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Supply Chain Network of IT Industry in East Asia: From the Viewpoint of Japan's Core Competence

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Abstract:

In studying catch-up of newly industrialized nations such as Korea and Taiwan, it is necessary to think about supply chain network structure among East Asian countries centered on Japan. While Korean and Taiwanese firms have achieved a very successful catch-up with Japanese firms and Chinese firms became world factory on behalf of Japan, the cutting edge technologies of steel and chemical industry remained with Japanese firms.

When we see Japanese manufacturing history, Japanese firms have also changed their manufacturing strategy corresponding to environment change. Japan's domestic manufacturing industry has for more than a decade shifted to one based on intermediate goods, and intermediate goods can now be said to be the source of Japan's manufacturing competitiveness. In recent years, new developments are providing signs of changes to Japan's industry. Until now, Japan's intermediate goods makers maintain strong competitive advantage, and have attained high profits in exporting their goods to Korea and Taiwan in East Asian market. However, Japanese intermediate goods makers are increasingly building production bases in Korea, Taiwan and China for LCD and semiconductor related goods.

Japanese firms will thus come under new pressure to reinvent their unique position in the new East Asia production network. In an increasingly volatile global market environment, no country's competitive position remains permanently fixed. Thus, Japan's changing position in IT industrial network in relation to the dynamic global competitors--particularly those from Korea and China--are worthy of continuous research and careful examinations.

Keywords: Supply Chain Network, IT Industry, East Asia, Japan, Core competence

Supply Chain Network of IT Industry in East Asia:
From the viewpoint of Japan's Core competence

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1. Introduction

In studying catch-up of newly industrialized nations such as Korea and Taiwan, it is necessary to think about supply chain network structure among East Asian countries centered on Japan. Although Korean and Taiwanese firms have achieved a very successful catch-up with Japanese firms and Chinese firms became world factory on behalf of Japan, the cutting edge technologies of steel and chemical industry remained with Japanese firms. However, Japanese firms have also changed their manufacturing strategy corresponding to environment change.

When we overview Japanese manufacturing history, Japanese manufacturing, under pressure from trade friction and a strong yen, has shifted from its original export focused structure by relocating its industrial bases, and particularly its production functions, overseas. In the 1960s and 70s, Japan grew by relying on an export centered, advanced market model of exporting products made in Japan to affluent markets in Europe and North America. However, this model of development induced trade friction with its partners in each industry, with competition from Japanese exports causing particularly marked declines in US manufacturing. The resulting trade friction eventually led to negotiations between the Japanese and US governments and the adoption of voluntary restraints on exports. Trade friction between Japan and the US occurred repeatedly as Japan's exports moved from textiles in the 50s, to steel in the 60s, to color TVs in the 70s, and then to automobiles and semiconductors in the 80s. Amidst this background of trade friction, the 1985 Plaza Accord was reached to allow the value of the yen to appreciate internationally, which resulted in a rapidly strengthening currency.

Such trade friction and the strong yen spurred Japanese businesses to relocate their production bases overseas. At the time, advanced markets were still the main target markets for Japanese firms, resulting in a shift to an "overseas production/advanced market" export model for Japanese firms. At this time there were two types of overseas production. The first type was largely motivated by trade friction, and involved building of overseas production bases in large markets in Europe and North America for automobiles etc. In contrast, the second type of relocation was largely a cost motivated strategy spurred by the strong yen, and involved export to advanced markets of electronics etc. from regions with lower labor costs, including ASEAN and China.

Currently, Japanese firms are once again under pressure to revise their strategy as new developments alter market conditions. After the financial crisis of 2008, Japan's traditional markets in Europe and North America suffered a rapid contraction in their economies, while emerging markets like China and India have shown steady growth. In light of these new circumstances, Japan is switching from the "overseas production/advanced market" model to an "overseas production/emerging market model" as the basis of its growth in the future.

Much of the research has focused on the growth and success factors of East Asian firms including Japanese or Korean firms. Yet, little research attention has been paid to understand supply chain network structure among East Asian countries centered on Japan and to explain how these success factors are related to sustainable competitive advantage of individual global firms from these nations.

In this paper our main thesis is (1) that we introduce supply chain network of IT Industry in East Asia from the viewpoint of Japan's Core competence, (2) how international specialization of global supply chain occurs according to product architecture structure.

2. Literature Review

2.1. Technology transfer and Catch-up

Technology transfer is an important concept for a study of international supply chain network based on catch-up speed. Recently, some Japanese innovation leader firms do not necessarily reap the real competitive benefits because of their "too rapid innovation transfer" and thus find it difficult for them to maintain their international competitiveness (Shintaku et al., 2008). Such "too rapid technology transfer" is not merely an issue with Japanese firms. In the middle of 1980s and the early 1990s U.S.-Japan Trade Conflicts occurred because of "too rapid innovation transfer" from USA firms to Japanese counterparts. Much research in 1980s has focused on such "too rapid technology transfer by US firms" or "too swift catch-up by Japanese firms" (Abernathy & Clark, 1985; Teece, 1986). This particular issue stirred up American nationalism sentiment in 1980s. In this context, a theory of strategic trade management is developed (Tyson, 1992).

Next, we introduce the growth process of Japanese firms as a specific example for this. After

World War II, Japanese firms attained phenomenal growth through technology import from US and European firms. The actual number of technological import cases from 1949-1966 is 4,135 (Yamazaki, 2004). 60% of these transfers (2471 cases) are all from USA firms and 448 cases involve those from Germany. In this sense, after World War II Japanese firms depended their technological innovation mostly through the assistance of USA firms. Japanese firms devoted themselves to independent research and development based on technology know-how that has been accumulated over the ten years of post-War technology transfer processes. Such R & D investment in growth industry contributed to overcome the technological gap between Japanese and other advanced nations.

Between the latter part of 1950s and the early 1970s, R & D investment by private sector had shown very high growth in petro-chemical, petro-process, steel, machinery, electrical industry. Strong capability in heavy chemical industry supported vigorous R & D investment. After the first Oil Shock in 1970s more R & D investment poured in new cutting edge industry as well as in the traditional assembly industry (e.g., electrical machinery and automobile). Through this process, in 1960s there was a noticeable boom in establishing and expanding centralized research centers initiated by electrical manufacturers(For example, Nippon Electronic Company (NEC) in May 1965, Matsushita Co. Research Center in 1962, Toshiba Central Research Complex in July 1961). In case of chemical industry, Toray was No. 4 among Japanese firms in terms of its R & D expenditures in 1959 (Yamazaki, 2004).

In brief, Japanese firms experienced high level of growth after 1950s through their rapid technology important from the US and European counterparts, their joint research with Japanese government and independent centralized R & D centers. It was during analog era, Japanese firms achieved successful catch-up with Western firms by manufacturing field process innovation and thus kept their sustainable competitive advantage. Currently, Korean, Taiwan and Chinese firms around Japan have been trying to achieve same catch-up with Western and Japanese firms in digital era.

