. Secondly, in-house development of modules may better interact with one another due to technological insights and uniformed protocol. Thirdly, the designs of modules are the secret recipes of a product that a company retain as a competitive advantage. In the mobile phone industry, specifically, except for outsourcing integrated circuit design to some professional semiconductor companies, large mobile phone companies take up most other activities of new product development, which includes integrated circuit design, software and system design, hardware design (consisting of mainboard, driver program, user interface and system integration design), industrial design, and product project management (consisting of product definition, parts procurement, appearance design, outsourcing of manufacture, and project control) (see Figure 1). In order to handle the complexity of mobile phones, vertical integration of the value chain is necessary so that the consistency of all interrelated elements is ensured by in-house coordination and development (Simon, 1962). However, a weakness of this type of development is the long cycle (typically more than six months) that mobile phone firms have to spend on product design.

On the other hand, Shanzhai firms face a completely different set of challenges. Firstly, they are small and have limited resources for R&D. Secondly, they are technologically inferior. Thirdly, the secondary market or the niche markets they are in tend to be segmented. Hence, there is a demand from Shanzhai firms for cheap and readily

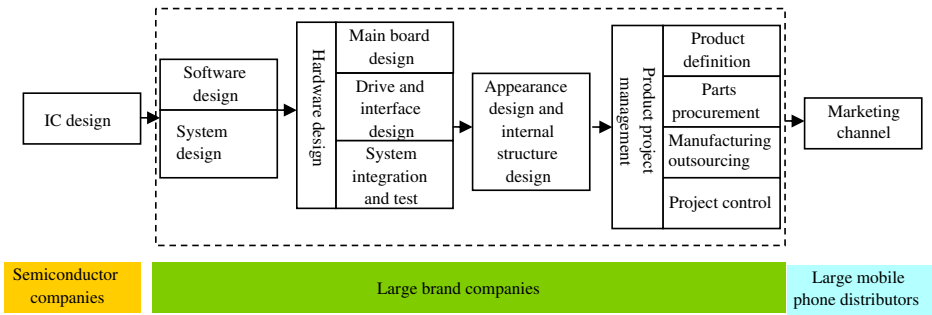


Figure 1. The Industrial value chain of traditional mobile phones.

available modules. Incentivized by such demand, electronics suppliers gradually start to design and sell modules and turn themselves into module developers. These module developers form loose networks to bring new products, and each firm interacts with multiple upstream and downstream firms. The value chain is laid flat and becomes horizontal as shown in Figure 2.

In the Shanzhai phone business, the integrated circuit design, software design and system design are separated and each managed by independent businesses. Because the majority of Shanzhai phones use MTK's chips, MTK is able to recoup the R&D cost from its sales to Shanzhai firms. This allows MTK to continuously develop newer and more powerful modules like integrated circuit, software and system design, and supply turnkey solutions for downstream mobile phone companies. Subsequently, design project companies builds the hardware; Shanzhai firms take charge of manufacturing project management; and industrial design (ID) companies and mechanical design (MD) companies carry out internal structural and cosmetic design. As a result, the traditional vertical integration of new mobile phone development is replaced by horizontal new product development processes, in which multiple firms are involved in contributing to the development of new models of mobile phones. Consequently, the time required in the development of a new mobile phone is greatly reduced. Our case studies find that the interviewed Shanzhai firms need only an average of two to three months for such development. With the low-cost supporting modules, Shanzhai mobile phone companies can use their strong sense of the market to quickly develop final products that appeal to consumers. The outcome is that a wide range of low-cost Shanzhai mobile phones with diverse external appearances and unique functions are offered to markets.

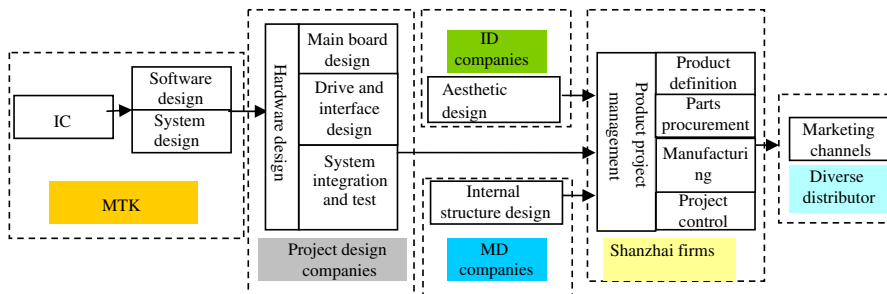


Figure 2. The industrial value chain of Shanzhai mobile phones.

