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**Global Knowledge Transfer of East Asian Auto Industry:
Comparative Study of Toyota and Hyundai**

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Keywords : Knowledge transfer, Global Production, Production system, Automobile industry

Abstract: East Asian automobile industry is one of the most important industries in East Asian capitalism. Japan and Korean automobile firms have their own unique production system. We discuss about Japanese and Korean firm's global knowledge transfer processes by comparative study of Toyota and Hyundai. Knowledge transfer of Toyota is based upon humane transfer; on the other hand knowledge transfer of Hyundai is based upon codified knowledge. Differences in knowledge transfer are linked to firm's own unique history and social environments.

1. Introduction

Automobile industry is one of the most important industries in East Asian capitalism. Automobile industry was traditionally competitive industry in western nations. But late 20th century Japanese automobile firms were appeared as strong players in global markets. Not only Japanese firms, but also Korean companies show a significant presence in global automobile industry.

Japanese firms, especially Toyota has been studied and compared with US firms. Many studies indicate that the source of competitive advantage of Toyota is its production system. Toyota Production System (TPS) was created in Japanese social and economic environments.

Korean firms also have unique production system. Base of Korean firm's production system comes from Japan. For example, Mitsubishi motor transferred their knowledge and know-hows about manufacturing to Hyundai motor. Hyundai also struggled to learn TPS. However, despite the influence of Japanese production systems Korean firms have its unique production system. It was created from Korean social and economic environments.

Japanese and Korean firms have own unique production system made by national conditions. In this paper, we treat production system as knowledge. Different production systems were made from different knowledge creation processes and it also influences its transfer processes to overseas. We discuss about Japanese and Korean firm's global knowledge transfer processes by comparative study of Toyota and Hyundai. This study can help understanding Asian automobile industries and its globalization.

2. Transfer of Productions as Knowledge Transfer

In this paper, we assume that transferring of production function from home country to foreign countries as knowledge transfer process. It means that home country's factories and organizations have knowledge about mass production. And this knowledge forms a production system. Transferring production system to foreign countries means that transferring knowledge about production from home country to foreign countries.

Transfer of Production system to Foreign Country

Why multinational Companies (MNCs) expand overseas? This is because MNC transfer their competitive advantages based on the home country's headquarters to overseas (Hymer1960). Foreign subsidiaries, compared to local businesses have disadvantages such as languages, local economy information, laws and regulations, and distribution networks. So MNC has to have some advantages over local businesses in order to succeed in overseas markets. Dunning (1979) developed eclectic theory by combining ownership advantages, location advantages and internalization incentive advantages.

In research on Japanese MNCs, transferring ownership advantage are considered important

factors of their overseas business. Japanese management system and Japanese production system are treated as competitive advantages. Especially in Japanese MNC's production system, foreign factories heavily depend on home country's advantages (Yamaguchi, 2006; Abo, 2007). But Japanese management and production system might not work well at foreign country, because foreign country has different language, cultural backgrounds, and market environments. Abo (2007) explains Japanese foreign plant by 'application-adaptation (hybrid) evaluation model'. By this model, Japanese foreign plant has two sides. One side is 'application'. It means Japanese management and production system are introduced and transplanted without modification. On the other side is 'adaptation'. It means Japanese systems are modified by foreign environments. Any Japanese firm's foreign plant have characteristics of both sides. Similar discussions are claimed by Jeffrey et al. (1999). It insist that Japanese firm's factories in America has Japanese production system as its ownership advantage. But it has been modified because of American environments. These researches assume that Japanese production system as ownership advantage, and Japanese firms want to transplant it to foreign countries.

Yamaguchi (2006) indicates that the mother plant is a key factor of Japanese production system. When a Japanese firm tries to manufacture its own products in foreign countries, it has to transfer its own knowledge to its foreign factories. In this situation, the mother plant functions as a part of tacit knowledge transfer system. Tacit knowledge is much harder to be transferred than explicit knowledge. The mother plant transfers tacit knowledge by sending its skilled workers and teaching foreign workers in the mother plant. And the mother plant also has a role in creating new organizational routines. It supports foreign factories by creating and teaching new organizational routines.

