

Trends of Open Product Architecture and Internationalization of Private Companies in the Chinese Automobile Industry

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Abstract

In recent years, a new concept of "product architecture" has emerged in the areas of management and economics to compare the competitive edge among nations, industries and companies. "Product architecture" represents the basic design policy of products. In other words, the "architecture" of products generally refers to the basic design policy regarding the ways in which a product should be divided into components (modules), product functions should be allocated to each component, and how the interface (connecting part where information and energy interchange) between the components that became necessary should be designed and adjusted.

From this perspective, it is often observed that the Chinese companies have "the capability to modify product architectures through copying and remodeling of parts". The *quasi-open architecture* has been observed more or less in Chinese electric alliance and motorcycle industries. Then, is the way of the *quasi-open architecture* observed in passenger cars, which have been identified antithetical to the open modular architecture?

It is not easy for automakers to transform the architecture to an "open modular type," as the number of parts required in passenger cars is by far greater than motorcycles. In such context, Geely, the first private passenger car maker in China, has played the role as a pioneer to have open architectures in the Chinese car industry.

Geely has adopted the method of car manufacturing close to "open modular style," purchasing engines and transmissions from foreign joint ventures. Although the level of annual production is still around 90 thousand units, the company has been able to offer the cheapest price in the Chinese market. Geely's

movement has attracted attentions in and out of the country as an entrant of a new type in the car manufacturing.

A private company is also initiating a new movement in the auto parts industry as well. That is to enter the international market. The Wanxiang Group can be mentioned as the pioneer of internationalization in the Chinese automobile industry at present. Wanxiang has started exporting auto parts to the U.S. since the 1980s, started supply to GM in 1997, located the "North America Technical Center" in Chicago, U.S..

In view of the above, this article illustrated the representative cases of the private companies which has emerged as the new players and been given the central attention in the Chinese automobile industry. In Section 2, I presented the case of Geely from the perspective of architecture-based analysis. In Section 3, I examined the new movements in the auto parts industry such as the participation in international division of labor by Chinese companies, through the case study of Wanxiang Group which is the pioneer of internationalization. Finally, in Section 4, the limits and prospects of the Chinese private companies had been analyzed.

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Key words: Architecture-based analysis, Quasi-open architecture, Mix-and-match design, Chinese private companies, Chinese automobile industry

1. Introduction: "Modification of Architectures" in the Chinese Manufacturing Industry

In recent years, a new concept of "product architecture" has emerged in the areas of management and economics to compare the competitive edge among nations, industries and companies. "Product architecture" represents the basic design policy of products. In other words, the "architecture" of products generally refers to the basic design policy regarding "the ways in which a product should be divided into components (modules), product functions should be allocated to each component, and how the interface (connecting part where information and energy interchange) between the components that became necessary should be designed and adjusted¹."

Product architectures can be classified into "integral type" and "modular type." The former refers to the type which cannot perform well as a total product unless the parts design is inter-adjusted among different parts and to optimally fit each product, while the latter is the type with which the interface for parts and modules is standardized and therefore it is possible to produce various products just by combining the ready-made parts. So-called "open architecture" is a kind of modular type whose interface is standardized on the industry level, which enables "mix-and-match design" among different companies².

From this perspective, Japanese companies are generally good with the products of "integral type" which requires integration, of which Japanese passenger car is a typical example. On the other hand, what the U.S. companies show strength in is the products of "open modular type" architec-

1 Fujimoto (2001).

2 *Ibid.*

ture that requires the standardization of the interface for parts and modules in advance, of which a typical example can be found in their digital products represented by internet.

According to Professor Takahiro Fujimoto at University of Tokyo, it is often observed that the Chinese companies have "the capability to modify product architectures through copying and remodeling of parts", when looking at the Chinese manufacturing industry from the perspective of such "architecture-based analysis"³. For example, such pattern has been repeated in the products including television, electric appliances, motorcycles, tractors, and small-sized trucks.

In particular, what has been happening in the Chinese motorcycle industry which has become the world largest (13 million units per year) can be regarded as a typical example of the "modification of architecture." The industry followed the process in which

- (1) it started with copying foreign products (such as Honda's regular model), and
- (2) gaining the *ex post facto* approval from the government for the copied parts, which consequently generated "generic parts," of which domestic production expanded,
- (3) launching several hundreds of Chinese assembly companies which engage in assembly and remodeling using such generic parts, followed by
- (4) excessive supply and exacerbated profitability due to severe competition, negatively affecting the performance of Japanese companies, and
- (5) the emergence of a strong Chinese company which survived such competition.

Thus, the key concept to discuss the Chinese industrial competitiveness

3 Fujimoto (2002).

is "modification of architecture", in which process the products which had been developed as "integral type" in Japan, such as passenger cars, electric appliances, and motorcycles, are transformed into "*quasi-open modular type*" products, almost like the mix-and-match of generic parts, through the repetitive imitation and remodeling. While on the surface the problems such as diffusion of imitation products and the *ex post facto* approval of these products by the government, or neglect of intellectual property rights (IPRs) are indicated, the "mechanism of architecture transformation" that lies underneath is the important point in considering the Chinese manufacturing industry⁴.

The *quasi-open architecture* represents the way of new product development, imitating products originally designed by some incumbent firms and assembling those imitated components as if they are generic components. In the way of *genuine open architecture* for personal computers or bicycles, it is the premise that components are designed to assemble as generic modules based on the *de facto standard* interface. In the way of *quasi-open architecture*, on the contrary, the follower firms imitate and/or modify product-specific or firm-specific components designed by the incumbent firms *ex post facto* to assemble them as generic components. In other words, foreign firms-designed products are remodeled to become *quasi-open architectural* products⁵.

The *quasi-open architecture* has been observed more or less in Chinese electric appliance and motorcycle industries⁶. Then, is the way of the *quasi-open architecture* observed in passenger cars, which have been identified antithetical to the open modular architecture?

