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CATCH UP STRATEGIES OF ASIAN FIRMS: A MICRO-LEVEL PERSPECTIVE

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Abstract

In this paper we study a case-study of Haier Corporation of China in order to illustrate how successful companies in China have been able to catch up technologically with western countries and Japan. In spite of the common opinion in the managerial and academic literature, in which China is often noted as a low cost production country, we show that there is evidence that a number of companies are catching up technologically as well. Some of them are even threatening the competitive technological position of dominant companies in the US, Europe and Japan. In this paper we analyze a typical example of such a successful Chinese company; The Haier Group.

Keywords: strategy, Chinese companies

1. INTRODUCTION

In this paper we aim to analyze the way in which companies in East Asia try to catch up technologically with western countries and Japan. In the managerial and academic literature [1-11] these countries are often noted as low cost production countries that are competing primarily on low margin commodity products, but there is evidence that a number of companies are catching up technologically as well. Some of them are now well positioned to compete with dominant companies in the US, Europe and Japan. Detailed analyses of the strategies these companies employ and the mechanisms they use for learning are rare. In order to fill this void in the current management and academic literature we will analyze a typical example of a company that was able to succeed in the technological catching up process. By analyzing the Haier

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Group we aim to show how a Chinese firm has been able to catch up with western companies. By comparing Haier's catch up strategy with that of other companies, lessons are learned about the micro-level mechanisms that underpin the development of low tech companies into technologically competitive industry leaders.

2. CATCHING UP OR FALLING BEHIND

Over the past two decades, we have witnessed an increasing number of publications studying catching up strategies of latecomer firms [12-18]. Especially the 1990s provided us with a large body of literature studying developing countries catching up processes. These studies have been particularly geared towards the dynamics of these processes in East and South East Asian firms. They all aimed to explain the so-called "East Asian Miracle" [19]. The majority of these studies have taken on a policy level perspective and have focused on the impact of government on the catching-up processes of latecomer firms. In spite of some notable examples [20-30] much less attention has been paid to the individual strategies of latecomer firms that where able to catch up technologically with their western competitors. In fact, academics have been unable to unravel the technological transformation process of East Asia [31]. This article shows that this process can be unravelled by studying the micro-level mechanisms companies employ to become not just technology followers, but innovators in their own right.

East Asian companies face some latecomer disadvantages, associated with the lack of technological know-how, access to sophisticated markets and other competitive disadvantages, but they also have some potential advantages (Gerschenkron, 1962). Leading firms are often more resistant to change than other firms. This so-called 'success breeds failure syndrome' (Starbuck, Greve and Hedberg, 1978) is often observed by industry leaders. Incumbent firms may be characterized by strong inertia which prevents them from transforming their current products and technologies. Latecomer firms, however, have the speed and flexibility to enter into new resource spaces fast. They are not bothered by sunk costs and other inertial pressures as in the case of incumbent firms. As put forward by [31] "the distinguished feature of the latecomer firm is its preparedness, and its ability to learn; it is a learning organization 'par excellence'". Other advantages are associated with low cost production inputs (e.g. materials and labor) and the fact that they might be shielded from competitive pressures by protection of their markets by their local government.

In the literature, we find many stage models of catching-up processes. Because of our focus on technological capability development stages we follow Wong [32] who proposes five generic routes for technological catch up by latecomer firms:

2.1. Reverse Value Chain strategy.

In this strategy a firm starts with subcontracting the manufacturing of simple components for MNE's. This is typically done on an OEM (Original Equipment Manufacturer) basis where the OEM-customer gives the detailed specifications to the latecomer firm. The next step is to acquire design capabilities and let the OEM-customer give only generic specifications so

the details are worked out by the latecomer itself (ODM phase; Own Design Manufacturing). Many firms following this strategy stay in this phase but some start to create products based on their own ideas and develop their own brand, which makes them independent of the OEM-customers. The success of this strategy depends on the willingness of OEM-customers to outsource an increasing part of their products so the latecomer can learn all aspects of the value chain step by step. Companies following this strategy emphasize process innovation first and then move into product innovation. Learning is mostly done by doing.

2.2. Reverse Product Life Cycle Innovation Strategy

A latecomer firm may start to control the complete value chain of a mature product from development to marketing. The technology of this mature product is not very advanced for leading firms and thus relatively easy to acquire and to imitate. The low-end market can be captured because the latecomer has a competitive advantage by lower labor costs, better knowledge of domestic market or other advantages. When this mature market is captured more sophisticated technology can be learned and the firm may move from being a late follower to a fast follower. This strategy makes use of imitative R&D and reverse engineering to simultaneously innovate in products and processes.

2.3. Process Capability Specialist Strategy

This strategy is different from the Reverse Value Chain strategy in that the firm does not move to the last step where it get its own brand. In this phase the firm keeps improving its' manufacturing processes and the goal is to become the most advanced, cheapest and thereby best manufacturer of components in its sector.