2.2. Product Architecture and Catch-up Speed

Product architecture is deeply associated with catch-up speed in digital era.

Firstly, we consider relationships between product architecture and global supply chain management. Recently, with the broad range of global SCM, supply chain structures and organizational systems are becoming increasingly more complex. An effective control mechanism for global supply chain may be modularity. It was Starr who first conceptualized the idea of modularity in the context of supply chain in 1965. His main argument is that marketing's role is to make customers assume that they enjoy diverse product offerings in fact that through modularity of product design it is quite possible for customers to enjoy maximum diverse product choices without too much cost incurred to the firms.

Modularity is also a strategic practice that effectively organizes and manages complex products and processes. With it everything is controlled by explicit design rules (Clark and Baldwin, 2000). Modularity is the process of dividing the complex system into semi-independent subsystems based on certain connection rules (Fujimoto, 2001; 2003). Modularity is the process state of dividing a complex system into divisible subsystems (Aoki and Ando, 2002).

Besides, modularity requires standardization of component parts and product groups and facilitates the internal integration of functions within firms. For example, research and development (R & D) requires efficiency in product design while manufacturing needs to respond to the marketing that demands flexibility and customization requirements for customers. As a result, modularity requires both horizontal and vertical component responses. In terms of procurement and distribution the total responses of supply chain are expected. Through modularity product assembly work is simplified and drastic cost reduction is possible. In this way, global supply chain is enhanced.

However, much of research has focused on the advantages of modularity, while very little research has ever been conducted in the areas of industry comparison based on two parameters (1) modular and integral and (2) open and close (Ulrich, 1995; Fujimoto, 2003; Park et al., 2012). Furthermore, it is more reality to be little research concerning relationships between product architecture and catch-up speed in digital era.

When we consider global economic history, most of the initial specialization was limited to the advanced economies that produced the products. However, as product architecture was becoming turn-key-solution (i.e., modular type in the extreme sense), then the international specialization between advanced and NIES/BRICs firms was done. Here, NIES/BRICs firms focused on assembly and manufacturing of modular types of technologies or modular types of finished goods, while advanced economies specialized design & manufacturing in integral types of technologies.

Any firm may participate in this market for modular products, because the barriers of entry are low and the speed for technology adaptation is very fast. On the other hand, speed of integral technology implementation is quite slow (Fujimoto, 2006). From product architecture's standpoint the patterns of the 21st century international specialization suggest two types in terms of implementation speed difference in the global market (Shintaku et al., 2008). Strong global supply chain is needed as infrastructure that supports business structure.

The present state of the 21st century international specializations between advanced industrial nations and NIES/BRICs show that much greater level of global supply chain is being applied from the product/ process architecture.

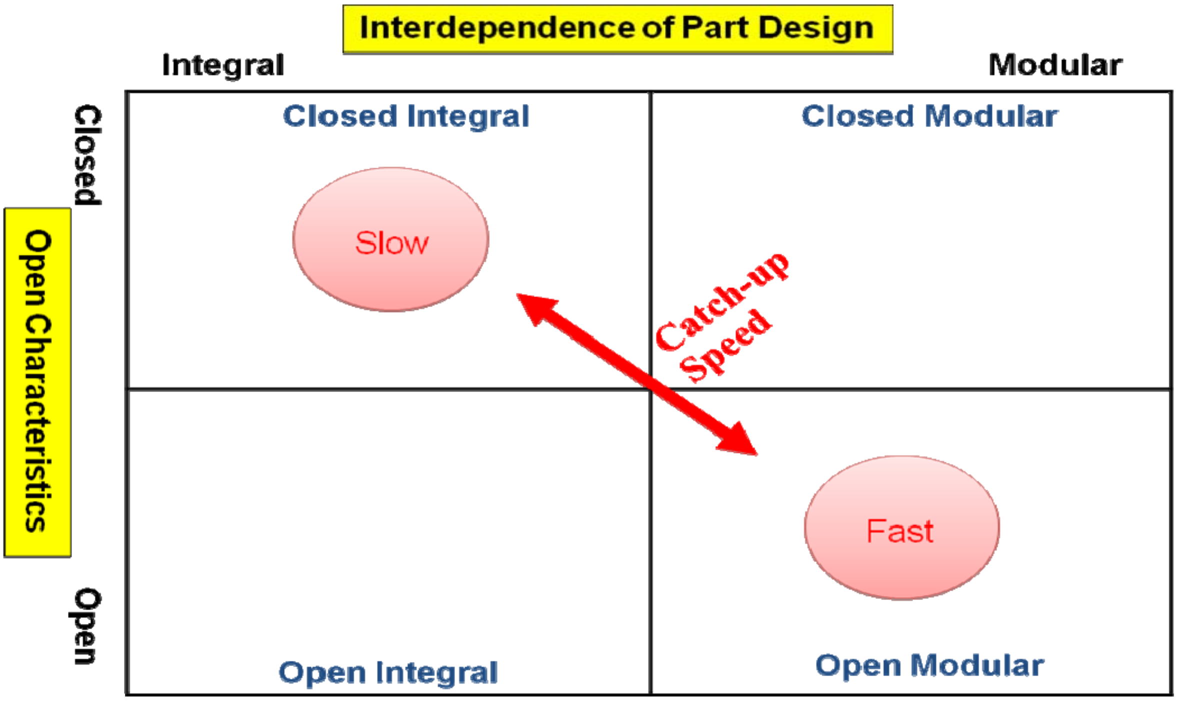
Any industry with open modular product/process architecture for its products achieves relatively rapid catch-up while closed integral architecture requires much longer catch-up period. Japanese material industry that is built on Japanese chemical industry still maintains very strong global competitiveness. Toray (a Japanese chemical firm) accomplished its growth through technological import from US DuPont. Its catch-up was not so easily attained. Rather, its independent technological development was possible through a few decades' accumulated investment on basic research from 1950s, as we mentioned before. Reverse engineering is not quite feasible in material science or chemical industry and thus technology transfers do not occur so readily. The technology transfer speed is different by industry. Product architecture has certain hierarchical intensity. If a firm's product is more or less finished assembly good, technology transfer is easy. However, if a firm's product is mostly component parts or materials that require basic technology knowhow, then technology transfer is difficult with the requirements of process knowhow and patent restrictions. The representative case is CD/ DVD player and LCD panel, semiconductor with smooth technology transfer. However, little technology transfer occurs in the areas of light pickup, light film, filter, silicon wafer and liquid panel. Besides these component parts, Japanese firms still maintain technological advantage in the areas of infra-equipment areas of semi-conductor and LCD panels.