Effectiveness of Knowledge Transfer

Knowledge can both be created inside and acquired from outside. And these knowledge can be a source of firm's competitive advantages (Kogut and Zander, 1993; Darr, Argote, Epple, 1995; Zander and Kogut, 1995; Szulanski, 1995; 1996; 2000; Almeida and Kogut, 1998; Argote and Ingram, 2000; Tsai, 2001; Schlegelmilch and Chini, 2002)

To utilize knowledge, knowledge has to be transferred from its original source to other organizational units. But knowledge transfer is far from easy. There are many barriers to knowledge transfer. Szulanski (1995; 1996; 2000) indicates that there is stickiness in knowledge transfer processes. Stickiness defines as the difficulty of transferring knowledge within the organization.

Kogut and Zander (1993) and Zander and Kogut (1995) explain transfer of knowledge by knowledge's characteristics. They analyzed characteristics of knowledge by codifiability, teachability, and complexity. If the knowledge is much codifiable, easy to teach, and not

complex, that knowledge is less hard to transfer and its transferring speed has to be fast.

Many researches pointed out that efficiency of knowledge transfer and organizational relationship are related. Darr, Argote, Epple (1995) examine transfer of knowledge acquired through learning by doing in service organizations. Knowledge is found to transfer across pizza stores owned by same franchisee. Almeida and Kogut (1998) found that interfirm mobility of engineers and communications influences the local transfer of knowledge. Tsai (2001) focuses on intraorganizational network. It emphasizes that the network of interunit links provides channels for distributing information and knowledge. If A unit positions central network position, it has opportunities to access other unit's knowledge and knowledge transfer will be more activated than others. Schlegelmilch and Chini (2002) also emphasize the link between knowledge transfer and organizational distance.

These researches focus on characteristics of knowledge and organizational relationship. They focused on effectiveness of knowledge transfer, but did not consider about the differences in knowledge transfer. Each organizations have own knowledge and it has different characteristics. And there must be differences in the most suitable way of knowledge transfer.

In this paper, we assume transfer of production system as transfer of knowledge. And we discuss about Toyota and Hyundai motors. By comparing these two we can figure out the differences in production system (knowledge) affect to its transfer process.

3. Production System of Toyota and Hyundai

Toyota Production System (TPS)

Toyota has its own unique production system. Toyota Production System (TPS) has two core concepts. First Just In Time (JIT), Second Jidoka (Ohno, 1978).

JIT is the key concept of TPS. The idea and slogan of JIT was created and advocated by Toyota's famous founder-entrepreneur Kiichiro Toyota. It simply means parts must be supplied just in time when it is assembled. Inventory is waste. To reduce waste (inventory), parts must be arrive just in time. By using this concept, shop floor can reduce its inventory. Kanban system is a method for JIT. In Toyota's plant all inventory is managed by Kanban system. JIT is linked to market demands. Car production is based on market demand (order). TPS is based on pull system.

Jidoka is a concept for machine and automation. In Japanese, Jidoka has same pronunciation with automation. Fujimoto (1999) explains Jidoka is automatic defect detection and machine stop. These were introduced in the late 1960s, according to Ohno. The key feature of Jidoka is that the machine simply stops responding to the defect, which dramatizes the problem and forces human intervention, which in turn triggers a problem-solving cycle by shop floor people resulting in process improvement. Thus, Jidoka is recognized as an

important part of the TPS for effective problem recognition and organizational learning.

Finally continuous improvement of productivity and quality (Kaizen) is also pointed out as a core capability of TPS. Workers of Toyota can discover problems at shop floor. They have right to solve problems by themselves. And these improvements are reflected to routine works.

Hyundai Production System (HPS)

Hyundai also has its own unique production system. Many researches pointed out that production system of Hyundai is similar to Japanese production system. Lee (1994) explains that production system of Hyundai is combination of Fordism and Toyotism. It means Hyundai Production System has both characteristics of Ford production system and Toyota production system. We will explain brief history of Hyundai for understand HPS.

In 1968, Ford and Hyundai Motor signed a contract to produce a car. To produce vehicles Hyundai built a factory in Ulsan, Korea. Technical team of Ford and Hyundai communicated for factory building. Shop order and factory layout and other knowledge for producing has transferred to Hyundai from Ford (Hyundai Motor Company, 1997).