2.4. Product Technology Pioneering Strategy.

Maybe this is the most difficult strategy for a latecomer firm because it is in fact the strategy of leading firms. By creating new products through radical innovation or a series of incremental innovations the global market can be conquered because the product is newer and better than other products. The question remains how the technology capabilities needed to create these innovations are acquired. This can for example be done by large investments in R&D centers, well educated personnel, R&D collaboration with other firms or universities.

2.5. Applications Pioneering Strategy

This strategy is based on a new application of an existing mature technology and thereby creating a new product. To apply this strategy the relatively mature technology should be well understood and made suitable for use in another application but there is no need to improve it and leapfrog leading companies of this technology. Technological capabilities are spread throughout the company to ensure continuous product innovation. Figure 1 graphically depicts the five strategies.

These generic routes raise the question how they are implemented. Which micro-level mechanisms underpin these strategies?

To answer this overall question the next sub-questions need to be addressed:

1. Which external mechanisms for

learning do companies use in catching up processes?

2. Which mechanisms do they use to embed knowledge inside the company?

3. Do different catch up strategies come with differences in learning mechanisms?

4. Are certain catch up strategies more effective than others?

5. Does knowledge of micro-level mechanisms help to unravel the catching up process?

To study these questions detailed case analysis is required. Below the Chinese Haier group is studied in-depth to find out how it implemented its catch up strategy. This case analysis gives a first, preliminary answer to the first two questions. Next a comparison of Haier with other cases gives us insight into the last three questions.

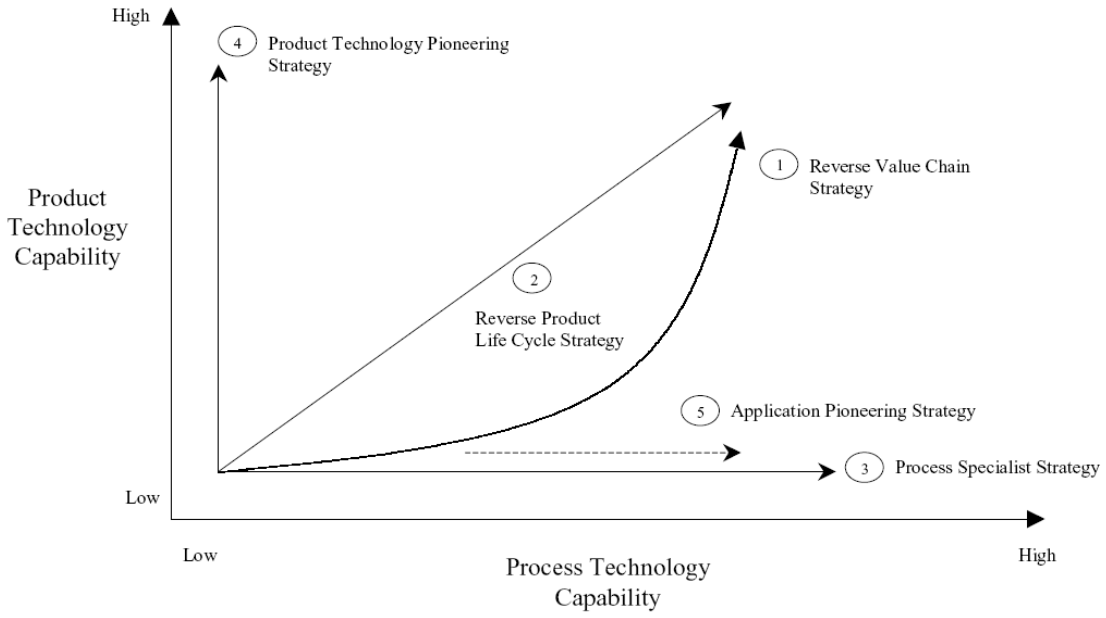


Figure 1: Five strategies for catching up (Wong, 1999)

3. COMPANY CASE: THE HAIER GROUP OF CHINA

The Haier Group is the single largest maker of comprehensive household appliances in China. In 1984 Haier, being close to bankruptcy, was taken over by a new owner, Zhang Ruimin [33]. At that time its sales were only a mere RMB[1] 3.48 million and it faced a debt of RMB 1.47 million. In 2004, Haier 's global sales had reached RMB 101.6 billion (see Graph 1) and it employed about 30,000 people worldwide. At first, Haier only produced one specific kind of household refrigerator-the BCD-212. Today, it manufactures a very broad range of household appliances; i.e. 15,100 product varieties grouped in 96 product lines. In 2003, the Haier brand topped all Chinese trademarks in a nationwide survey. On January 31, 2004, Haier was recognized as one of the World's 100 Most Recognizable Brands in a global name brand list edited by the World Brand Laboratory[2] . The latest Euromonitor statistics on company sales also show that Haier is 4th among the global white goods manufacturers with the largest

[1]Outside China, the RMB or renminbi is better known as the yuan. For the entire period of the case study the yuan's exchange rate was pegged to the dollar at 8.28 yuan to the dollar. In July 2005 China pegged the yuan to a currency basket and the yuan appreciated.

world market brand share for refrigerators. On the list of the most respected global companies in 2002 issued by the Financial Times, Haier ranked 1st among Chinese enterprises. The Chinese Fortune magazine (issue 8/2004) rated Haier second in their list of most admired companies in China. In this rating Haier was perceived as number one in the fields of management performance, innovation capability and Social Responsibility. These figures provide clear indicators that Haier is widely recognized for continuous innovation and reform.