4.2. Disruptive innovations of Shanzhai mobile phones

Disruptive innovations often take place in low-end niche markets (Christensen, 1997). It is no exception for Shanzhai products. Shanzhai firms started with simple imitation of branded products, so it is not surprising that the initial Shanzhai phones were of low reliability, low quality and had limited features, but they were cheap enough to appeal to cost-conscious consumers who used mobile phones primarily for making phone calls.

After modularization, the Shanzhai value chain was truncated into modules, and the existing imitators and new entrants gradually specialized in one area on the value chain. Because the firms work in a loose network and engage in contractual relationships, the Shanzhai technologies must be adaptable to upstream designs and usable for downstream module development. Compatibility is a disruptive feature that is different from the exclusivity of the in-house phone design utilised by conventional producers to seek control of the technology. For example, working from the base of the phone chipsets provided by MTK, project design firms develop mainboards of mobile phones to integrate chipsets with other components. Industrial design companies and mechanical design companies then take up the activities of appearance and internal structural design. Finally, Shanzhai firms carry out the product project management involving manufacturing outsourcing and products distribution.

Our case studies show that an advantage Shanzhai firms have over large major producers is that they are closer to the local market, and they have a better sense of the needs of local consumers in niche-markets. With precise market analysis and the technological support of the Shanzhai value chain, Shanzhai firms are able to profit on engineering mobile phones that either trim away unnecessary features for cost-sensitive customers, or add new features that local consumers consider essential. For example, Shanzhai firms invented the concept of dual SIM cards that allowed a phone to switch numbers for business use during work hours and personal use for off-work hours. Some phones include ultra-loud speakers targeting the elderly, and farmers and factory workers whose work environment demand a higher volume. Others have analog TV receivers that let people watch programs without data usage.

Figure 3 shows how Shanzhai mobile phones conduct disruptive innovation.

There is a dual social and economic structure in China due to significant differences in the level of economic development between urban and rural areas. As Figure 3 shows, the high-end market demands superior technological performance, while the low-end market is more cost conscious and tolerates inferior technological performance.

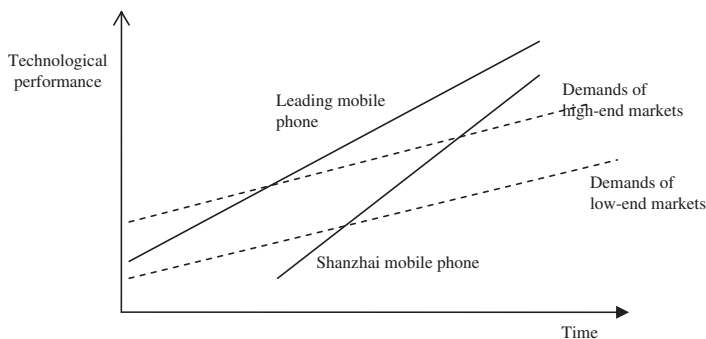


Figure 3. Disruptive innovation of Shanzhai mobile phones.

The leading mobile phone companies have resources and innovative experience in developing mobile phone chip, software and system design. The technological performance of leading mobile phones may surpass the demand in the high-end market over time. Because brand products are of high quality, relatively expensive and standardized, they are marketed mostly to the high-end market.

The low-end market is left to be fulfilled by cheap alternatives like Shanzhai phones. In the Shanzhai phone value chain, MTK entered the chip design business as a late-comer but with rich R&D experience accumulated from the semiconductor industry. Since a latecomer can learn from the incumbent frontrunner, it is able to catch-up on the speed of innovation with the leading firms. As Figure 3 shows, the technology progress curve of the Shanzhai mobile phone manufacturers is steeper than that of leading mobile phone companies. Over time, the technology performance of the Shanzhai mobile phones may satisfy the demands of low-end markets. This is exactly the kind of disruptive innovation suggested by Christensen (1997).