Then, Hyundai Motor developed its own model, and canceled the contract with Ford. Hyundai chose Mitsubishi motor of Japan as new partner. Mitsubishi offered technology of car development, parts, and its manufacturing. Mitsubishi helped to renovate Ulsan plant to produce Hyundai's own model.

In 1996, Hyundai built a new plant. New plant is built in Asan, Korea. Asan plant is different from Ulsan plant in production system. Ulsan plant is affected by 2 companies, Ford and Mitsubishi. But in Asan plant Hyundai tried to benchmark Toyota. They wanted to adapt Toyota production system. Cho (2005) Pointed out that Hyundai benchmarked Kyushu Miyata plant of Toyota for Asan plant.

To understand Hyundai production system, we have to understand these learning processes of Hyundai. HPS is based on Ford and Japanese production systems. But HPS is not imitation of those production systems. It has its own unique characteristics (Oh, 1998; Cho, 2005; Cho and Lee, 2008).

The most important part of HPS is gap between workers and engineers. In TPS workers has very important role in manufacturing floor. Workers do Kaizen and it improves entire production system. But in HPS workers do not have such role. Their roles in shop floor are limited only in routine manufacturing. Workers do not have right to modify their routine work. Also Hyundai prefer automation than human work. In fact, automation rate of Hyundai's plants is high (Oh, 1998; Cho, 2005).

Another important characteristic of HPS is its production plan. As mentioned before, TPS is pull system. HPS is run by push system. Hyundai schedule production based on demand

forecast (Oh, 1998). This is different part from TPS. HPS is optimized for push system.

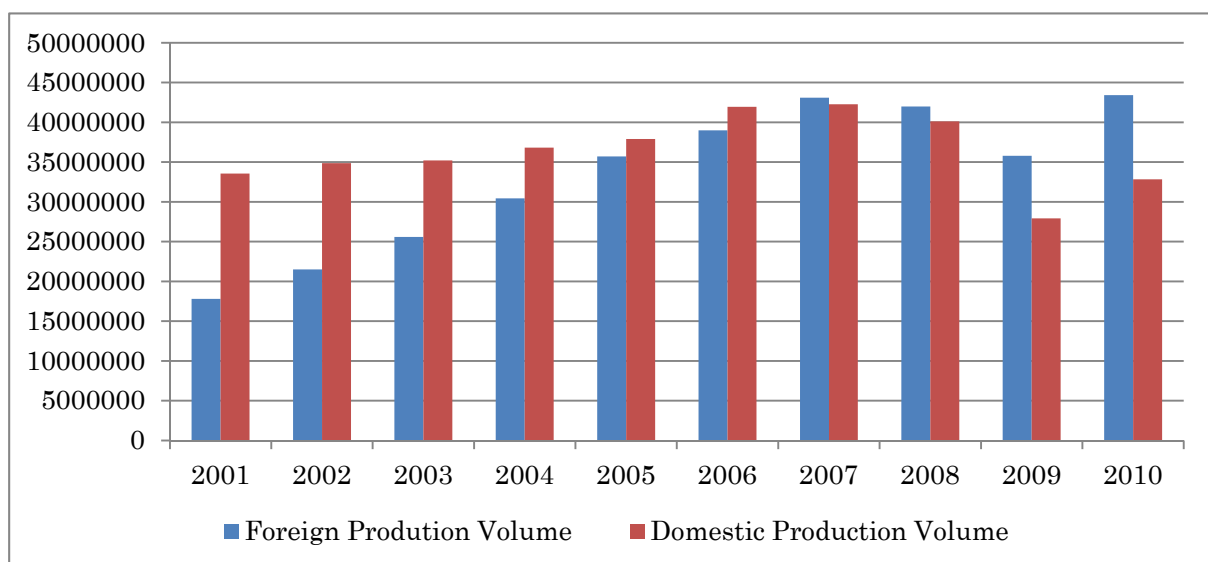
Finally, HPS uses many module parts. Module refers to the integration of multiple parts or components. Modular production refers to the shipment of modules from the module supplier to the automobile assembly plant. By modular production OEM expects to get dynamic ability to respond rapidly and flexibility to handle the complex model mix from the diverse needs and demands of their customers maintaining its cost and quality level (Kang, 2001). There are many module suppliers but the most important supplier is Hyundai Mobis. Hyundai Mobis is affiliate of Hyundai Motor. It supplies Chassis module, front end module, rear end module, bumper module, cockpit module and etc.