From product architecture standpoint, Japanese firms hold technological know-how in the areas of integral products (i.e., having very strong interdependent relationships among component elements and infra-equipments) while technology know-how of modular products (e.g., DVD players and liquid panels) are mostly transferred to newly industrialized nations. What is important is that classification of integral-modular product architecture is dynamic, not static. Product architecture, once determined, is not necessarily permanently fixed; instead, it changes over time. Such architectural changes make a huge impact on the international competitive advantage of Japanese firms.

2.3. Research Framework and Focus

In this paper our main thesis is (1) that we introduce supply chain network of IT Industry in East Asia from the viewpoint of Japan's Core competence, (2) how international specialization of global supply chain occurs according to product architecture structure. By using Japanese chemical firms related to semiconductor and LCD as case examples we illustrate this main thesis. Fujimoto (2003) classified product architecture into two broad category: modular/integral and open/closed. The above mentioned industries are different depending on whether their product development and commercialization is based on digital or analogue technology. Chinese and Korean electronic industry (started with digital technology) and Japanese chemical industry (started with analogue technology) are quite different in terms of their processes of modularity. Figure 1 shows difference of catch-up speed by product architecture pattern. Open modular architecture is faster than closed integral architecture in catch-up speed. In next section, we will analyze Japan's position in East Asia's IT Industry and supply chain network based on this framework.

Figure1. Research Framework



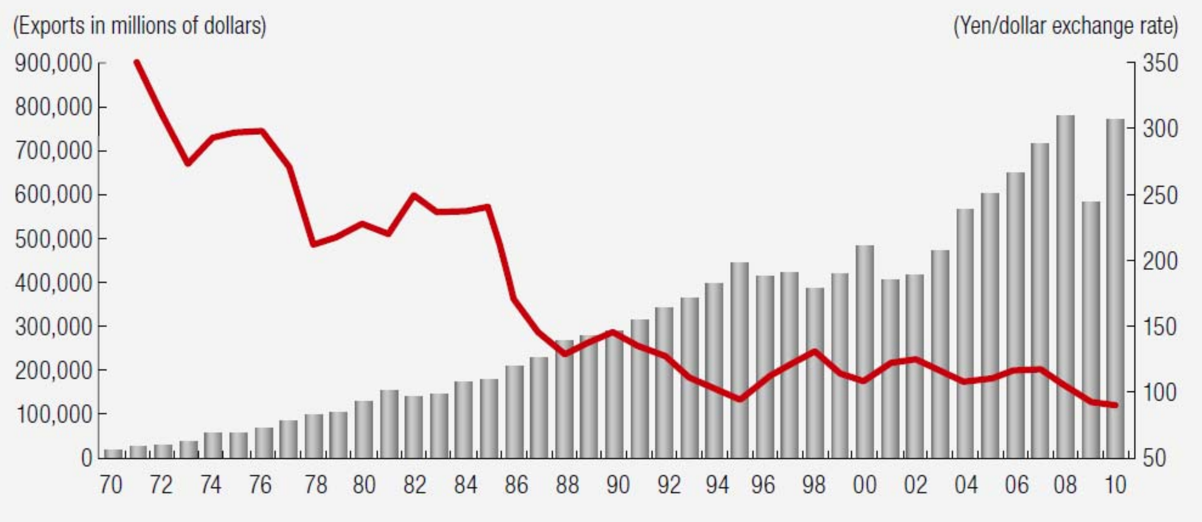
3. Japan’s Position in East Asia’s IT Industry and Supply Chain Network

3.1 Changes in global strategy for Japanese manufacturers

3.1.1 Trends in Japanese exports and exchange rates

Here, we introduce trends in Japanese exports and exchange rates to look at changes in global strategy for Japanese manufacturers. The following Figure 2 exhibits trends in Japanese exports and the yen/dollar exchange rate from 1970 to 2010. The data exhibit two noteworthy points. The first is that while Japanese exports have grown steadily over the long term, exports experienced unusual stagnation from 1996 to 2002. Somewhat surprisingly, even after the strong yen arrived in 1985, exports expanded in dollar terms. Second, during the favorable economic conditions from 2003 to 2008, exports continued to grow rapidly even though overseas production increased. Surprisingly, exports nearly doubled over 10 years from $386.3 billion in 1998 to a record high of $775.9 billion in 2008.Although exports fell to $580.8 billion in 2009 after the North American and European markets declined in 2008, 2010 saw exports climb once more to nearly the level of 2008. In 2011, however, after effects from the Tohoku Earthquake in the spring and the floods in Thailand in the fall are likely to reduce exports.

Figure 2. Trends in Japanese Exports and Exchange Rates



Source: Export trends are from data prepared by JETRO's external relations department based on the Trade Statistics of the Ministry of Finance. Data on exchange rates is from the monthly report from Toyo Keizai Statistics and graphs prepared by the author.

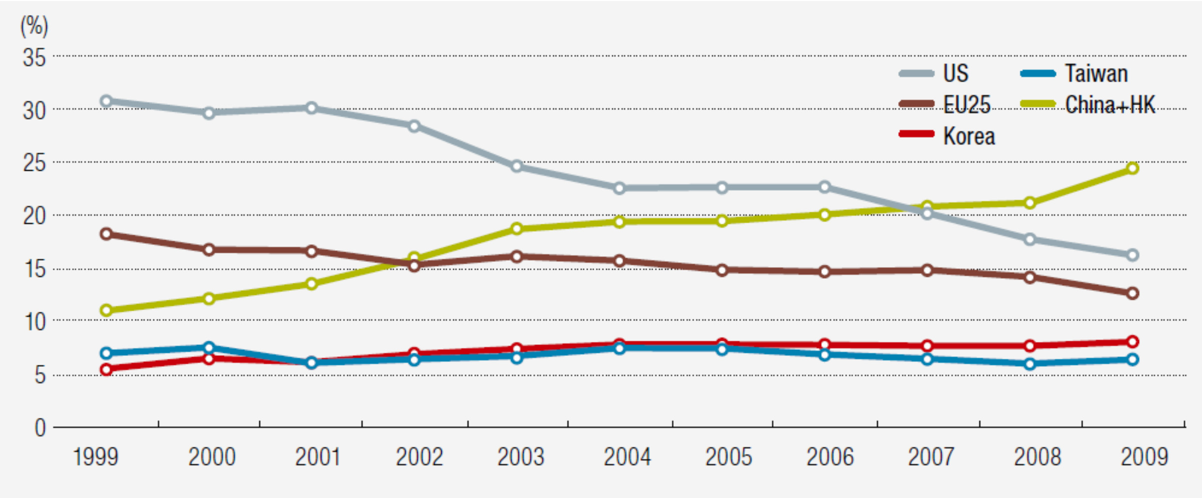
Based on this shift toward overseas production, it is easy to understand why exports were stagnant in the second half of the 90s, but it becomes unclear why growth in exports returned again in the 2000s. Various industrial bases both domestic and overseas suggest that Japanese firms have struggled to adapt to changing circumstances from 1996 to 2002, In the following section, we explain Japan's changing export model in the 2000s using trade related statistics.