After gaining ground in the mobile phone markets, MTK drew in more sustaining cash flow to improve the technological performance of its chipsets. In February 2009, MTK introduced its first smart phone chipset. Eventually, the mobile phones with MTK's chipsets were made well enough to also meet the demands of high-end markets. Gradually, MTK's R&D capacity is approaching that of the big brands. To date, even Motorola outsources its chipsets to MTK. With the progress of MTK's technologies, it is expected that Shanzhai mobile phones can potentially take a greater share of mainstream markets currently dominated by leading mobile phone companies.

4.3 The speed of innovation of Shanzhai mobile phones

Several researchers suggest that firms need a pool of new product ideas to develop a marketable final product via an innovation process (Dougherty & Hardy, 1996; Tushman & O'Reilly, 1996; Van de Ven, Polley, Garud, & Venkataraman, 1999). Then they discard the ideas that are deemed inappropriate for further development. Hence, R&D activities are convergent processes beginning with many new product ideas and ending with only one chosen for commercialization. The innovation process of the large brand mobile phone companies is convergent, as suggested by Figure 4. These companies are self-reliant in almost all stages of the development process, so the traditional in-house innovation process may take much longer than that based on modularity, followed by the Shanzhai phone companies.

In contrast, the innovation process in the Shanzhai mobile phone industrial value chain is emanative (see Figure 5). By specializing in module development, module suppliers work as a loose alliance. MTK is responsible for developing phone chipsets,

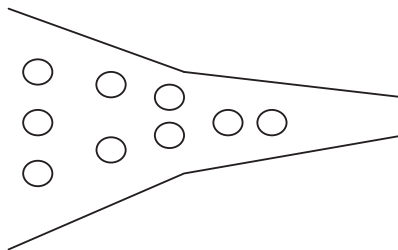


Figure 4. The innovation process of big brand mobile phones.

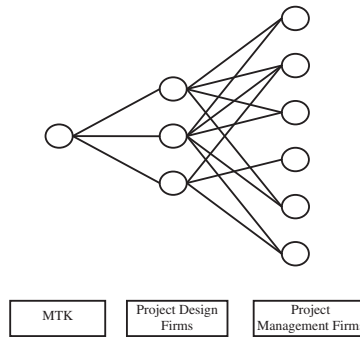


Figure 5. The innovation process of Shanzhai mobile phones.

providing a technological platform for downstream development of mobile phones. Downstream companies focus their work on designing phone mainboards. There are more than 1000 phone project design firms in the Shenzhen area in southern China. They integrate MTK phone chipsets with the other parts of phones to develop phone mainboards. Then, the project management firms (Shanzhai firms) buy phone designs from these companies, and buy internal designs and appearance designs from industrial and mechanical design companies. Project management companies take responsibility for product definition, outsourcing of manufacturing processes and project control. By making use of different combinations of the modules purchased, these companies can create a variety of novel Shanzhai mobile phones. Therefore, the development of Shanzhai mobile phones is an emanative process. Collaboration based on modularity can boost the speed of innovation and increase the variety of products.

5. The strategic transformation of some Shanzhai mobile phone firms

Korean firms' growth path from imitation to innovation by Kim (1997), can also be extrapolated to examine the development of China's Shanzhai firms. In the Shanzhai sector, firms started the business with exact copies or close imitations of leading brands, but simple imitation was not a sufficient strategy to ensure their survival. On the one hand, leading brands have the most up-to-date technologies, proven quality, reputation and royalty, and that is a top-down pressure on Shanzhai firms to do better. On the other hand, as the Shanzhai mobile phone sector continues to expand, the competition amongst Shanzhai firms increases, so they have to create new competitive advantages through strategic transformation and upgrades.

Our study of the Shanzhai industry has shown that some Shanzhai firms have undergone four stages of strategic upgrades to meet with the challenges. Figure 6 shows a model of the process of strategic transformation of some Shanzhai firms.

Many Shanzhai firms started as part suppliers or distributors of brand companies. For example, Tianyu Communication Equipment Co., Ltd (Tianyu) was a sales agent for large brand mobile phones firms prior to making its own mobile products. As a mobile phone distributor, some Shanzhai firms accumulated experience and knowledge in markets and cultivated stable and long-term relationships with sales channels, thus laying the foundation for the development and marketing of their own mobile phones.