4. Transfer of Production System

Rapid Growth of Foreign Production

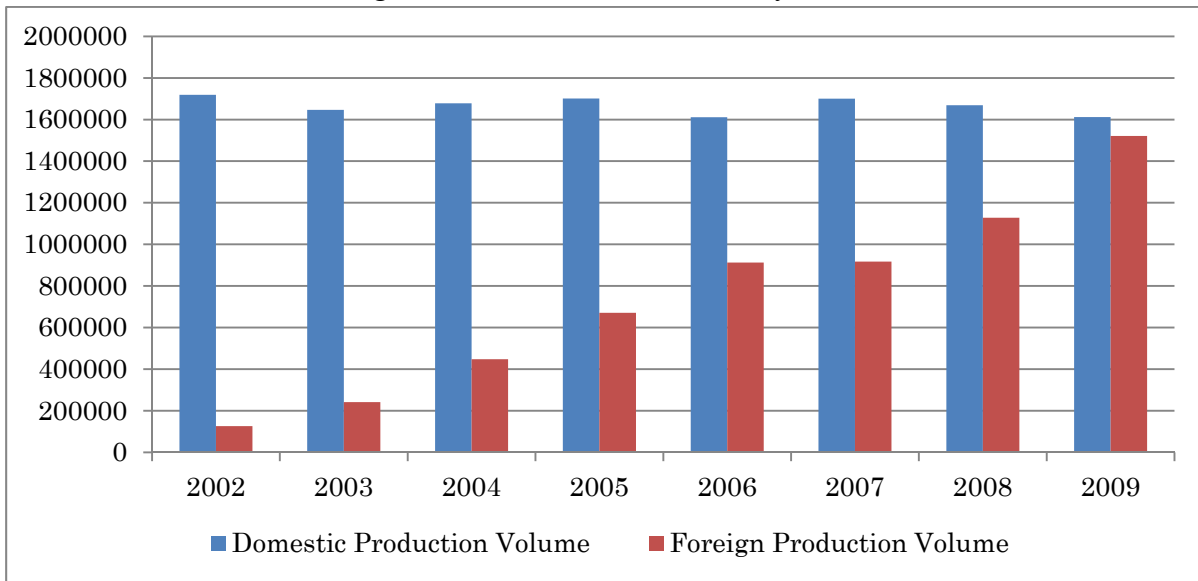
Figure1 represent for domestic and foreign production of Toyota. After 2000's, production in overseas grew rapidly. Figure1 shows Toyotas Production Volume of domestic and foreign sites. Foreign production volume grows fast after 2001 and it overgrows domestic production volume in 2007. With growth of production in overseas, numbers of foreign factories grew too.

Figure1. Production Volume of Toyota



Source: <http://www.toyota.com>

Figure2. Production Volume of Hyundai



Source: <http://pr.hyundai.com>

In figure 2 Hyundai has same situation. Foreign production volume grew rapidly. In this situation, foreign plants grow rapidly in numbers and volume. And transfer knowledge of production to foreign plant became important factor for competitive advantage.

Transfer of Toyota Production System

We focus on three parts of Toyota's system, the mother plant, Operations Management Consulting Division (seisan chosa shitsu) and Global Production Center(GPC).

When Toyota build foreign factory, they choose Japanese plant to support it. Not only support for launching foreign plant, but also support for daily manufacturing. Supporting Japanese factory is called 'mother factory' of 'parent plant'. In this paper we call this system as 'mother plant system'. Mother plant is a key factor of Toyota's knowledge transfer system.

Mother plant has 5 roles for supporting foreign plant. First launching support; second new model manufacturing support; third skill training; fourth kaizen; and finally problem solving support. These kinds of mother plant's support are done by humane transfer. Supports are done by sending mother plant's engineers and workers to foreign plant or by accept foreign plant's engineers and workers at mother plant. These kinds of mother plant's support are done by humane transfer.

Operation Management Consulting Division (OMCD) is an organizational unit unique to Toyota. It established in 1970 by Taiichi Ohno as a staff office in the Production Control Division. It has been in charge of maintaining, diffusing and educating employees about the Toyota Production System (TPS) both inside Toyota and at Toyota Group parts suppliers (Fujimoto1999).