It is not easy for automakers to transform the architecture to an "open

4 *Ibid.*

5 See Lee, Chen and Fujimoto (2005) for details.

6 For example, Fujimoto and Shintaku eds. (2005).

modular type," as the number of parts required in passenger cars is by far greater than motorcycles, and it is more difficult to secure driving stability and safety. Previously, passenger cars in China had been produced only by foreign joint ventures as well as the state-owned enterprises (SOEs) which officially introduced technology from foreign counterparts. Nonetheless, in the auto parts industry, copy makers had already begun production, among which loose supply network centering on the production of generic parts has been established. Having such basis, Geely has recently come into existence as the first private passenger car maker in China.

In such context, a private company, Geely, has played the role as a pioneer to have open architectures in the Chinese car industry. Geely has adopted the method of car manufacturing close to "open modular style," purchasing engines and transmissions from foreign joint ventures. Although the level of annual production is still around 90 thousand units, the company has been able to offer the cheapest price in the Chinese market. On the other hand, however, vehicle quality problems have often been pointed out. In any case, Geely's movement has attracted attentions in and out of the country as an entrant of a new type in the car manufacturing.

It is also necessary to look at the sales market for such low-priced and low-quality cars. "In China, it is possible that a vast auto market for low-price, low-quality vehicles will emerge in the rural areas where the safety and environmental regulations are lax, by merging with the markets for small-sized trucks and vehicles for agricultural transportation. As a consequence, we may have a strange dual-layered structure consisting of a market for high-quality, high-performance and environmentally-safe cars made by foreign companies in urban areas and a market for low-quality, low-price vehicles made by numerous private companies in rural areas. We cannot deny the possibility that, like in the case of

motorcycles, the cars as well as auto parts industry may achieve higher technological level by making products by combining parts of modular types at low cost and selling well mostly in such rural areas⁷.

A private company is also initiating a new movement in the auto parts industry as well. That is to enter the international market. The Wanxiang Group can be mentioned as the pioneer of internationalization in the Chinese automobile industry at present. Wanxiang has started exporting auto parts to the U.S. since the 1980s, started supply to GM in 1997, the first sales to the world major automakers as a Chinese auto parts maker. The company is especially active to explore the U.S. market, locating the "North America Technical Center" in Chicago. Furthermore, the company is enhancing its affiliation with foreign companies in many ways including the acquisition of U.S. companies, and inter-shareholding and sharing of sales networks with companies from various countries such as U.S., U.K., Germany, and Canada.

In view of the above, this article will illustrate the representative cases of the private companies which has emerged as the new players and been given the central attention in the Chinese automobile industry. In Section 2, I will present the case of Geely, the first private passenger car maker in China from the perspective of product architecture, and the trends of open product architecture in the Chinese car industry will be analyzed. In Section 3, I will examine the new movements in the auto parts industry such as the increase of exports and the participation in international division of labor by Chinese companies, through the case study of Wanxiang Group which is the pioneer of internationalization. Finally, in Section 4, the limits and prospects of the Chinese private companies will be analyzed and presented.

7 Marukawa (2002).

2. Case Study on a Private Automaker: Geely Automotive Company - "Quasi-Open Development by Mix-and-Match Design" -

In this section, we will present a case of Geely Automotive Company, a private company in Zhejiang Province, which is being given great attention and widely disputed in the Chinese automobile industry at present⁸. In particular, the company's "quasi-open modular development by mix-and-match design" and "low-cost, low-price strategy" will be closely examined.

Established in 1997, Geely is the first private passenger car manufacturer in China. The founder, Shufu Li (Chairman) who is 41 years old as of 2005, started producing refrigerator in 1984, followed by the starting up of an architectural interior design business, and entered the motorcycle industry in 1994 and the passenger car industry in 1997.

2.1 Production System

At present, Geely has four manufacturing bases. The speed of the company's growth and investment for expansion is noteworthy.

(1) "Linhai-Haoqing Plant" (Linhai County, Taizhou City, Zhejiang Province)

The plant was established in 1997 with the site area of 0.55 million square meters. Production capacity is 100,000 units. The produced car model includes a compact hatchback, the first model of "Haoqing" (1300cc, 3-cylinder engine EFI, 2-box), of which the price was approximately 34,000 RMB (approx. US\$4,150, \$1=8.2 RMB) in 2002. As of the

8 Data in this section is based on interviews at Geely Merrie Plant and Haoqing Plant on March 22, August 30 and 31, 2002.

Photo 1 "Haoqing": Geely's first generation model



Source: By the author.

year 2005, it is the cheapest car (about 29,000 RMB) in China.

(2) "Ningbo-Merrie Plant" (Ningbo City, Zhejiang Province)

The construction of the assembly plant of "Ningbo Merrie" started in August 1999, and 9 months later, in May 2000, the plant started its operation. The site has the area of 0.24 million square meters, and the initial investment amounted to 0.7 billion RMB (about US\$85 million). Production capacity is 100,000 units. Production capacity of the engine plant is 50,000 units and the transmission plant's capacity is from 70,000 to 80,000 units. The produced model included the following:

a) "Merrie" (1300cc, 4-cylindere engine EFI): the mounted 8A engine is procured from Tianjin Toyota Motor. The sales catch phrase was "Powered by Toyota." Price was about 45,000 RMB (about \$5,500) in 2002.

b) "Uliou" (1300cc, with 2 subtypes of 3-box sedan and 2-box coupe): Uliou is the Geely's first sedan which is launched in March 2002. Uliou and Merrie mount the same type of engine and transmission and the

Photo 2 "Merrie": Geely's second generation model



Source: By the author.

platform for both is standardized. Price was 55,000 to 65,000 RMB (about \$6,700-7,900) in 2002.

(3) **Luqiao "Geely Auto Industry Park"** (Luqiao, Linhai County, Taizhou City, Zhejiang Province)

Luqiao New Assembly Plant, under construction as of March 2002, with the site already acquired amounts to approximately 0.2 million square meters. The location by the way is the home of the Chairman Shufu Li. Production capacity is said to be 300,000 units. Produced car model includes the third generation sporty type of "Meirenbao" (Beauty Leopart) which was developed in-house (1300cc and 1500cc), and launched in January 2003.