3.1.2 Increased exports to Asia, and a shift to export of intermediate goods

Figure 2 shows the regional distribution of Japan's exports over the past 10 years. Japan's major export destinations have undergone dramatic change compared to the 1980s, as economic and trade patterns have altered. The US share of Japan's exports has declined precipitously from 30 percent in 1999 to 16 percent in 2009, while the EU's share has declined from 18 percent to 13 percent. In contrast, China's share of Japan's exports jumped dramatically from 11 percent to 24 percent, while Korea's and Taiwan's share showed slight increases to 8 percent and 6 percent respectively.

Such changes in Japan's export destinations were reflected in Japan's trade balance. Japan's global trade surplus reached a peak of $110 billion in 2004, before declining thereafter. Its trade surplus with the US prior to the financial crisis reached a peak in 2006 before declining. Nonetheless, Japan maintained a trade surplus of $20 billion even as the financial crisis hit in 2008, and total trade showed a steady recovery trend after 2009. The consistent surplus in trade with Asia reached $75 billion in 2007, and experienced virtually no decrease even in 2009, when the world struggled with the financial crisis.

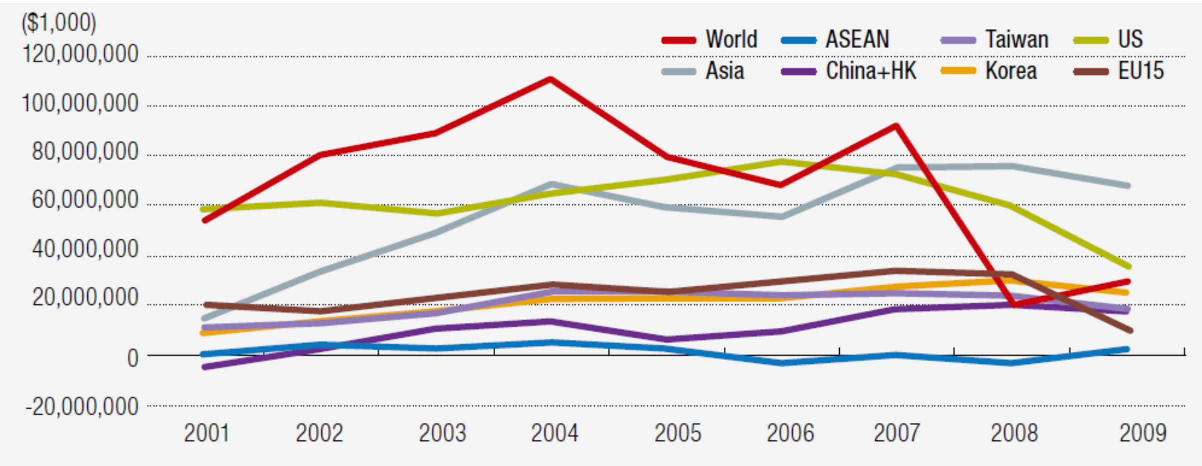
Figure 3. Share of Japan’s Export Destinations by Country/Region



Source: Data prepared by the author based on JETRO’s data from statistics from the Ministry of Finance.

The change in export destinations came simultaneously with a change in the main items exported. Previously, durable consumer goods accounted for 30-35 percent of exports to the largest export destination, which had been the US. This continues to be the case with automobiles. Presently, however, Japan’s largest export market is China, and in this market, durable consumer goods account for only 5 percent of exports, while industrial use materials account for 35 percent, and capital goods account for 50 percent; a structure that has remained consistent over the past 10 years. Japan maintains the same export structure with Korea, Taiwan, and ASEAN. Exports to the whole of East Asia consist of approximately 85 percent intermediate goods, including capital goods and industrial use materials.

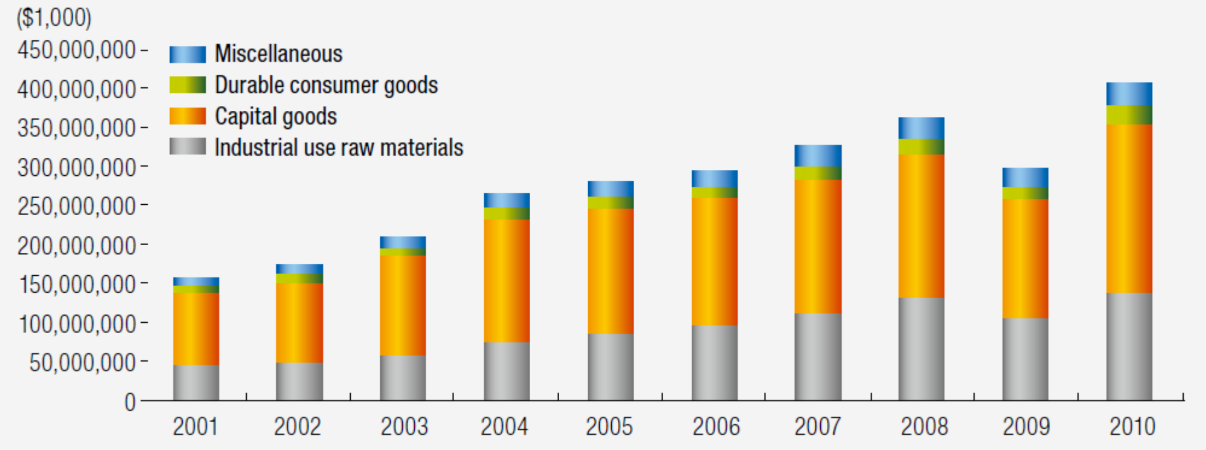
Figure 4. Japan’s Trade Balance



Source: Based on data prepared by JETRO from Ministry of Finance trade statistics.

The destinations for intermediate goods exported to East Asia include Asian factories owned by Japanese businesses, as well as Korean, Taiwanese, and Chinese manufacturers. For example, a large number of destinations in southern China show a pattern of “round trip processing.” First, intermediate goods are exported from Japan to Hong Kong, where they pass through customs. The intermediate goods are then taken into Japanese owned factories in Dongguan, Guangdong province. Finished products assembled in Dongguan are then returned to Hong Kong, and then reexported to destinations like the US. Japanese businesses that have entered ASEAN show the same pattern of exporting to the European and North American markets using intermediate goods made in Japan.