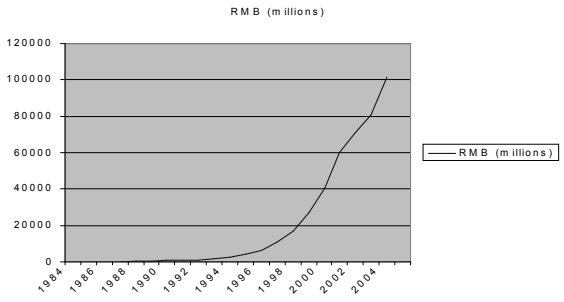
Within 20 years, Haier has developed from a small, almost bankrupt enterprise into one of the leading household appliances makers in the world. In this paper we will show that an active technology alliance strategy has played an instrumental role in Haier's path to achieve this leading position.

3.1. Haier's historical development

The first step into the development of Haier's technological catching up process was taken in 1984, when Haier decided to invest in refrigerator technology. After a careful evaluation of 32 potential cooperative partners, Haier decided to establish an alliance with Liebherr Company of Germany. This move enabled Haier to import Liebherr's four-star refrigerator production technology and equipment into China. Liebherr had 70 years experience in producing high quality refrigerators. The refrigerators made in Liebherr Company were generally regarded as the leading ones in the world. Compared to the four-star technology of Liebherr, Chinese products were still very old-fashioned, featuring two-star single door refrigerators with a freezing capability of -12 degrees Celsius. The freezing capability of a four-star refrigerator was -18 degrees Celsius. By importing four-star refrigerator technology Haier was the only Chinese company that was able to offer these innovative refrigerator products in China.

After these first steps into the technology acquisition process, Haier developed an active learning- and R&D strategy. It established a sophisticated R&D department, and sent more than 40 of their top engineers and management people to Liebherr for further training. They studied the development of four-star refrigerators, and were eventually able to learn the key technological skills that were required in successfully developing advanced refrigerators. Liebherr proved to be a very successful training institute for Haier's top R&D talents. This greatly improved Haier's innovation capability. Because of these developments Haier was able to introduce its first four-star refrigerator into the Chinese market in 1985. This product instantly established Haier as the leading refrigerator producer in China.

Haier worked very hard to improve its quality, service, design of products and R&D capability during the 1990s. Haier redirected its local focus into a strategy aimed at becoming a global leading enterprise whose product quality should be ranked among the



Graph 1. Haier's sales in Million RMBs [40]

[2]World Brand Laboratory is one of the five leading brand evaluation organizations.

best in the world. For some time, the household appliances of Japan were considered to be among the highest quality in the world. Haier however decided to set even higher quality standards than the stringent JIS quality standards as applied in Japan. According to the industrial standard of Japan, the return-repaired ratio of refrigerators should be less than 0.6%. Haier's international standard was set at less than 0.4%. The average life of Haier refrigerator was 15-years (the longest life off all refrigerators in the world). Haier's refrigerators passed American UL certification in 1990, and it gained the most excellence award of management in China. Since then, Haier successively passed, among others, ISO9001 certification, ISO14001 environment system certification, the European CE certification, Canada CSA certification, Germany VED and GS certification, Japanese S certification, and the Australia SAA certification. This allowed Haier to introduce its products into developed country markets.

Inspired by Japanese TQC management and Frederick W. Taylor's scientific management Haier also started to use the OEC (Overall every control and clear) model. The OEC model implies that everything should be controlled and cleared within the specific time frame that was set. Today's tasks must be finished today and the problems showing up during the work process must be dealt with immediately and improved at once after finding out the reasons and responsibility.

Haier first imported advanced refrigerator technology and equipments from Germany in its initial development-stage, and then internalized this technological knowledge into its own products. By further improving their R&D capabilities and their management models Haier was able to grow into one of the most successful refrigerator brands in the world.