(4) Shanghai Maple (Huapu) Auto Industry Park (Jinshan District, Shanghai City)

In 2002, Geely acquired Shanghai Jieshida Auto and rename it to Shanghai Maple (Huapu) Auto to make it affiliated. The company launched compact car Maple (Huapu) SX7130, 7150 (1300, 1500cc).

The company was established through the acquisition of "Jiangnan Alto," located in Xiangling City, Hunan Province, which had been licensed by a Japanese auto manufacturer, Suzuki, for several tens of millions of RMB in December 2001. It was said to be a part of the measures to acquire the "7-numbered license" which is a license for passenger car manufacturing provided by the central government. The Chinese government could no longer neglect the reality of having private companies like this enter the passenger car industry, and in December 2001, the former National Economic and Trade Committee finally gave the license for passenger car manufacturing to Geely. As a private company, it was the first one to receive the license in the country.

According to the company, the present production capacity of Geely Auto amount to 500,000 units in total of 4 assembly plants. The number of employee in the whole Geely group is about 8,000 people. The sales of automobile is 45,972 units in 2002; growth rate to the previous year is 97%; and it places 9th in the car sales ranking. In 2003, the number of sales at Geely was 80,065 units and growth rate to the previous year was over 70%. The number of sales in 2004 was 93,285 units and it places 8th in the car sales ranking.

Besides automobile, the company has a production plant for motorcycles in Linhai County, Taizhou City, which produces 300,000 units per year.

Apart from the automotive business, Geely is engaged in education business; the company runs a technical college called "Zhejiang Economy and Management College," a Technician Training School (Linhai

County), and Beijing Geely University. Beijing Geely University, established in 2001, is a private university that offers four-year courses, approved by the government of Beijing.

As for other business areas, the company is engaged in hotel business, financial business, interior design business, and real estate business. It could be said that the profits which had been earned in these business areas was invested in the automotive business.

According to the Forbes ranking (China), the founder, Shufu Li, ranked 54th in the nation, with the private assets amounting to 130 million US dollars in 2002.

2.2 Management of Purchasing

In the case of "Uliou" and "Merrie," the rate of in-house manufacturing is just below 30% (including body, transmission, and engine), and the rate of outsourcing parts is over 70%. Transmission for both models was purchased from a Japanese joint venture, Tianjin Aishin, but later switched to in-house supply.

Most of the parts used by the company are made in China, while as for the element technology pertaining to the key components, it is active to introduce the technology from partners selecting from Japan, U.S., Europe, Korea and Taiwan, or to improve the in-house technology through the affiliation with universities and research institutes. A part of the key components are imported from Japan, Korea and Taiwan. The parts procured from foreign countries include, for example, external body panels that are imported from POSCO (Korea), and paint, from Kansai Paint Co., Ltd. in Japan. However, external body panels are also purchased from Bao Steel in Shanghai, and the speed of the increase in domestic procurement has been high, including plastic materials. The company endeavors to improve its product quality in terms of materials as well.

The company has dealings with approximately 300 suppliers at present, including Shanghai Bosch, Siemens, and Tianjin Denso. In parts procurement, the company only give orders to 2 or 3 suppliers in principle in the planning stage, which will be narrowed down to 1 or 2 when decided. Cost sharing of parts development differs case by case. The company is providing technical assistance to the parts manufacturers; 70 to 80% of the workload is carried out by the suppliers, and 20 to 30%, by the company.

The company has the organization of association called "Zhejiang Geely Automotive Supplier Association" in which there are over 20 member companies at present. The company divided suppliers into three classes of A, B and C, and the number of the class A suppliers stood at 23 at the end of 2001, 6% of total. On the other hand, 10% of total is the class C suppliers. As a procurement management policy, the company plans to introduce an open, competitive mechanism to largely curtail the cost in the future. Concretely, it is to reduce the number of suppliers and enlarge the amount of each parts supply. As a schedule, it plans to reduce the number of suppliers to 200 by June 2002, and to 120, by the end of 2003.

2.3 Production and Quality Control

Located in the Economic and Technological Development Zone in Ningbo City, "Merrie Plant" has an easy access to the nationally known Beilun Port. The company boasts a vast site and grand buildings, which is uncommon for a private company. Within the site, there are five plants for stamping, welding, painting, assembly and inspection, as well as the newly established engine plant and transmission plant.

The assembly line of the "Merrie Plant" is 1,080 meters long, consisting of 106 work stations. Production is in principle to orders, and the amount of production is adjusted according to the amount of sales. At the end of the assembly line, there is a wide repair space where a dozen finished

vehicles are awaiting for repairs to be done. Parts inventory at line side is maintained approximately in the amount needed for a week, and the finished vehicle inventory amounts to some hundreds.

Regarding product quality, the in-process defect rate for finished vehicles is said to be about 1-2%. Free guarantee for a finished vehicle is valid for 2 years or 60 thousand kilometers. The random inspection is administered to the outsourced parts. According to the data presented by the company's public relations section, one of the factors accounting for the small amount of production and sales is the improvement of quality, which has not progressed as desired. In particular, there are a number of problems in the quality of the parts that are outsourced, which may adversely affect the company's brand image if neglected. "Haoqing" and "Merrie" acquired ISO9000 in 1999 and 2001, respectively. In the future, the company plans to encourage its parts suppliers to acquire ISO9000. In the present China, an increasing number of companies are making the acquisition of ISO9000 a condition to have business deals.

According to the information provided by some sales agencies as feedback, the reactions of users seem to be as follows. For example, in terms of cost performance, the prices of cars made in Geely compare quite favorably to the small cars sold by competitors, while at the same time, they have adopted relatively good elementary technology, so some models carry EFI and foreign-made engines. Nevertheless, "Haoqing" models present many quality problems, and regarding the "Merrie" 2-box hatchback model, opinions such that the style of instrument panel is obsolete and that its interior is somewhat coarse have been heard. As a common opinion among sales agencies, the company's efforts to improve quality are regarded essential.