Figure 5. Structure of Exports to East Asia by Category



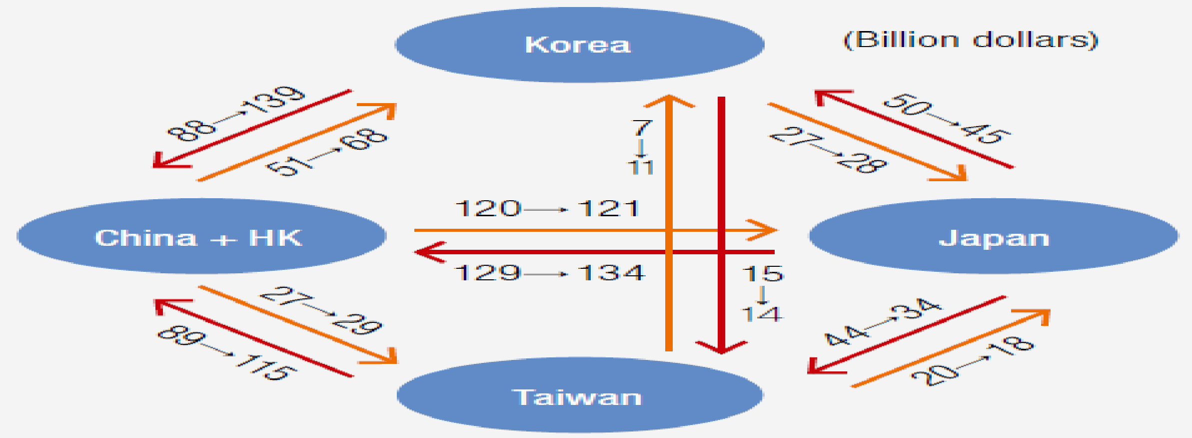
Note: “East Asia” as used here consists of China, Korea, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, the Philippines, and Indonesia.

3.2 East Asia’s production network and supply chain structure

3.2.1 East Asia’s production network

Japan’s share of the global semiconductor and liquid crystal display (LCD) industry has been steadily decreasing from the 1990s. At the same time, Korean and Taiwanese firms have acquired a large share of the semiconductor and LCD market by expanding production of these two items. If one looks only at this phenomenon, it appears that Korean and Taiwanese firms are engaged in a competitive relationship with Japan in semiconductors and LCDs. However, as shown in Figure 5, Korea and Taiwan are also both major export destinations for Japan. In 2006, Japanese exports to Korea amounted to $50 billion, while Japanese imports from Korea were only $27 billion, indicating that Japan has a large surplus in its trade with Korea. The same situation also applies to Taiwan. Although this trend weakened slightly in 2010, the trade relationship has changed little overall. At the same time, trade between Korea/Taiwan and China has shown extremely rapid growth.

Figure 6. East Asian Trade Structure (from 2006 to 2010)



Sources: Prepared by JETRO from Trade Statistics, Ministry of Finance, Japan, as well as data from the Bureau of Foreign Trade, the MOEA (Ministry of Economic Affairs, R.O.C.), and the Korea International Trade Association.

What kind of products then, are being exported from Japan to Korea? The most exported items include steel (Korea took 20 percent of all of Japan's steel exports in 2006), chemical products (16 percent), electric measuring instruments (14 percent), precision machinery (12 percent), electronics parts (11 percent), and metal processing machinery (10 percent). These are all production materials, and constitute indispensible parts and manufacturing equipment for industries in which Korean firms maintain strong international competitiveness.

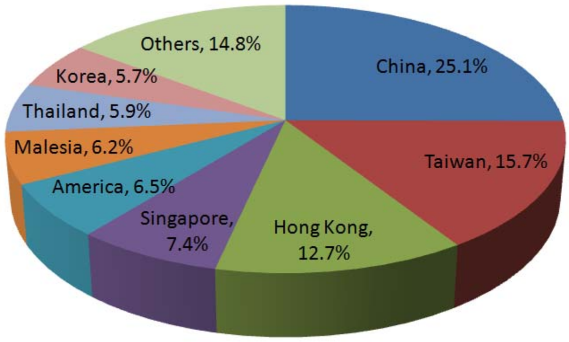
Korean and other Asian firms are important customers for Japanese parts makers and manufacturing equipment makers. For example, three countries, consisting of Korea at ¥116.9 billion, Taiwan at ¥280.5 billion, and China at ¥158.3 billion, accounted for 62 percent of all of Japan's exports of semiconductor and flat panel display manufacturing equipment in 2006. As shown in Figure 6, this trend remained unchanged in 2010, with 80 percent of exports of Japanese semiconductor parts going to Asia.

Currently, an international division of labor has emerged in East Asia where production goods like manufacturing equipment and parts are made in Japan, and exported to Korea and Taiwan, where they are processed in capital intensive high tech industries. The goods are then exported once more to China, where labor intensive final assembly is completed.

For example, in the LCD industry as described in more details below, 37 percent of Japanese exports of deflection plate materials for LCDs in 2004 went to Korea, while 27 percent went to Taiwan. Share for Japanese manufacturers in LCD parts and flat panel manufacturing equipment ranges from 60 percent to 100 percent in each category, with sales to Asia far outpacing domestic sales. Sales of Japanese manufactured large screen flat panels, on the other hand, account for only 15 percent of the global total, while share for Korean and

Taiwanese firms together accounts for 80 percent. Moreover, some of these panels are reexported to China, for final assembly in LCD TV plants owned by local Chinese firms as well as Chinese subsidiaries of Japanese and Korean firms. The end result of leveraging the comparative advantage of each country has resulted in an East Asian industrial structure where labor is divided so that production materials are made in Japan, capital and facilities intensive intermediate goods are made in Korea and Taiwan, and labor intensive finished goods are made in China.

Figure 7. Export Destinations for Japanese Semiconductor Parts (2010)



Source: Trade White Paper 2011

3.2.2 East Asia's supply chain structure as seen in the LCD industry

As shown in the foregoing, although Japan's global share in two leading IT products, semiconductors and liquid crystal displays, has steadily declined since the 1990s, intermediate goods (production goods) like parts and materials remain a firmly Japanese led industry. The following will examine East Asia's IT supply chain to ascertain the roots of competitiveness in the industry.

Previously, the transfer of markets and production bases from advanced countries to emerging markets was attained via the "flying geese" model (as described by Akamatsu) or the "product life cycle" model (as described by Vernon). New products were marketed in advanced countries, with production gradually moving to developing countries as the products reached maturity. Recently, however, the time lag between advanced countries and emerging markets has shortened considerably, and products introduced in advanced countries are rapidly introduced into emerging markets. This trend is particularly strong in electronics products like LCD TVs, mobile phones, digital cameras, and optical disk drives (Shintaku, 2006). LCD TVs typify the trend. Production and marketing began in advanced countries like Japan in 2000, but by 2005, marketing and production had already begun in China, with production by Chinese companies rapidly increasing. The same dynamic applies in the LCD industry. LCD panel production began in Japan, before moved moving to Korea and Taiwan, with materials and equipment production remaining in Japan. The existing vertical structure of transfer between advanced and emerging markets was maintained, though greatly accelerated, resulting in an international division of labor in LCDs. The same pattern is visible in optical disks, where optical pickups and chipsets are made in Japan and finished products made elsewhere, and in mobile phones, where chipsets are made in Japan and completed handset made elsewhere (Shintaku et al, 2007). Factors that affect the speed of this transfer can be traced to the product and process architecture of the items in question. In other words, production of products and parts with modular assembly can be rapidly transferred, while products and parts that require precision finishing will be much slower to move (Shintaku et al, 2008). More specifically, the international division of labor in the LCD industry exhibits clear variations based on the individual architecture of the finished products, intermediate components, and parts and materials used.