Its current mission can be broken down as follows: educating employees about TPS, implementing TPS principles on the shop floor in collaboration with TPS instructors (shusa) who belongs to each plant, participating in “voluntary problem solving studies (jishu-ken)” by the plants or by the suppliers, diffusing and educating employees about TPS to foreign subsidiaries and plants. OMCD has a role for maintaining, diffusing and educating TPS not only in domestic sites, but also foreign sites.

Global Production Center (GPC) is established in 2003. Establishment of GPC is deeply related to growth of foreign production. Toyota’s production volume in 2003 was 6millions. Toyota planned to increase its volume to 10million till 2010. It means Toyota has to increase 4millions in 8 years. And it depends mainly on foreign production. When Toyota increases its production volume in overseas, many problems have been occurred.

GPC has established to solve these problems. GPC has 2 roles. First, it develops tool for training of human resources of domestics and foreign. Second, it reduces the time of switching new model. We focus on GPC’s role in Toyota’s global knowledge transfer system.

GPC is located in Japan, but there are sub unit of GPC in Toyota’s regional headquarters. Toyota has 3 regional headquarters, America, Europe (England), Asia (Thai). Each regional head quarter has its own sub unit of GPC. Master trainers in regional GPC train trainers and send them to regional foreign plants. But these Master trainers of regional GPC are trained in GPC of Japan. Also regional GPC has its own pilot line for preparing new model’s production, but it only be used for regional models.

Transfer of Hyundai Production System

When Hyundai try to build foreign plant, the base is Asan plant. Basically Hyundai wants to replicate Asan plant to overseas. Asan plant offers the concept of production. But Asan plant is not a mother plant.

As mentioned before, mother plant’s support are done by humane transfer. Workers and engineers are transferred and knowledge embedded in human can be transferred. But in Hyundai’s transfer of knowledge humane transfer is limited. Hyundai transfer its engineers and managers to foreign plants but transfer of workers are limited.

Suh (2012) explained about HPS and the case of Beijing Hyundai Motor Company (BHMC). It explains knowledge transfer of Hyundai from Korea to China. Production knowledge transferred from Hyundai’s Asan plant to BHMC’s Beijing plant. Knowledge transfer is done by managers and engineers. Transfer of workers and their knowledge is highly restricted.

It also pointed out the reason of limitation of transfer of workers is the labor union environments. Hyundai has considerably strong labor union. So it is hard to run production flexible. HPS has very rigid shop floor organizational culture in Korea. Hyundai wanted to

run flexible shop floor in foreign plants. By limiting transfer of workers Hyundai also can limit influence of rigid shop floor organizational culture.

Instead of transfer of workers, working manual is key factor in transfer of HPS. Working manual is created by engineers in Korea and transferred to overseas. In foreign plant engineers use working manual to teach workers. Production knowledge of Hyundai codified in working manuals and transferred. But knowledge embedded in workers cannot be transferred.

Transfer of Module parts supplier is also important part of transfer of HPS. Module parts system is very important factor in HPS. And hence transfer of module parts supplier is essential for production of foreign plants.

5. Conclusion

We discovered Toyota and Hyundai have a different way of knowledge transfer. That difference is come from differences in characteristics of knowledge. A firm has its own knowledge. Unique knowledge of the firm can be source of competitive advantage. Effective knowledge transfer to foreign country is linked to competitive advantage of overseas. Former researches explain about effectiveness of knowledge transfer but they did not mention about differences in way of knowledge transfer. In this paper we compared knowledge transfer of Toyota and Hyundai. They have different way of knowledge transfer because they have different production knowledge. Each company has their own optimal way of knowledge transfer. But it is hard to find optimal way. Trials and errors are needed for finding optimal way. Knowledge transfer of Toyota is based upon humane transfer; on the other hand knowledge transfer of Hyundai is based upon codified knowledge and it limits humane transfer.

Differences in knowledge transfer are linked to history and environments. Toyota and Hyundai have their unique production system because they developed their production system in different environmental and historical backgrounds. For instance, the concept of JIT is developed from the situation of resource shortage after World War 2. And Hyundai's gap between workers and engineers came from the labor environments of Korea. Further studies about link between differences in knowledge transfer and environmental, historical backgrounds are needed.

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