2.4 Product Development

Geely has "Technical Development Center" and "Die Manufacturing

Center", of which the number of staff is 300 for "Haoqing Plant" and several dozens for "Merrie Plant." At present, there are approximately 200 3-D CAD installed. Dies are internally produced.

(1) Remodeling of Engine

While Geely had purchased Tianjin Toyota 8A model engine (4-cylinderead, with 16 bulbs) since its early stage, it switched to in-house products due to the high price. As for engine parts, it manufactures cylinder block and cylinder head, and purchases casting of cylinder block, crankshaft, connecting rod and piston from suppliers. Also, when modifying engine, EFI made by Denso was replaced with Bosch-made.

According to the technical executive of Geely, in the process of the production of the company's own 4-cylinderead engines, the standards of product design were lowered compared to the externally procured Japanese engines like Toyota 8A model and the performance was adjusted to reflect the conditions in which the products are used in China. In fact, since the speed limit of the Chinese highways is currently 110 kilometers, the performance to exceed this limit is useless, and the cost of having this extra performance is high.

By mixing and matching outsourced parts and reducing the variety of parts, in addition to switching outsourcing to in-house production and lowering the standards of product design, the company made it possible to produce low-cost, low-priced cars.

(2) Crash Safety Test

While the company does not have its own facility for the test, it is collecting data through the tests conducted at the governmental "Center for the Management, Inspection and Test of the Quality of Domestically Produced Automobile," to meet the regulative change in 2002 when crash tests became obligatory. The company also demonstrated a crash safety

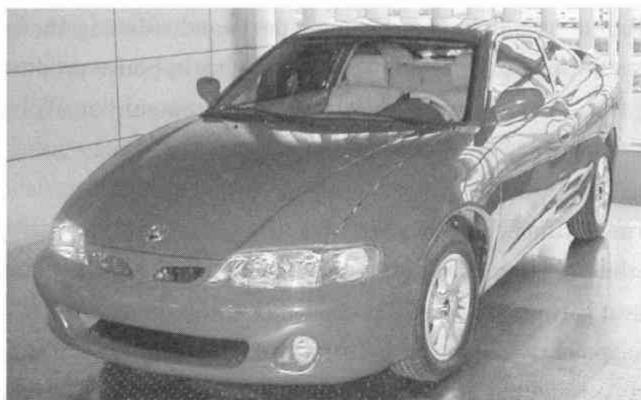
test on "Haoqing" purchased in the market in the closing ceremony of the annual conference of the World Safety in 2001, hosted by Tsinghua University (Mercedes-Benz demonstrated one in the opening ceremony).

(3) Development of Beauty Leopard

Geely's third generation model, "Meirenbao", i.e. Beauty Leopard is the first sporty car which was domestically developed in China. It took one and half year that the concept was started to created in June 2000 to complete the car. An Italian design firm was involved in the car's styling design at the stage of conception. The platform is used for the similar model to Merrie. However, all the drawings are said to be Geely's proprietary. The model remains "mix-and-match design" but shows some originality in interior and exterior so that it can be said that the car has certainly been changing from gathering imitation parts.

On the other hand, a Chinese automobile journal criticized Geely's "Haoqing" as a "super copying show", manufactured with a copy body of "Charade 2000" originated by Tianjin Auto, an engine purchased from

Photo 3 "Beauty Leopard", Geely's third generation model



Source: By the author.

Tianjin Toyota and a transmission purchased from a Japanese auto parts joint venture Tianjin Aishin, a copy headlight of Mercedes Benz, a bumper purchased from Guangzhou Honda, and above all, with the parts gathered from the parts suppliers across the country.

To this criticism, Geely argued, "Imitation is a modality in the process of development, and advanced countries with developed automobile industries have done the same in the initial stage."

2.5 Future Management Policy

Shufu Li (Chairman) criticizes the Chinese government for its industrial policy which has facilitated the market supply of only high-priced cars produced with foreign capitals, which are making undue profits. He believes that, in the future, there should always be a market segment of cheap cars that any Chinese citizen could afford, and that Geely will produce cars which the common people could purchase. Although the prices of the company's cars are currently set at 40 to 50 thousand RMB (approx. US\$ 4,900-6,100), the appropriate price level for the common people in China should be around 20 thousand RMB (about US\$ 2,400), considering the level of their income. The company has announced that it will expand its production capacity to 1 million units, in order to maintain the lead in price competitiveness. In any case, there is no doubt that the emergence of the company's low-cost, low-priced cars with a mix-and-match design policy opened fire on the price cutting competition in the passenger car market in China which had been rather highly priced.

In his visit to India, Chairman Li took notice of the experience of the TATA Group, which has successfully competed with the foreign auto manufacturers with the "Indica" strategy, which is to produce low-cost, low-priced cars through mix-and-match design and to strengthen the sales and service network at low cost. On the other hand, the TATA Group in India has also shown its interest in the Chinese market by

participating in the "Shanghai Motor Show," where the "Indica" was exhibited. Geely exhibited every model in the "Shanghai Motor Show."

The company is now seeking collaboration with foreign automobile industries including Japan and Korea, to find a good business partner with which it aims to foster a collaborative relationship.

2.6 Discussion from the Perspective of "Architecture-based Analysis"

Geely has a simple competitive strategy. Since it is a new entrant from other business sectors, independent development for core technology is almost impossible. Nonetheless, it does not have enough resources or political power to get formally full set of technology for foreign designed car through licensing. As a result, a basic pattern is the "mix-and-match design".

Still, of particular interest is that Geely emphasizes on "Powered by Toyota", just like that "Zhonghua"(China) of Brilliance Auto (Shenyang in Liaoning Province) and "Dongfang-Zhizi" (Oriental Kid) of Chery Auto (Wuhu in Anhui province) mount the same Mitsubishi engine, appealing the "Powered by Mitsubishi." At all events, emerging companies in the automobile industry are now deploying price competition as the electric appliance industry or motorcycle industry does; they still depend on core technology of foreign manufacturers. If such a business model increases the market share, that means the "*quasi-open architecture*" penetrates into the automobile business world. As of the year 2005, it is not concluded whether or not that kind of "model developed by mix-and-match" retains competitiveness in the long run in China⁹.