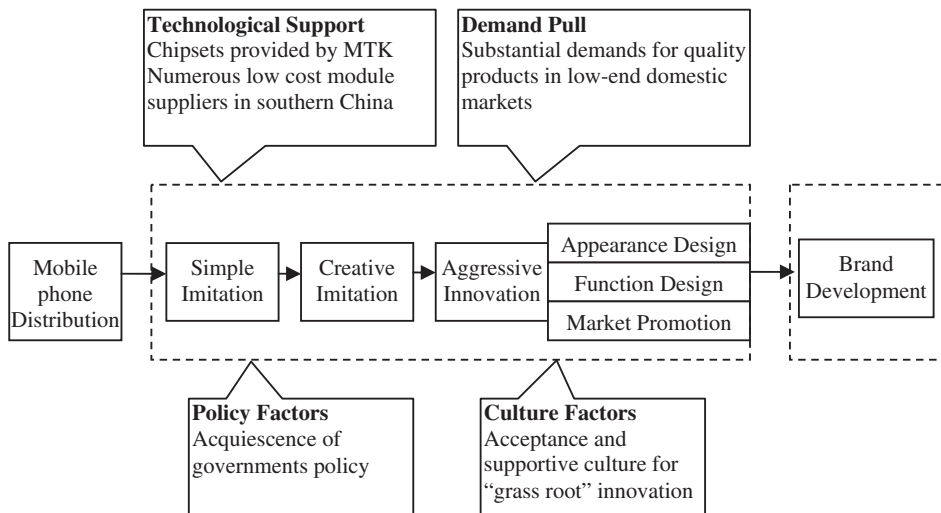


Figure 6. The strategic transformation of Shanzhai mobile phone firms.

In the second stage, the Shanzhai firms imitated external design of existing branded mobile phones. The imitative products were low in quality and inconsistent in the technological performance. There was almost no aftermarket service.

The third stage was creative innovation. In this stage, Shanzhai firms continued to imitate the design and function of branded mobile phones. They began to learn R&D from the market leaders. Shanzhai mobile phone firms even outperformed some leading companies in terms of aesthetic design. Modularisation also made it possible for Shanzhai firms to select different modules from diverse suppliers to develop new mobile phone models with a variety of styles and functions. At this stage, the trends in design of Shanzhai firms became more sensitive to market information and more operationally flexible than the competing processes of large mobile phone firms. Thus the Shenzhai firms were more able to target different consumers with tailored packages, especially consumers in low-end markets.

The fourth stage is aggressive innovation. At this stage, Shanzhai firms used their creativity in mobile phone appearance design and internal function design. By combining different parts from module suppliers, Shanzhai firms developed many new mobile phones including those that emulate, even supersede, mainstream mobile phones. Some of them also employed marketing techniques similar to that of leading companies. Tianyu and other firms at the forefront of the Shanzhai movement have gained capacity to develop new mobile phone models by their own internal R&D processes.

In the most recent stage of this evolutionary process of brand development, some Shanzhai firms have introduced new brands with fast, efficient and novel local distribution channels. Shanzhai firms not only compete in domestic markets, but also endeavor to sell their products in overseas markets. Some Shanzhai firms have invested plenty of resources in R&D activities, and have also collaborated in this field with leading mobile phone companies. Through these processes of independent research, development and collaboration with leading companies, some Shanzhai firms have enhanced their product innovation capabilities. The resultant increase in innovation capacity supports strategic brand development and builds their brand images. After this transformational process, they cease to be Shanzhai firms and become mainstream with their own characteristic brand images.

Such development and strategic transformation of Shanzhai firms was supported and facilitated by external factors. External technological support has been the basis for the development of Shanzhai mobile phone firms. The emergence and diffusion of integrated chipset solutions provided by module producers like MTK allows Shanzhai firms to start developing mobile phones independently. Many electronics manufacturers in the Pearl River Delta area of southern China accumulated sufficient capacity to locally manufacture electronic products. This was an offshoot of the processes involved in providing manufacturing services for multinational corporations. Each module supplier specialized in a specific part of the mobile phones, and gradually improved its manufacturing technologies. On the basis of experience in these operational processes, module suppliers and Shanzhai mobile phone firms gradually improved their relationships with each other, which enhanced the performance of the whole supply chain.

The Shanzhai mobile phone business was also boosted by huge Chinese domestic demand. In low-end markets, there were low income city dwellers and migrant farmer workers. In these groups, there was a strong demand for low-cost Shanzhai mobile phones. Their needs were readily satisfied by Shanzhai mobile phones that were inexpensive and sound in quality, although inferior to mainstream mobile phones in brand image and technological performance.