3.2. Realizing Diversification Operation

Haier made extensive use of the technological and managerial learning from the Liebherr technology cooperation. It continuously extended its cooperative efforts after it gained its leadership status in the refrigerator market. This allowed them to gradually enter into others markets by means of technology alliances. Haier successfully diversified its operations. At the same time, Haier's technology alliance partners grew from a single partner (Liebherr) to a multitude of partners in a wide range of sectors. Table 1 shows some of the Haier's international technology cooperative partners,

Technology alliances proved to be instrumental to Haier's diversification strategy. During the period 1984 to 1991, Haier was a single product company focused entirely on refrigerators. Haier's sales were RMB 724 million, and profits were 31.2 million in 1991. From then on, Haier started to diversify into new product markets ranging from freezers to air-conditioners. It took Haier about three years to get successfully established in these two industries. By 1994 Haier's sales had grown to RMB 2.56 billion, and its profits were RMB 200 million. Subsequently Haier successfully developed among others washers, microwave ovens and water-heaters. Untill August 1997 Haier's products were primarily focused on white household appliances. At that time Haier decided to enter into sectors of black household appliances and others sectors. Table 2 shows the process of Haier's diversification.

Table 1. Selection of Haier's most important international technology cooperation alliances

Year	Partner	Cooperative Target
1993	Merlonic Company of Italy	Produced automatic roll-washers
1993	Mitsubishi Heavy Industry, LTD of Japan	Produced air-conditioners
1994	GK Design Company of Japan	Engaged in the cooperative design of new products
1997	Philips Company of the Netherlands, Metz Company of Germany	Produced color TV-set
1998	Beihang University of China and America C-MOLD Company	Software development
1999	Toshiba Company of Japan	Produced MRV inverter series of commercial air-conditioners
2002	Sanyo Company of Japan and SAMPO Company of Taiwan	R&D

Source: a)Ouyang Taohua [34]; b) Zeng Xiaoli and Zhong Shuhua [35]; and c) www.haier.com.cn [36]

In the course of Haier's diversification efforts, Haier repeatedly adjusted its R&D organization structure and increased its R&D expenditures so that its new products could be brought to the market quicker. After it's first diversification efforts in 1991, its R&D lab, formerly known as the refrigerator institute, was split up into three main R&D groups, i.e. the refrigerator, freezer and air-conditioner group. Haier founded a new technology research center in 1995. The center consisted of three main administration levels. The first level was the corporate group which was responsible for the development of core technologies and basic research. The second level was created in every department (business unit). The third one was connected to every plant (cost center). In 1998, the technology center was split into the technology development institute and the new product development institute. The technology development institute was composed of 11 institutes and laboratories that aimed to develop leading technologies for international use in 5-10 years. In addition, Haier invested RMB 500 million to build up an academy that was responsible for developing new products that had the capability to be internationally competitive. In 2001 the State Economic & Trade commission of China and the Evaluation Research Center of the Chinese Academy of Science co-evaluated Haier's technology development center and ranked it first among 284 state-judged enterprise technology development centers. The new product development institute was composed of 14 institutes that developed new products in order to satisfy emerging market needs. It was placed under the technology development institute's guidance. Before 1996, the proportion of Haier's R&D expenditures as a percentage of total sales was about 3%, it subsequently reached 4% in

Table 2. The process of Haier's diversification

Stage	Period	Additional Operation Area	Method
1	1984-Dec. 1991	Refrigerators	Imported refrigerator technology from Liebherr Company of Germany
2	Dec. 1991-Jul. 1995	Freezers Air-conditioners	Merged Qingdao Freezer General Plant and Qingdao Air-conditioner Plant
3	Jul. 1995-Aug. 1995	Washer Microwave ovens Water-heaters	Merged Red Star Electric Appliance Factory. Established a joint venture with Laiyang of Shandong Household Appliance General Plant
4	Sept. 1997-	Black household appliances	Established a joint venture with West Lake of HangzhouElectric Group
5	1998-	Knowledge sectors	Formed technology cooperation with many external organizations

Source: a) Sun Jian. [37]; b) Yan Jianjun and Hu Bing [38]; and c) www.3rd56.com [39]

1997 and was 4.6% in 1998. It is estimated that it will reach 8% in 2006 [34]. Figure 2 shows Haier's diversification in terms of its patents.

3.3. Implementing a Globalization Strategy

Along with the increase of Haier's technology capability and its subsequent competitive status, Haier made use of its technology advantage to extensively enter into overseas markets by means of strategic alliances. Haier's products successively entered into Europe and North America and a large number of other developed countries since 1990. In line with this strategy it established a global network for design, manufacture, distribution and after-sales services. After 1996, Haier started to export its technologies and products to other countries. It established joint ventures in countries, such as Indonesia, Philippine, Malaysia, United Arab Emirates, Iran.