Observing the case of Geely Auto from the perspective of "architecture-based analysis" and in this context, the company's "low-cost, low-priced strategy" becomes more evident. At this stage, Geely is criticized as

9 See Lee, Chen and Fujimoto (2005).

"super copying show" and its problematic product quality is pointed out. Yet, the company's fundamental position on its "low-cost, low-priced strategy" lies in the attempt to transform cars, which had required the optimization of components design for each model as well as integration in order to maximize performance of the whole product, into "open modular type" products by mix-and-match design.

This leads to the fact that the quality problem of the company's cars, pointed out by the users and sales agencies, should stem essentially from its design policy, although the quality of the outsourced parts is certainly problematic. In other words, the company's design policy to design and manufacture the "integral type" products with the same ideas that come with the "modular type" products are of greater significance in considering the quality issues. Together with the limits set by the product traits of passenger cars which require integration, on top of the fact that Geely does not at this stage have sufficient "transforming capability to remodel product architecture" as demonstrated in the motorcycle industry, the company's cars consequently became "low in price and low in quality." Thus, one of the implications deduced from the perspective of "architecture-based analysis" is that the waves of "architecture transformation" which had occurred in the electric appliance and motorcycle industries have reached the automobile industry though it is still in the initial stage.

New entrants to automobile assembling business are skyrocketing. For example, local leading motorcycle manufacturers, Zongshen, Lifan and Longxin (all located in Chongqing) have been sequentially entering into the business. It is in some part reported that leading electric appliance companies, Chunlan (air-conditioner), Midea (air-conditioner), Xiaoya (washing machine), Xinfei (refrigerator) and BYD (battery maker) have already entered into the automobile assembling business. Those new entrants are assumed more or less to select the "mix-and-match design".

Whether those "*quasi-open type*" products including the preceding Geely's ones will survive or not implies the future of architecture in the Chinese automobile industry. Depending on consequences, it cannot be denied that the "*quasi-open architecture*" caused by "transformation of architecture" may possibly become mainstream in passenger car which was seen as a representative of "integral type" products as well as motorcycle and electric appliance¹⁰.

Considering the experiences and paths that have taken Geely to success in the electric appliance and motorcycle industries, the company's orientation to the "low-cost, low-priced strategy by mix-and-match design" is rational and also shows the aspect of path-dependence. Given the notable gaps in income and among regions, there should be a room for low-priced cars to survive, as there is potential and realistic demand in the low-income population in urban areas, vast rural areas and inland areas. The context as above shed light on the reason why the company showed interest in the "Indica" strategy of the TATA Group in India, which is the low-cost, low-priced strategy by mix-and-match design. Therefore, the view that the business strategy and pattern of Geely, is basically in the initial stage of the same process which the electric appliance and motorcycle industries had gone through could be regarded as valid.

The entrepreneurial spirit and management stance of Geely should be highly evaluated, as they enabled a private company to expand the production scale to this extent on its own in the Chinese passenger car industry where the primary players are the joint ventures of advanced automakers from Japan, the U.S., Europe and South Korea. The slogan, "Not afraid of heaven or earth, let's be the China No.1 with our teamwork," which is indicated as its corporate culture, concisely represents its entrepreneurial spirit.

10 See Lee, Chen and Fujimoto (2005) for details.

The greatest hurdle for Geely is how it could actualize the low-cost, low-priced strategy in its true sense by improving the capability of development, and of quality management after the imitation stage, just like the Japanese automakers in the 1950s to 1960s. The success seems to depend partially on whether the international business environment for China after gaining its membership in WTO allows such management pattern. This holds true not only for Geely but also for all the private companies as well as the emerging companies that have courageously entered the Chinese automobile industry.

3. Internationalization of Private Companies: Wanxiang Group - Corporate Growth by Entering International Market -

3.1 Profile of Wanxiang

Wanxiang Group is a private company, a so-called "independent" parts manufacturer, which does not belong to any corporate groups¹¹. Under the umbrella of the Group's core company, there are Wanxiang Qianchao Limited Company, which is a auto parts maker which owns more than 30 factories. In 2001, the number of employees for the whole group was approximately 13,000, and total sales and total assets amounted to 8.6 billion RMB (US\$1=8.2 RMB) and about 10 billion RMB, respectively. As for Wanxiang Qianchao itself, the number of employees was 5,877, of which the average age was 28, and total sales was 2.5 billion RMB (Table 1).

(1) Product Lineup

Wanxiang's main products include 8 components, i.e., universal joint

11 Data in this section is based on interviews at Wanxiang Group on March 22 and August 29, 2002.

Table 1. Summary of the Wanxiang Qianchao Limited Company (2001)

Number of Employee	5,877
Production Volume of universal joint(thousand units)	20,000
Production Volume of drive shaft (thousand units)	860
Sales (thousand RMB)	2,500,000
Total Asset (thousand RMB)	2,490,000
Total Tax Payment (thousand RMB)	200,000
Profit (thousand RMB)	130,000
Export (thousand US\$)	178,000
Average Yearly Wage (RMB)	19,200
Total Capital (thousand RMB)	367,000
Area of Factory Site (thousand square meters)	2,000,000

Source: Interviews by the author. Note: US\$1=8.2RMB

(UJ), constant velocity joint (CVJ), drive shaft, shock absorber, break, suspension, wheel hub, and bearing. The following is the list of major customers and the products being sold (Table 2).

Other customers include Guangzhou Honda, Chang'an Auto, Changhe Aircraft, Hainan Mazda, Guizhou Spaceflight, SAIC-GM Wuling, FAW-VW. The models for which the company's products are used the car models include Santana, Charade, Audi, Jetta, Alto, Citroen ZX (Fukang)

Table 2. Wanxiang's Major Customers and Products for Supply

Customers	Items
• Shanghai Auto	universal joints, bearings (delivered via Shanghai GKN)
• First Automotive Works (FAW)	universal joints, drive shafts, bearings
• Dongfeng-Citroen Auto	units of breaks
• FAW-Tianjin Auto	bearings, drive shafts, break drums (assembled into Charade 2000)
• Nanjing Auto	drive shafts, shock absorbers, bearings
• Dongfeng Motor	breaks, drive shafts, dumpers, bearings
• Harbin Aircraft	front modules, universal joints, drive shafts

Source: Interviews by the author.

and Wuling, etc..