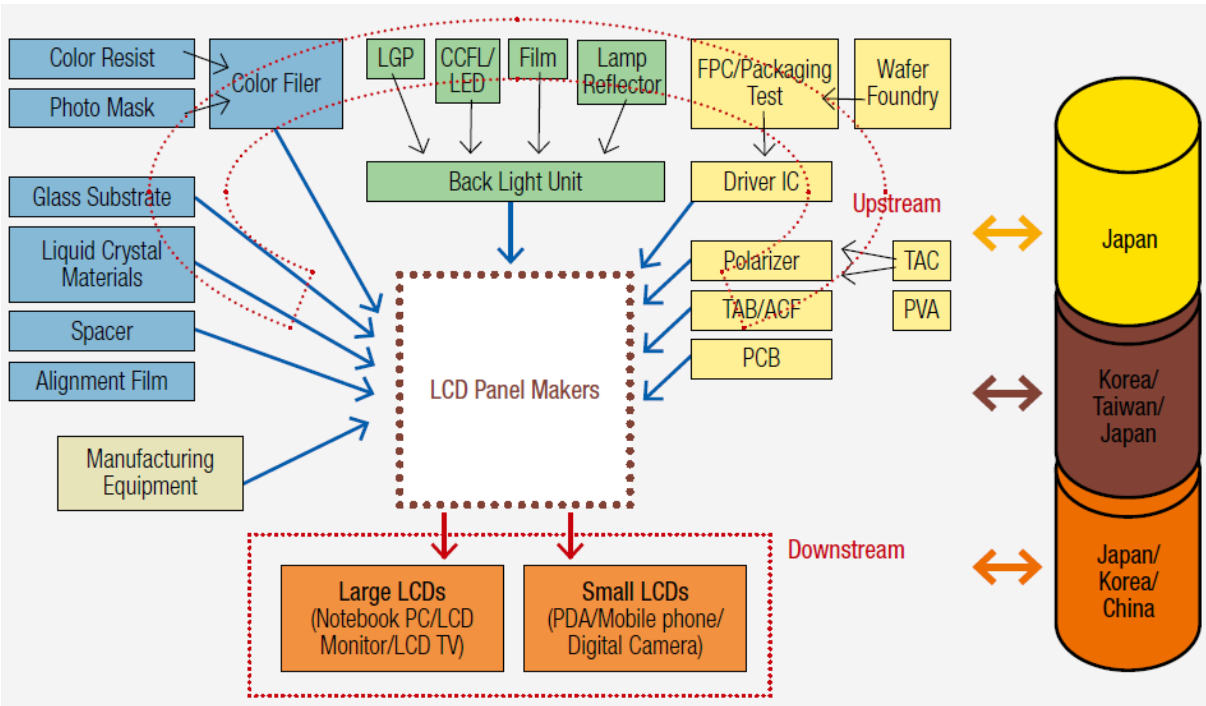
Originally, Japan had a pattern of cooperation in development of new products between materials and equipment makers and finished product makers. However, as Japan's makers of finished products and devices weakened in competitiveness, companies like Samsung Electronics and LG, who were once little more than customers of Japan's upstream makers, made aggressive investments, and by purchasing manufacturing equipments and materials from Japanese firms, were able to rapidly develop a global reputation. Thereafter, Taiwanese panel makers also invested aggressively through acquiring technology from withdrawing Japanese panel makers which were defeated by Korean panel firms. The end result was the emergence of a competitive structure between Korea, Taiwan, and Japan in the LCD industry. Korea and Taiwan's LCD industry grew rapidly from the mid 1990s, while in the background, Japan's LCD equipment and parts makers provided massive supplies of parts and materials as well as equipments. Thus, Japan plays role in providing a foundation that supports the LCD industry (Shintaku 2006).

While companies like Samsung Electronics and LG Display of Korea, and AUO and CMO of Taiwan have become leaders of the panel market through their massive investments, they have almost no competitive advantage in upstream areas like parts and equipments. LCD parts production is not merely a semi "black boxed" proprietary process, it is also protected by patents on source technology that are not easy to imitate or evade. In other words, the architectural structure of the LCD parts industry is nearly integral, and thus it will not be possible to catch up over the short term. However, LCD panels, where Korean and Taiwanese firms have been successful, have a nearly modular architecture where new firms can catch up in a relatively short time, provided they make massive investments.

The downstream of the LCD industry (i.e. LCD TVs) has a somewhat more complex structure. Looking at their share of the global market for LCD TVs, Samsung and LG Electronics are leading through their successful vertical integration of TVs and LCD panel production. Sony, in contrast, does not engage in panel production, but has succeeded in securing stable panel supplies through its joint venture with Samsung, S-LCD. However, as LCD TVs are in an industry where the core parts (i.e. panels) are nearly modular, LCD TVs can be easily assembled by technologically immature Chinese firms if one does not consider quality issues. In the Chinese market, for example Chinese makers of LCD TVs have entered the market using low cost Taiwanese LCD panels. While Korean and Japanese firms are strong in high end LCD TVs, based on their possession of supplies of high quality LCD panels, and the expertise they accumulated in the cathode ray tube era, competition in low end LCD TVs is fierce due to the entry of new Chinese firms that compete aggressively on price.

Under these circumstances, the LCD industry can be said to have a three level structure with upstream parts and materials and equipment makers, midstream makers of intermediate goods (i.e. panels), and downstream television makers. This three level structure has Japanese firms on the upstream, Korean and Taiwanese firms in the midstream, and Korean, Japanese, and Chinese firms competing fiercely in the downstream. In the upstream, Japanese firms have a near monopoly on the parts, materials, and equipment businesses, and constitute the base of competitiveness that supports the IT industry.

Figure 8. Division of labor in the LCD industry



4. Case Studies

Japan’s core competencies in the IT industry will be considered from here. As shown in the foregoing, LCD parts are not simply a black boxed proprietary process, but are protected by source technology patents, and Japanese firms have a near monopoly on the technology. Here we will consider the core competencies of Japan's IT industry while introducing the characteristics of companies in detail. Japan's LCD parts makers have secured high operating profits on sales, high rates of profit, and high share in most of their product lines. In particular, two Japanese firms supply the entire global supply of TAC and PVA film. In addition, Japanese firms account for more than 80 percent of the world market in color resist and resist materials. Characteristically, none of these successful makers deals exclusively in LCD parts and materials (Takeshi, 2006; Fuji Chimera Research Institute, 2006). In fact, in many cases, LCD parts and materials were developed as a byproduct of other chemical products, as with the chemical firms supplying materials for LCD film mentioned above. These firms commercialized their core chemical products before the birth of the LCD, and many of them maintain high shares in those areas. Many of these firms have high share in those fields. Such firms have a long history, and have been tested under difficult business conditions in the past. These firms recognized LCDs early on as an area with high potential for growth, and underwent much trial and error in determining how to apply their technology. As a result, while LCD parts and materials are a highly profitable product contributing substantially to the revenues of Japanese chemical firms, they are only one among many diverse applications for their products. The following will examine case studies of leading firms in terms of their core competencies.