It developed cooperative research programs with leading foreign companies. Its cooperative partners included Toshiba, Philips, Metz and Lucent. By teaming up

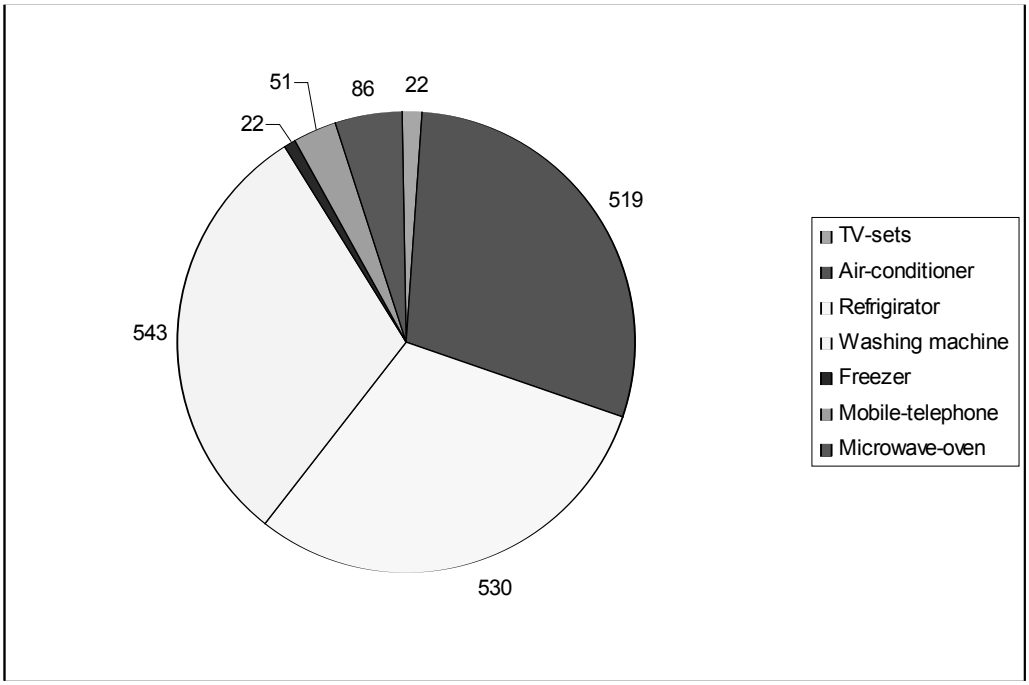


Figure 2 Haier's key patent applications in China (1988-2003)

with these globally leading innovative companies, Haier was able to establish a radar function that allowed Haier to scan and evaluate new emerging technologies around the globe. Haier simultaneously established many technology cooperations in developed countries and territories, such as Tokyo, Los Angeles, Montreal, Lyons, Seoul, Sydney and Amsterdam. Together they provided Haier with information about the global trends of technology development. This allowed Haier to quickly close the technological gap between Haier and its leading international competitors.

Moreover, Haier established 6 overseas design branches in Tokyo, Los Angeles, Montreal, Lyons, Amsterdam and Silicon Valley. Haier's oversea design branches are in charge of developing a broad variety of household appliances that satisfy consumer needs in a broad variety of countries in Europe, North America and Asia.

In its effort to increase management efficiency and development capability, Haier continuously improved its organization structure. It changed its U-type organization form into a M-type organization [38]. Currently Haier's organization structure contains four administration levels, the top level is the group headquarter, the headquarters consists of four centers (center research academy, project development center, capital center and human resource center), the subsequent level is the department (business unit), the departments are divided into department branches (plants).

Haier carries out its globalization strategy according to a "three one-third" principle, i.e. one-third of its products are produced and sold in its own country, one-third of the products are produced in its own country and sold overseas, and one-third of the products are produced and sold overseas. Haier's strategy is "from difficulty to ease", i. e. it first lets its products enter into developed

country markets, followed by an introduction into developing country markets. Haier thought it was easy to let its products enter into developing country markets after its products won brand status in developed country markets. For example, Haier first successfully entered into the German market, which is generally recognized as one of the most difficult markets to penetrate in the European Union. Haier's most recent internationalization efforts now primarily focus on the United States. Haier freezer sales amounted to 10,000 in 1997 in the United States, 25,000 in 1998, and reached 43,000 in 1999. The United States APPLIANCE journal announced that Haier freezer and air-conditioner moved up into the top ten in the United States in sales volume. It is estimated that the market share of Haier's small refrigerator (less than 180L) is 30% or so in the United States currently. In 1999, Haier built a plant in South Carolina of the United States for production of refrigerators, the design center in Los Angeles, and the trade center in New York. The new plant in South Carolina has a production capacity of 500,000 refrigerators per-year. It ranked 6th among all refrigerator companies in the United States. European and North American markets account for about 60% of Haier's export. Haier has established three overseas industrial parks (they are located in the United States, Pakistan and Jordan), 13 overseas factories and 58,800 sales agents worldwide, and it exported products to more than 160 countries that included Europe, North America, Middle East, South-east Asia, etc.

After gaining technological and economical advantages by means of technology cooperation, Haier started to export its technologies. Haier changed its initial importing of technologies into a strategy of exporting technology. This clearly shows that Haier has improved its technology capability. Whereas Haier started out as a weak partner in technology alliances, it has now achieved a position in which it is at a similar level as other leading house hold appliance and consumer electronics firms.