(2) Strategic Alliance

A remarkable characteristics of the company in terms of its business practice is that it has been enhancing long-term stable transaction relationships with automakers through technical tie-up and financial affiliations. Since automakers often change auto parts makers one after another and business deals based on contracts entail instability, Wanxiang started to form strategic financial affiliations with automakers mostly in the form of joint ventures. At present, the company has capital investment in Dongfeng-Citroen Auto, Nanjing Auto, and Harbin Aircraft, and with Dongfeng-Citroen and Harbin Aircraft, there are joint-venture plants in Hubei Province and Harbin City. Furthermore, the company has endeavored to promote organizational commitment to auto makers, by establishing project teams for each auto maker within the assembler marketing section.

3.2 Entry into International Market

Among the Chinese auto parts makers, Wanxiang Qianchao is exceptionally active to make inroads into international market. The company has been expanding its exports, with a central weight on the parts sales to GM.

(1) Outline of Overseas Business

Wanxiang is known as the first Chinese company which succeeded in exporting auto parts in 1984. In August 1997, the company started exporting parts to GM (for the model, GMT800=SUV), which again was the first time that a Chinese company ever sold parts to the world major automakers. Moreover, in 2000, Wanxiang acquired Zeller (in Ohio), an American company which had been a provider of technology, which then

became a U.S. subsidiary company. On the other hand, the company has been enhancing affiliation with 8 foreign companies in the countries such as U.S., U.K., Germany and Canada, which had previously been its competitors, through mutual share holding and sharing sales networks. The companies include UAI (Universal Automotive Industries Inc., US), ID, BT and Bearing (UK)¹². The company presently owns 3 trading companies. In 2001, Wanxiang spent \$2.8 million for a 21% stake in UAI, a Nasdaq-listed brakes maker. All told, Wanxiang's investments brought close to 1,000 new employees under its umbrella in the U.S.¹³.

(2) Export and Destination

The following is the record of the company's export for 2000 (Table 3). Since the company's total sales was 1.23 billion RMB (approx. US\$150 million) for the same year, the export ratio of the year is 25%. The main destinations were U.S., Europe, Japan and Africa.

In the interview with the company, it was revealed that total exports

Table 3. Wanxiang's Exports (2000)

Product	Volume (sets)	Exports (million US dollars)
Universal joint	6.46 million	\$17.19
Bearing	5.05 million	\$ 9.09
Drive shaft	0.37 million	\$ 5.18
Constant velocity joint (CVJ)	0.16 million	\$ 5.52
Shock absorber	70 thousand	\$ 0.61
Total exports		\$37.59

Source: *Zhongguo Qiche Gongye Nianjian 2001* [Chinese Automobile Industry Yearbook 2001], p.218.

12 Based on interview with Mr. Pin Ni, President of Wanxiang America Corporation in Elgin, Illinois, the U.S. on March 16, 2005.

13 Wonacott (2004).

for 2001 amounted to 178 million US dollars (1.46 billion RMB), and the export ratio reached 58% of total auto parts sales (2.5 billion RMB=\$305 million). If there is no mistake in the statistics, total sales doubled and total exports were 4.7 times greater in 2001, compared to the figures in 2000. Moreover, over 90% of the increase in sales (by 1.27 billion RMB=\$155 million) came from the increase in exports (by 1.17 billion RMB=\$143 million), whereas only the residual 9.2% (100 million RMB=\$12 million) was attributed to the increase in domestic sales. Wanxiang can thus be regarded as a typical example of corporate growth fueled by exports in the Chinese automobile industry.

Overseas customers include Delphi, Bisteon, Nasdaq UK (mediating sales to VW), Dyna, and Rockwell. Looking at the breakdown of sales by variety of parts, while assembly parts (OEM) and repair parts each accounted for 50% of total in the domestic market, assembly parts was only 10%, and repair parts accounted for 90% of total exports. As a future plan, Wanxiang will promote the export of OEM parts.

According to the company, there is competition imported parts at present, in which the company is maintaining price competitiveness. While some of the Taiwanese parts are cheaper, the company boasts the price competitiveness that is more than double what the Japanese competitors can provide. In terms of quality, the company still lags behind the Japanese competitors. Technical assistance from the Japanese companies is currently considered.

(3) Local Production

Wanxiang is particularly active in its attempts to make inroads into the U.S. market, and at present, the preparation for the local production in the U.S. is in progress for the first time as a Chinese auto-related company. *Nihon Keizai Shinbun* (Japan Economic Journal) has reported Wanxiang's business expansion in the U.S. as follows¹⁴.

"Goodbye to made-in-China — A Chinese company has begun to consider local production in the U.S. as a realistic option. This was triggered by their experience of facing a limit to the imports that are 'just low-priced'. 'We will acquire a parts manufacturer in the U.S.. 5 companies are currently in negotiation.' President Pin Ni (age 38) of the American subsidiary of the Wanxiang Group, a large auto parts manufacturer, spoke with a young voice which echoed across the gigantic storehouse. To put it simply, 'what we want is the brand competitiveness.'

It was in 1995 when Wanxiang started the sales of bearings and shafts in the U.S. As we met the request for a 15 to 20% discount each year without any trouble, we had our name up. Yet, we thought that there was something more that customers wanted beside low-price. 'Low-prices are of value only when backed up by minute delivery networks and technological capability' (President Ni) ... What he immediately completed in

Photo 4 "Wanxiang America, Corporation"



Source: Wanxiang America's website {<http://www.wanxiang.com/>}

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- 14 "Chugoku, beikoku to kisou" (China, Competes with the U.S.), *Nihon Keizai Shinbun* (Japan Economic Journal), 7th June, 2002.

the suburb of Chicago was the gigantic storehouse for distribution. Beside the storehouse, a technical center is under construction, for which approximately 40 engineers will be hired, all coming from the U.S. major auto companies. To finish off, local production in the U.S. is to take place, which no other Chinese auto-related company has done before. Having resort to the reliability of 'made-in-America,' we will challenge the Japanese and U.S. parts majors squarely."