The government plays a passive but positive role in the rise of Shanzhai firms. Initially, regulation lagged behind overall economic development and the government was weak in enforcing existing laws and regulations. This provided a short “free for all” period of low-cost entry for Shanzhai firms to enter the phone market. It was estimated that as many as 80% of Shanzhai firms were not registered with the government in the early stage of the Shanzhai phenomenon. As the government gradually stepped up efforts in law enforcement and the protection of intellectual property rights after China joined the World Trade Organization (WTO), the Shanzhai business had evolved and firms were gradually abandoning the practice of copying, and started to source modules from developers and conduct disruptive innovations. Unlike South Korean electronics firms who faced relatively tight regulation and received government incentives like joint research facilities, Chinese Shanzhai firms were loosely regulated initially but did not enjoy any subsidy. The entire business was market-driven and the whole industrial value chain of Shanzhai mobile phones was formed spontaneously through ongoing competition and collaborations.

Finally, we argue that the business and social culture positively contributes to the emergence and development of Shanzhai mobile phone firms. As mentioned above, Shanzhai products also mean a kind of “grass roots” innovation to some extent. There is also a kind of “grass roots” culture in China, especially in southern China. On the one hand, there is a business culture of venture-taking, nurturing disruptive innovations. On the other hand, although many consumers are brand-loyal, many others like to try new things and distinguish themselves from others. So if a differentiated product is reasonably reliable enough, many are willing to try it. This cultivates a market for Shanzhai products.

6. Conclusions and policy implications

In the course of examining of the China’s Shanzhai mobile phone industry, this paper proposed that technological modularity and the evolution of the industrial value chain lower the threshold of disruptive innovation and allow latecomer firms in emerging economies to catch-up on disruptive innovations. Specifically, some firms in possession

of better technologies refocus their business on the design and production of chipsets and software, while others with other advantages such as market information reallocate their effort in cosmetic design, differentiation, or marketing. These local firms that used to be electronics suppliers to major OEMs gradually transform themselves into module designers and producers, causing the value chain to evolve from a vertical and OEM-centric system to a horizontal, project-oriented and loosely cooperative network. Modularization and the evolution of the value chain promote disruptive innovations and accelerate latecomers' accumulation of knowledge and technology. This paper provides a new theoretical perspective on the examination of innovation and strategic transformation of local firms in emerging economies, enriching extant research about latecomers' growth and processes of catching-up with incumbent leading firms.

There are several policy and managerial implications from this paper. Governments in emerging economies can consider multiple directions in industrial policy-making to nurture modularization. When they have sufficient resources, they could actively facilitate innovations like in South Korea. But when they have insufficient resources, they should at least avoid over regulating innovation and could assist in transforming the value chain towards modularization.

Presented with the demand for low-cost alternatives, latecomer firms in other industries or other economies can emulate the success of China's Shanzhai mobile phone industry. When product technologies are too complex to handle, latecomers can use the opportunities provided by modularity and thus attempt a similar collaborative evolution of the industrial value chain, creating new business models to overcome the obstacles to innovation. Then they can move forward with disruptive innovations to meet the demands of specific niche markets neglected by established leading firms. Through the accumulation of marketing operation experiences and product innovation capacity, latecomers can initiate strategic transformation, and compete with established firms in mainstream markets in the long run, gaining sustainable competitive advantages. In the absence of modularity, firms should consider internal transformation and forming strategic alliances to stimulate industrial modularization.

This research pioneers a new field, and a new paradigm for consideration and refinement by further research as to what extent can the phenomenon of China's Shanzhai mobile phone industry be extrapolated to industrial situations in other developing economies. Other possibilities for future research include in-depth case studies of Shanzhai firms based on the analytic framework suggested in this research, and efforts at transcultural comparison with models and strategies emerging in other developing economies. In this way, some contextualization of this original theory can be developed, in order to contribute to mainstream theory and practice (Tsui, 2007). Also, future research should consider the technological regimes (i.e., technological opportunities, appropriation of innovation, accumulation of technical advances and intellectual property) and modularity as well as organizational learning effects in inter-firm networks as antecedents of disruptive innovation. Methodologies for empirical exploration and testing of these and their interactions need to be developed.

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Note

1. CCID Consulting is the largest research, consulting and IT outsourcing service company in China.

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