4. DISCUSSION

Haier used a number of micro-level mechanisms aimed at external acquisition of technology. Alliances, in which staff is educated, and mergers and acquisitions were used repeatedly by Haier to build up a knowledge base. Alliances with leading companies like Liebherr, Philips, Mitsubishi and Toshiba provided important knowledge and experience for the catch up process. Similarly a number of mergers and acquisitions strengthened Haier's technology position. External learning however was not sufficient for Haier to attain the strong market position it currently occupies.

External learning was supported by internal capability development in R&D and design; as well as the development of general management capability. Repeated investment and organizational change in the R&D organization indicate that Haier is continually investing in and monitoring progress in this area. The development of the R&D organization after its establishment 1985 underlines this: it was split in three in 1990, in 1995 the Technology Research Center was established, which was split in 1999, followed by the establishment of overseas design branches.

Using Wong's strategies, Haier can best be classified as executing strategy 2, the reversed PLC strategy. The emphasis Haier puts on controlling an entire value chain

from the beginning and the orientation on both product an process innovation clearly fit with the reversed PLC strategy. There is one important difference with the strategy as described by Wong. Haier's strategy 'from difficulty to ease' does not fit with Wong's description which assumes 'from ease to difficulty'. Even though Haier makes use of low labor costs, it has not entered the low end of the market (except for its domestic sales). Instead it has opted for serving the most demanding markets at an early stage in its development.

For the Haier case, this answers research questions 1 and 2. A multitude of external learning mechanisms are combined with a heavy emphasis on developing an R&D capability. In order to shed light on research questions 3 and 4, a brief comparion is made with 3 other examples of catching up: Acer, Samsung in microelectronics and Samsung in consumer electronics.

5. CATCH UP STRATEGIES COMPARED

The three cases were chosen to replicate the findings of the Haier case. Samsung used a reversed PLC strategy for its DRAM business. Hence it is expected that Samsung employs similar micro-level learning mechanisms as Haier. For consumer electronics Samsung used a different catch up strategy, namely the reversed value chain. Because Samsung followed a different strategy for this business, the expectation is that it employs different micro-level learning mechanisms as well. In order to avoid too idiosyncratic conclusions from being drawn the case of Acer is used as well. Acer also followed a reversed value chain study and hence we expect its use of learning mechanisms to follow a similar track as Samsung's in consumer electronics. Table 3 summarizes the Haier case and the four mini-cases.

5.1. Acer PC and notebooks (Reverse Value Chain)

Acer is a Taiwanese company with annual revenues of 8.4 billion dollars and 34,000 employees (in 1999). Its main products include desktops, notebooks, monitors and projectors. Acer learnt by reproducing IBM compatible computers for some years. Then a strong network of foreign suppliers and OEM customers including Fujitsu and IBM was built up to complement their small domestic knowledge base and market. This enabled them to concentrate on the manufacturing of PC-components and let their OEM customers do the R&D and marketing to complement the (manufacturing) technology Acer had. Their market consisted mainly of MNE customers and this helped them overcome their disadvantage of being located in a small developing country. Their competitive advantage was based on large scale and low costs and the OEM market is characterized by small margins. OEM customers need a broad range of products so Acer is able to get a knowledge base in the production of a broad range of products and components.

The next step was an acquisition of some USA companies (e.g. Altos computers) to get a better knowledge base for designing their own products (Own Design Manufacturing) and sell them under their own brand (Own Brand Manufacturing). This is in line with a reverse value chain strategy. Acer however had difficulties to absorb this knowledge and they were not able to penetrate the developed country market with their own brand using

Table 3. Comparison of cases

	Haier home appliance	**Acer PC/Notebook**	**LG, Samsung DRAM**	**Samsung electronics**
Strategy	Build up brand and learn in parallel using alliances	OEM-ODM-OBM, leapfrog IBM	Late follower, fast follower, leapfrogging on homogeneous specialized product	Use the advan tage of vertically integrated large scale production
External learning	Importing, imitating from alliances and merging domestic manufacturers	Supported by government, acquisition of USA companies	Licensing, purchasing. Research in Silicon Valley, working with Micron (US)	Joint ventures from Japan, licensing and informal contacts
Internal learning	First learning by doing later also by research	Learning by doing	Learning by doing and intensive research (reverse engineering)	Learning by doing and reverse eng ineering
Organization of R&D	Absent initially, emerges later	Separate R&D unit from the beginning (government) and spin-offs. R&D also done by OEM customers	Intensive R&D, with much investment	R&D comes from OEM customers, as well as design.
Growth	Driven by ambition and by client demand	Government driven (ITRI), OEM customers and internal	Internally driven, by own ambition	Internally driven and by OEM customers
Competitive differentiation	First quality and later innovative product, brand, design	Economies of scale and low costs for OEM, diversified products.	First low costs and economies of scale, later high -tech products	Low cost
Margins	Moderate	Low/moderate	Low to higher	Low
Type of products	Specific	OEM specific to consumer specific	OEM transition	OEM specific
Market	Domestic -developed - developing to get feedback from customer as fast as possible	Export OEM to OBM in developing countries	Based on export market, cyclical prices	Export market, mainly US
Production	Domestic to international for bran d building and low transport costs	Domestic to international for low labor costs	Domestic to international	Large scale domestic production. Economies of scale
Absorptive capacity	Engineers trained at Liebherr	Reversed brain -drain from US	Reversed brain -drain, from US	Training in Japan
Diversification	White appliance to black appliance	OEM only to OBM in developing countries	Octupus diversification, non -related products	
Diversification Base	Based on brand and what customer preferences. Brand also used fo r non-related sectors as life insurance.	Offer broad product mix to get large market share and use large economies of scale	Based on financial needs (chaebol) and key components	