3.3 Product Development System

The lack of product development capability generally applies to the Chinese automobile industry as a whole. Although the same applies to the auto parts industry, it cannot be neglected that some auto parts makers have gradually gained product development capability. It is assumed that the success of Wanxiang in both domestic and international markets is grounded on a certain level of development capability. Let us now turn to Wanxiang's product development system.

(1) Staff and Facility for Development

In the whole Wanxiang Group (approximately 13,000 employees), the base entity of Wanxiang Qianchao (5,877 employees), there are 3,400 engineers including office workers, of which approximately 2,000 staffs are regarded to engage in auto parts. In fact, among the approximately 170 staff for development at the technical center of the head office, 23 have master's and 10 have doctor's degrees, and 16 are postdoctorals. In addition, there is "North America Technical Center" in Chicago, the U.S., which is staffed with about 40 engineers coming from the U.S. major auto companies. At present, the technical center of the head office possesses 500 3-D CAD, which over 80 staffs can operate with the software, Pro-E. The evaluative equipments in place are mostly U.S.-made imports.

(2) Development Pattern and Lead Time

As a basic policy for development, Wanxiang attaches importance to the so-called "drawings approved (*shoninzu*) method" (or "black box parts" practice) in which the product drawings are created by the company itself and marketed. The lead time in development, from the receipt of a drawing to the delivery of a prototype, is 1 to 2 weeks in the case of universal joints, and around 25 to 30 days for drive shafts. Making of prototypes is done by the company. While the company bears the development cost, it is often added onto the unit price of the products depending on the number of orders.

(3) R&D Expenses

The investment plan in 2002 stands at about 1.5 billion RMB (\$183 million) for the whole Wanxiang Group, of which main area of investment is auto parts development. R&D expenses accounted for 3% of total sales in 2000, and over 5% in 2001. Until 1998, the priority had been placed on the investment in production facilities, whereas it has shifted to R&D to which no limit is set regarding the investment.

The focal projects currently in the process of development are "ABS electronic speed sensors" and "the 2nd generation wheel bearings" which are both conducted in collaboration with well-known universities in China. Furthermore, the company has been making endeavors in the development of the technology and facility for inspection. As the company considers it important to internally produce the equipments and facilities, for example, topics such as mechanical layout have been studied at its research division for equipment and production technology.

(4) Development System

The company's technical centers are equipped with the laboratories that are officially certified by the central government for its national

standards. Technical centers are divided into 5 sectors, which are the research and development center, the science and technology center, the computer center, the technical information center, and the inspection and testing center. The research and development center and the inspection and testing center constitute the central force in development.

Under the technical center, there are 7 research divisions, that are the division for universal joints, the division for heat treatment, the division for forging, the division for equipment and production technology, the division for quality and safety technical system, the division for automotive electronic system, and the division for testing and mathematics.

3.4 Production and Quality Control

Next, in order to overview the present situation of the stable manufacturing of high quality products which is a determinant of competitiveness, I will examine the actual state of Wanxiang's production and quality control.

(1) Form of Production and Personnel Expenses

In terms of the working condition of the production department of Wanxiang Qianchao, the average working hour is 2 shifts 8 hours plus 1-hour overtime, while in heat treatment, is 3 shifts, for higher thermal efficiency. They also operate on Saturdays and Sundays, which are treated as overtime work. As indicated in the Table 1, the pay for the direct workers are based on a piece rate, which averages around 1,500 to 1,600 RMB (\$183-195) per month, slightly higher than the average income in the local community. As social security, only endowment insurance is in place, and there is no medical insurance or housing allowance. Approximately 80% of the direct workers come from the local community.

(2) Equipment

As a method to constantly manufacture high quality products, the company aims to secure high quality basically by installing good machines. For the crucial manufacturing process of the line, foreign-made production facilities are put in place. For example, Korean "Hyundai", "Daewoo" machines are put in the mechanical processing line, and a part of the heat treatment is done by Japanese, Swedish, and Swiss machines. On the other hand, most of the machines for casting and forging are made in China (Wuxi Machine Tools Works, etc.).

As stated previously, the company has the research institute for equipment and production technology and attaches importance to internally manufacture equipments. Therefore, the company plans to displace the imported facilities with the company-made machines in the following years. On the whole, the ratio of in-house-made equipments has been on the rise, which contributes to the integrated manufacturing process from material to product. Since the company is manufacturing relatively low-value added products, the company tries to secure cost competitiveness by increasing in-house-made equipments through integrated production as well as by suppressing personnel expenses.

(3) Quality Control

The company mainly adopts self-inspection in each manufacturing process as an inspection method for quality. The defect ratio in the final inspection of the manufacturing process is 1.8~2.0%, and the ratio of returned products from auto manufacturers is approximately 300~500 PPM. Manuals such as standard operating procedure are posted up in each manufacturing process, where inspection records are also kept in order. 4 S, in a machinery plant, is cleaned up well, although things are not quite in order. The mechanical processing line is especially good and well in order. However, the standardization of parts box has not

progressed, and the inventory level of work in process is high. Cross joint processing line is in the U shape, and the number of machines handled by per worker is limited to 3. The company acquired ISO9002 in 1994, and QS9000 in 1997.

Reflecting the vigor of the growing company, morale is high from line workers to managers. Within the plant, the slogan that says "Think about a hero, work as a hero, accomplish the responsibility of a hero and enjoy the pleasure of a hero" is posted in large. The average age of the employees on the group level is 28, and director level managers and vice president in accounting are generally young, in the range from 25 to 35.