4.1 Kuraray

Kuraray Co., Ltd. is a leading Japanese chemicals firm that began life as a chemicals and textiles producer. Originally launched to localize production of rayon in 1926, Kuraray now provides a number of leading products, including synthetic leather, functional plastics, synthetic textiles, and Velcro. Approximately 60 percent of its sales come from its chemical products and plastics, including polyvinyl alcohol (POVAL) and ethylene vinyl alcohol copolymer (EVAL) films. Its share of the global market for the PVA film used in LCDs is 80 percent, while its share of the global market for the EVAL film used in gasoline tanks and food packaging is 70 percent. Kuraray maintains high competitiveness in new materials (centering on functional plastics), and strong proprietary technology.

Kuraray has a long history of developing significant new applications for its products, including PVA film for dress shirt bags in 1954, and optical POVAL for sunglasses in 1965. Its PVA film was adopted as the polarizing film for the world's first LCD calculators in 1973, and it has been involved with the LCD industry since it began. It continued to build its technology in PVA plastic by accumulating high level manufacturing expertise and technology in applications development, molecular orientation, and surface processing, presenting a formidable challenge to any prospective newcomer to the market.

4.2 Fujifilm and Konica Minolta

Fujifilm and Konica Minolta both began life as photographic film makers. Fujifilm, established in 1934, is Japan's leading precision chemicals firm. The firm was launched as a spinoff from Dai Nippon Celluloid in an effort to localize the manufacture of photographic film. Since then, Fujifilm has produced everything from cameras, digital cameras, photographic paper for general and X-ray film, to photo systems (including processing equipment), as well as copiers, office automation devices, medical devices, and cosmetics. In the 1990s, when the photographic film market contracted drastically, Fujifilm entered other fields, and leveraged the technology it had acquired in photographic film to expand into LCDs and healthcare. It now boasts an 80 percent global share for the polarizing film used in LCDs (TAC film), with the remaining 20 percent held by Konica Minolta holdings. As the first company to develop TAC film, Fujifilm built on its experience by releasing phase difference film in 1991, and WV film, which expands the viewing angle for LCDs, in 1995. In February of 2005, it established Fujifilm Kyushu to produce Fujitac, a material for LCDs, to cement its dominance in this area.

TAC film is not only a protective film; it also has applications as a substrate for phase difference film. Fujifilm was able to leverage its long experience in traditional silver halide film to coat TAC film with various agents and then apply it as a base technology in other products. Currently, Fujifilm and Konica Minolta together have a global monopoly on the supply of TAC film. The R&D and manufacturing technology that the two firms accumulated over a long period of developing and improving silver halide film was able to be leveraged in new applications like LCDs.

4.3 JSR and Zeon

JSR and Zeon Corporation are leading firms in synthetic rubber. JSR is a Japanese chemical maker established in 1957 with the goal of localizing production of synthetic rubber. The company began with government and private financing (the government provided 40 percent and private businesses 60 percent), of which the forerunner was Japan Synthetic Rubber Corporation as a statutory company. In 1969 it was entirely privatized, and began pursuing diversification of its business. Today, it is a player not only in petrochemical products, also in IT and electronics materials (including materials for semiconductors and LCDs) that are driving earnings growth. It also has high share in transparent plastics like optical fiber coatings and optical adhesives, based on its development of plastics with superior optical properties.

Zeon was originally the chemicals maker for the Furukawa Group, and was established in

1950 as a maker of vinyl chloride plastic through technology and investment provided by B.F. Goodrich Chemicals of the US. Currently, its main business includes special synthetic rubber and high function plastic.

Both firms handle butadiene rubber, which uses the C4 fraction as its raw material, and isoprene rubber, which uses the C5 fraction (where “fraction” refers to different outputs produced during petroleum distillation). By developing new applications for these raw materials, the firms were able to develop products like optical disk materials, synthetic fragrances, and water soluble polymers etc. COP plastic was also born out of this process. COP is a kind of transparent plastic, with lower permeability and superior heat resistance to similar transparent polycarbonate or methacrylic. Both companies together have a global monopoly on the supply of COP film for phase differential film.

The background for development of the new COP plastic stems from both firms’ R&D expertise in synthesizing products from the C5 fraction. The C5 fraction is a byproduct produced at ethylene plants arising from the separation of ethylene and propylene. C5 furnishes the raw material for isoprene, itself the raw material for synthetic rubber, pentazene, the raw material for adhesive compounds, and dicyclopentadiene, the raw material for COP. The proximity of both firms’ manufacturing facilities to their ethylene plants ensured that they had a stable supply of raw materials for consistent production.

4.4 Toppan Printing and Dai Nippon Printing

Toppan Printing and Dai Nippon Printing both started out as printing firms. Today they have an overwhelming share of the market for semiconductor photo masks, LCD color filters, and antireflective films.

Toppan Printing was launched in 1900 with an engineering team consisting of people from the printing department at Japan’s Ministry of Finance during the Meiji era. At the time, the company’s specialty was high precision printing suitable for use in bonds and securities. Initial orders focused on cigarette packaging design, and later, securities printing and semiconductor photo masks.

Toppan Printing’s entry into the color filter business dates back a long time (Izumiya, 2007). Toppan had already entered the industry by 1971, and by 1985, it commenced production using the photo lithography method (dyes). From 1987 to 1990, Toppan developed the photo lithography method (pigment dispersion). With the expertise it built up over this time, Toppan was eventually able to develop the world’s first spinless coating, an “ultra technology.” Up to then producing color filters generally used spin coating. But the process, which applies color resist to the glass substrate while rotating it, had numerous shortcomings that needed improvement. By developing a spinless coating method that uses slot dying rather than rotation, Toppan was able to find a new engine for growth.

Dai Nippon Printing was established in 1876, and in contrast to rival Toppan, was established by private citizens to become the challenger in the industry on its strengths in magazine and book publishing. Dai Nippon has developed an innovative method for producing color filters using inkjet printing. Dai Nippon dominates the industry in producing color filters with inkjets, a technology widely used for PC printers, for high definition and quality at low cost.
Such efforts to develop a base in printing technologies allowed both Toppan and Dai Nippon to secure overwhelming share in the market for color filters and anti reflective film, two critical components for the LCD industry.