the most advanced technologies. Therefore they are now penetrating developing countries in which the major players are not operating. This is a reverse value chain strategy from developing to developed countries. Eventually Acer could again try to sell in the developed countries and thereby leapfrog competitors.

5.2. Samsung Electronics (Reverse Value Chain strategy)

Samsung is a Korean company with a revenue of 56.3 billion dollars and 201,000 employees in 2004. Its main products include cell phones, monitors, DRAMs and microwave ovens. Samsung started out as a conglomerate in the sugar and textile industry. During the 1970s Samsung decided to enter the electronics industry by producing televisions and audio products. Samsung started joint ventures with Japanese consumer electronics manufacturers like NEC and Sanyo to get the technology needed for these products. Samsung became a television OEM manufacturer for these companies and thus had not its own brand or own R&D. For the export market its JV partners had the exclusive right to sell their products and for the domestic market the government prohibited Samsung from selling. Samsungs competitive advantage was based on the economies of scale and its strategy was to become a manufacturer of the complete OEM product including key components and assembly. Samsung succeeded in becoming a successful television OEM manufacturer using

technology (and marketing of course) from Sanyo and NEC.

In the mid 1970's Samsung decided to enter the microwave and VCR market but they were not able to get this technology by external learning. Therefore it used reverse engineering and it succeeded herein. This broadened their OEM product base but Samsung remained a contract manufacturer and did not do much on R&D and marketing. Later in the 1970's Samsung renewed its JV contracts with NEC and Sanyo and Samsung could export under its own brand, the domestic market became also available for Samsung. However, not much money and effort were put in the R&D and marketing of the products sold under the Samsung brand.

5.3. Samsung DRAM (Reverse Product Life Cycle strategy)

Supported by a new law Samsung decided in the early 1980's to become less dependent on suppliers from Japan for its integrated circuits. An internal drive for producing DRAM was created and a market for their low-cost chips was found. Samsung had already acquired a Korean chip manufacturer in the 1970's but now they invested heavily in research and licensing to become a fast follower or leader in the manufacturing of IC and especially DRAM. This is a very capital-intensive advanced industry which its rival Lucky Goldstar entered later as well. By licensing technology from Micron but also by using informal contacts it learned about DRAM technology. The other products of Samsung were used as milk cows and DRAM got R&D labs in Tokyo and Silicon Valley. These labs were needed to absorb and extend external knowledge acquired through licensing. This shows that Samsung used a very different strategy for catching up on DRAM then for catching up on consumer electronics. Samsung succeeded in leap-frogging the DRAM technology in the 1980s and they have become an internationally competitive player in the DRAM industry.

6. ANALYSIS OF MINI-CASES

Following the five research questions, the next cross-case conclusions can be drawn. As to the external mechanisms used by companies to learn, all companies employ a variety of them. The most important difference is that the companies following a reverse value chain strategy (Acer and Samsung Electronics) depend much more on learning from OEM's than the companies following a PLC strategy (Haier and Samsung DRAM). This is logical given the description Wong gives of Strategy 1. Learning from OEM is the object in this strategy.

The question of how companies embed that knowledge in the internal organization is answered differently for the two strategies as well. Strategy 1 companies have not invested in their own R&D capability to the extent that Strategy 2 companies have. This is the other side of the coin of their dependence on OEM's: R&D is in a sense contracted from OEM's whereas Strategy 1 companies have invested aggressively in their own innovative capability.

It therefore follows that research question 3, whether different strategies come with different micro-level learning mechanisms needs to be answered positively: external knowledge acquisition, embedding in the company and general management skills are different for the two strategies. Moreover the two Strategy 2 companies are quite similar even despite the substantial differences in

market and technology. Whereas Haier is oriented towards consumer markets with mature technologies, Samsung DRAM operates in a business-to-business environment with fast changing technology. The fact that their learning strategies are similar nonetheless, indicates this conclusion may be a quite solid one. As both companies are successful this may even indicate there is a best practice for realizing strategy 2. Strategy 2 requires simultaneous investment on different sides of the business over a sustained period of time to be successful. Hence this appears to be a demanding strategy not all companies will be able to realize.