(4) Technological Guidance

As technological assistance from overseas, the company received over 20 foreign engineers from the Department of Foreign Administration of the Ministry of Labor and Human Resources, about 10 from the company's North America Technical Center, and about 10 from foreign companies and research institutes in 2001. The company thus had technological guidance in the areas not only of development technology, but also of production management. For example, a professional from Toyota-related company gave guidance on the Toyota Production System (TPS) and diagnosis of manufacturing process, of which the frequency was twice a month, each time lasting for about a week. For this technological guidance, Wanxiang bore the consultancy fee.

(5) Manufacturing Cost

The breakdown of manufacturing cost consists of labor cost (8% of sales, or 30% of profits), general administrative expenses (11% of sales), profits (5%), and distribution expenses (2-3%). The cost of materials is low, as major materials are all made and procured domestically. It is said that increase in the distribution cost when procured from remote areas

does not significantly affect the cost. At present, the only material procured externally is springs. As many products are low-value added, profitability is notably low.

(6) Sales

The sales system has the network structure divided into three stages that are distribution centers, outlets, and second-tier outlets. At present, the company owns 23 distribution centers, 166 outlets under direct management, and about 3,000 second-tier outlets, in the focal nucleus cities of 20 districts (provinces and cities) across the nation. As for the exports to North America, there is a distribution storehouse in the suburb of Chicago.

(7) Business Environment

In regards to the business environment, Mr. Zhijun Shen, the General Manager of the Division of Development, presented his view as follows. "Zhejiang Province ranks 4th in GDP following Beijing, Shanghai and Shantong, and also 4th in income, after Shanghai, Beijing and Guangdong. The Province has established the current economic position on its own. Zhejiang Province boasts the greatest accumulation of private companies and the most vigorous economic activities. Organizational behaviors are highly flexible and mobile. Although there was nothing in here 10 years ago, it is now the manufacturing base for electronics and machinery."¹⁵

15 Interview with Mr. Zhijun Shen, the General Manager of the Division of Development at Wanxiang Group on March 22, 2002.

4. Conclusion: Limits and Prospect of Open Architecture

As indicated by these cases, private companies and state-owned-enterprises (SOEs) differ considerably in the awareness for competition. SOEs have stagnated in technological innovation due to protection under the industrial policies of the government. In contrast, private companies, without much governmental assistance, have made maximum efforts to improve technology for higher quality, lower cost and better delivery to successfully compete. In such circumstances, the gap in the thinking among the managers in private companies and SOEs has been widening.

As stated earlier, the manufacturers of passenger cars in China had previously been limited to foreign joint ventures and the SOEs which had officially introduced technology from foreign automakers. In recent years, however, it should be highly evaluated that private automakers like Geely have come into existence, breaking the oligopoly by SOEs and foreign joint ventures and accelerating the competition in passenger cars production. Besides, it has adopted a bold method of production, even from the perspective of the history of automobile industry, which is the "modification of architectures" occurring in the Chinese electric appliance and motorcycle industries. Having started in electric appliance and motorcycle business, together with the path-dependence and successful experiences gained from the business, Geely has notably located the car production as an extension of the strategy of "low-cost, low-price by mix-and-match design" in the motorcycle production.

The question lies in the understanding of such a "*quasi-open architecture*" that whether it is a transient phenomenon or a mainstream-to-be design concept in Chinese automobile industry. Nevertheless, in view of the experiences in automobile development and production up to now, passenger cars are the type of products which cannot perform well as a

total product unless the parts design is inter-adjusted among different parts and to optimally fit each model, which requires integration. Therefore, there is a limit to manufacture passenger cars in modules. If the mainstream of car development and production was "integral type," the attempts to make cars with open architectures in China can be regarded as transitory.

From the average view of automobile companies in developed countries, marketability of the "*quasi-open architecture*" is not evaluated in the mature market and will fade away at some stage. However, "disruptive technologies", which threaten those advanced firms, often rise by demolishing those companies' common knowledge¹⁶.

On the other hand, as mentioned earlier, there is an actual achievement in China that motorcycles, typical integral type products in Japan, were transformed to "*quasi-open modular type*" products, similar to combination of generic parts, by repeated copying and remodeling¹⁷. Since we have frequently observed that Chinese companies have the capability to "modify product architecture by parts copying and remodeling," we cannot deny the possibility that a new, challenging way of manufacturing may emerge as in the motorcycle industry, free from the past experiences. Rather, the question we should raise should be how they can acquire technological and development capability of their own, overcoming the technological limits that are "locked-in" by copying, after they pass the initial stage of copying and remodeling.

In any event, it is important to remember that the major principle is

16 Refer to Christensen (1997).

17 I refrain from discussing the motorcycles business in details as it is beyond the coverage of this article. For more information regarding Honda's strategy in China and the Chinese motorcycle industry, please refer to Hiroyuki Yoshino, former President of Honda, (2002), and Ohara (2001).

"Customers make decision on dominant architecture." Whether customers attach importance to the technical sophistication in integral architecture or to the variety and low cost served by modular architecture? The answer may vary by country or by type of product. From that point of view, it is necessary to continuously pay attention to what *"quasi-open architectural"* products are turning to become, because Chinese automobile industry is the extraordinary existence in the world in terms of the existing diversification of product architectures in market¹⁸.

[*This paper was based on an original discussion paper which was presented for the International Motor Vehicle Program (IMVP) at Massachusetts Institute of Technology (MIT), the U.S. in August 2002. A considerable revision has been made before publication. This study also represents a portion of the research findings from the following two research projects: (1) "International Competitiveness of the Manufacturing Industries in China and the Technology and Operations Strategies of Japanese Companies" (from 2003 to 2006), a study group led by Professor Takahiro Fujimoto at University of Tokyo; (2) "A International Survey on the Interfaces and Institutional Innovations on the Internationalization of Chinese Economy" (from 2004 to 2006), a study group led by Professor Shinichi Kawai at Aichi University. Both projects are the Grant-in-Aid for Scientific Research projects that sponsored by the Japanese Government's Ministry of Education. For all the above assistances, I wish to record my profound gratitude.]

18 See Lee, Chen and Fujimoto (2005) for details.

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