4.5 Asahi Glass

Asahi Glass was established in 1907 as part of the Mitsubishi Group, and is the world's No. 1 maker of glass. Even though it had little technology when it started, Asahi is now No. 1 in the world in flat glass and automobile glass. In glass panels for plasma displays, the company has secured an overwhelming 70 percent global share. In glass panels for LCDs it has 25 percent of the global market (second after Corning), demonstrating its strength in the industry (Izumiya, 2007).
Asahi started life as a flat glass company, and since then has always kept up with the times as demand for glass changed and evolved. In the building construction era, Asahi produced window glass, while in the automobile era it produced advanced automobile glass. As the PC, mobile phone, and flat panel TV era arrived, Asahi reinvented itself as a producer of flat panel high definition glass. By constantly pursuing new products and innovation as demand evolved, Asahi was able to ensure its preeminent position in the industry.

5. Discussion: Outlook for Japan's IT industry

Japan's domestic manufacturing industry has for more than a decade shifted to one based on intermediate goods, and intermediate goods can now be said to be the source of Japan's manufacturing competitiveness. However, in recent years, new developments are providing signs of changes to Japan's industry.

5.1 Movement of Japanese intermediate goods makers overseas

Japan's intermediate goods makers maintain strong competitive advantage, and have attained high profits in exporting their goods to Korea and Taiwan. However, Japanese intermediate goods makers are increasingly building production bases in Korea and Taiwan for LCD and semiconductor related goods. As shown in the following table, Japanese LCD parts makers were already rapidly increasing their presence in Korea by the mid 2000s.
This phenomenon is likely due to changes in the end customers for finished products. For

example, in the case of Asahi Glass, which entered Korea in 2005, Asahi began considering an overseas presence in 2003, when it forecast that 30 percent of demand for TFT glass panels would be in Japan, 40 percent in Korea, and 30 percent in Taiwan. Asahi decided to establish a production base in Korea due to its forecast that Korea would have growing demand for large-scale LCD panels in the future. Asahi established a polishing line as the first stage of its business development in Korea, and by making the necessary investments in response to expanding demand for glass panels, they could ensure stable supplies to their customers. In the future, it is likely that the number of businesses that shift production of intermediate goods themselves to Korea, Taiwan, and China will increase.

Table1. Current status of Japan's entry into the Korean parts LCD parts and materials market

Parts	Name of company in Korea	Investing company (nationality)	Location(time)
Glass board	Asahi Glass Fine Techno Korea (AFK)	Asahi Glass (Japan)	Gumi, Gyeonggi (Aug 2005)
	Paju Electric Glass	NEG (Japan)	Paju, Gyeonggi (Jun 2006)
	Schott Kuramoto Glass Processing Korea	Schott(Germany) Kuramoto Manufacturing Plant (Japan)	Ochang, Chungcheong (Nov 2005)
Polarizer/polarizing film	Dongwoo Fine Chemical	Sumitomo Chemical (Japan)	Sumitomo 100%owned (2002)
	Korea Nitto Optical	Nitto Denko (Japan)	Pyeongtaek, Gyeonggi (1Q 2005)
Color filter	Dongwoo STI	Sumitomo chemical (Japan)	Pyeongtaek, Gyeonggi (merger with Toshiba Fine Chemical 2005)
Backlight	Harrison Toshiba Lighting Korea	Harrison Toshiba Lighting (Japan)	Ochang, Chungcheong (May 2004)
Liquid crystal	Chisso Korea	Chisso (Japan)	Pyeongtaek, Gyeonggi (November 2005)

Source: Homepages from the respective companies

5.2 Expansion of sales of intermediate goods to emerging markets

In 2008, Japan experienced a drastic fall in its trade surplus to $19.8 billion, while simultaneously maintaining a trade surplus with Asia of $75.5 billion. In 2009, Japan's trade with Asia was $68 billion in surplus. Although it is likely that Asian production for export to Europe and North America will decrease as those markets continue to be dormant after the financial crisis; exports to Asia, and above all to China, have decreased very little. This is likely because exported intermediate goods were used for products released in the local market.

In fact, after the financial crisis, the majority of Japanese businesses were focusing their resources in pursuing emerging markets like China. Sales in China have become an urgent issue for Japanese home electronics and automobile firms. Moreover, such sales to expanding local markets are set to increase in the future, while trade with local businesses will expand. In other words, Japanese businesses are not only trading intermediate goods with Korean and Taiwanese firms, they are also looking to expand their business by increasing trade with Chinese and Indian firms.

5.3 Intensifying competition in the intermediate goods business

Up to now, Japan has maintained a large share in sales of intermediate goods in East Asia. Recently, however, Japan's share has been decreasing. In the electrical machinery area, ASEAN, China, Korea, and Taiwan have started to appear as exporters of intermediate goods.

Table 2. iPhone 4 supply chain structure

	Parts	Supplier	Price
Processor	Core processor	Samsung A4	10.75
	DRAM	Samsung	13.80
Memory	Flash memory	Toshiba 16G byte	27.00
Communications	Baseband	Infineon HSDA/ HSUPA/ WCDMA/ EDGE	11.72
	Receiver	Infineon GSM/ EDGE	2.33
	Memory	Intel NOR-Type FM, ELPIDA DDR	2.70
	PWU module	Murata SAW Module	8.25
Power management	Main power management	Dialog	2.03
Wireless connectivity	Wi-Fi, Bluetooth	Broadcom	7.80
	GPS	Broadcom	1.75
Video	Display	Toshiba Mobile Display	28.50
	Touch Screen	Wintek/ TPK	10.00
Interface	Electronic compass	Asahi Kasei Electronics	0.70
	Accelerometer gyro	STMicro	6.40
Cost			$187.51

Source: HIS iSuppli

In the case of Korea, the existing trade structure involves Korean firms using Japanese intermediate goods to produce LCD TVs etc. Now, however, Chinese firms are doing the same, and Korean firms are faced with the prospect of losing their role between Japan and China. Korean firms are thus aiming to follow Japanese firms in converting their domestic manufacturing to intermediate goods.

In fact, Korean firms have experienced remarkable growth in electronic parts like ceramic condensers. Looking at Apple’s iPhone and iPad, though the core components are still made in Japan, many of the parts are made in Korea. The future international division of labor, where Taiwanese manufacturers build products out of Korean, Taiwanese, and US parts, and with American firms handling sales, is visible in products like the iPhone 4 and iPad. Japanese firms will thus come under new pressure to reinvent their unique position in the new East Asia production network.

In this paper our main, we introduced supply chain network of IT Industry in East Asia from the viewpoint of Japan’s Core competence. Furthermore we analyzed how international specialization of global supply chain occurs according to product architecture structure. East Asian firms have caught up Japanese firms in open modular industry, while Japanese industrial competitive advantage has remained in closed integral architecture.

In an increasingly volatile global market environment, no country’s competitive position remains permanently fixed. Thus, Japan’s changing position in IT industrial network in relation to the dynamic global competitors--particularly those from Korea and China--are worthy of continuous research and careful examinations.

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