The companies following Strategy 1 are quite similar to each other too. Both rely more on OEMs than own R&D for their innovation. The only important difference between the two companies is that Acer has made some use of M&A, whereas Samsung Electronics has engaged in reverse engineering.

Whether one strategy is more successful than the other, as research question 4 asks, can of course only be answered indicatively based on the four cases studied. Among the cases the Strategy 2 firms are more successful than the Strategy 1 firms. Acer appears to be the least successful. This may be caused by the fact that it operates in a high tech environment and that such an environment requires a more substantial independent R&D capability than a Strategy 1 firm can build up. Strategy 1 firms' dependence on OEMs may also mean that there is a limit to what they can learn, as OEMs will not educate Strategy 1 firms to such an extent that they create a competitor. This 'OEM-trap' inhibits Strategy 1 firms to make the next step and grow into a really competitive business on their own. Samsung electronics is relatively successful, albeit that it is in a low margin business. Without a substantial R&D capability it may be able to survive because in a low tech market cost competition may be relatively more important than innovation as a source of competitiveness. These cases therefore suggest that Strategy 2 firms will in the long run be more effective than Strategy 1 firms. The proviso here is that the Strategy 2 option makes high demands on capital investments and can only be followed by companies that have the deep pockets, time and management skills that this strategy requires. Companies that do not possess these resources may have no other option then to follow Strategy 1. In order to become successful they will need to invest in their own R&D capability once they have reached a certain knowledge base, because their OEM partners may not let them learn more than that.

As to the final research question, it seems that studying micro-level mechanisms for catching up does shed light on the catching up process. Different strategies come with different mechanisms for learning. Our understanding of the effectiveness of catch up strategies may be improved by studying these mechanisms. For example, the possible existence of an OEM trap and the high demands made on Strategy 2 firms show the limits to possibilities for catching up. Some conditions for the succes of catching up are found on a micro-level. To the extent that companies in a country engage in (or are limited to) Strategy 1, catch-up of that country may be limited. It will not pass a certain limit of technological competitiveness. This limit is set by the extent to which OEMs are willing to share and transfer knowledge. When companies are able to follow Strategy 2, catch-up may go further and companies in a country may

eventually become global competitors, provided that general management skills are sufficiently well-developed to manage this challenging strategy

Of course our method implies there are some important limitations to this study. Larger scale research into micro-level mechanisms is required to confirm our conclusions. When these studies take into account the other catch up strategies identified by Wong as well, an even clearer view of the preconditions for catch up success may emerge than we can realize with the limited scope of our research. However, despite the limited scope some interesting similarities and variations among the cases have been found that cannot be accounted for by differences in industry or culture. Studying the micro-level learning mechanisms behind catch up strategies therefore appears to be a fruitful research territory.

6. DISCUSSION

The paper shows that it is interesting to consider catch up strategies at a micro-level, because at that level the specific mechanisms for learning can be unraveled. Conditions for successful catching up can be defined by studying these micro-level mechanisms. Hence, studies into catch up processes of countries need to include the learning and managerial mechanisms that companies in that country implement. It is not sufficient to look at national characteristics only (legislation, education, labour force, natural resources) or business systems. Studies at the micro-level should supplement the higher level studies and may shed light on some of the unexplained issues around catching up processes.

For managers this analysis holds a number of implications. First of all, catching up is a multidimensional process. Micro-level analysis shows that technological catch up requires a holistic approach involving working simultaneously on external learning, internal R&D capability development and building up of general management skills. Second, catch up strategies can not be chosen at will. Strategy 2 is only possible when a number of conditions are met. In particular stamina is important: continuous improvement must be kept up for at least two decades, before a company becomes a credible competitor in the world market. Third, a 'from difficulty to ease' strategy may speed up the catching up process, but it needs to start with a relatively simple/mature product, before the company can move into more complex/high tech products. 'From difficulty to ease' applies to markets and customers served; for products 'from ease to difficulty' is the better strategy.

A conclusion for government policy emanating from the previous analysis is that investing in management skills is important for countries wanting to catch up. The correct regulatory framework may be a necessary condition for catch up, as may be the availability of capital, but they are not sufficient. Stimulating the diffusion of management best practices may stimulate catching up processes. Teaching companies how to manage and learn from alliances, how to learn from M&As and how to embed knowledge in the company will stimulate and speed up the catching up process. The catching up process should therefore not be seen as only a technology problem. It is a challenge for management development as well. Finally, governments with many Strategy 1 firms within their borders may try to stimulate these firms to build up their own

internal R&D capability. When this is successful, countries may not be stuck in the OEM-trap of remaining suppliers, but they may become innovative themselves.

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