

Transferring Production Systems: An Institutional Account of Hyundai Motor Company in the United States

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*Our goal in this article is to explain how South Korea's Hyundai Motor Company successfully transferred its production system to the United States. When a production system is transferred to another country, it is modified under the influences of different institutional environments. The key to the success of Hyundai Motor Manufacturing Alabama, Hyundai's transplant in Montgomery, Alabama, is found in Hyundai's relatively low dependence on skill formation and high reliance on numerical flexibility of its production system relative to its Japanese counterparts. While Japanese automakers had difficulties transferring their production system to their US transplants, Hyundai did not because its production system did not require highly skilled labor. Alabama's flexible labor market and the absence of labor unions enabled Hyundai to more efficiently utilize the numerical flexibility of production workers than was possible at its original plant in Korea, which suffered from adversarial labor relations. This case study casts doubt on the convergence model of technology and globalization, because it shows varieties of production systems developing under different institutional environments. **KEYWORDS:** institutionalism, Hyundai Production System, Japanese Production System, transferability, US transplant, skill formation, labor market, labor relations*

WHILE THE BIGGEST US AUTOMAKERS WERE BEING BAILED OUT BY THE US government and Japanese car sales were shrinking in the recession-hit US market, Hyundai Motor Company (HMC), South Korea's biggest carmaker, expanded its sales volume as well as its US market share in 2009 (*Economist* 2009). Hyundai was not only selling cheap cars at the lower end of the market but also attracting US consumers with middle-range and even luxury vehicles. Behind the success of Hyundai's sales is Hyundai Motor Manufacturing Alabama (HMMA), its US transplant located in Montgomery, Alabama. This transplant initially produced the

Sonata, a midsize sedan, in 2005, then added the Santa Fe, a midsize sports utility vehicle (SUV), in 2006. The Montgomery plant manufactured 251,000 and 238,000 units of these two models in 2007 and 2008, respectively.

HMMA's remarkable success in the US market seems to be supported by the outstanding quality of cars it produces. The success of HMMA is astounding because it has risen to one of the highest-ranking automakers in the United States in terms of productivity and quality within a short period of time. The Harbour Report ranked HMMA second in productivity among North American auto plants in 2008 (*WARD'S Auto World* 2009). *Consumer Reports* has reported exceptional consumer satisfaction with Hyundai cars. In 2009, the publication recommended the Sonata and the Santa Fe to consumers because of the models' reliability and safety. Various automobile quality ratings, such as the initial quality study (IQS) and the vehicle dependability study (VDS), have put Hyundai cars at top levels (J. D. Power and Associates 2009).

It has often been argued that only Japanese automakers, with their lean production system, can successfully operate their transplants in the United States. Although a couple of European automakers successfully established their transplants in the United States, they were specializing in luxury vehicles. Hyundai is the first non-Japanese automaker not focusing on luxury cars that has successfully established its transplant in the United States.

As Japanese transplants in the United States successfully increased their production and penetrated the US market starting in the 1980s, proponents of lean production argued that every automaker should adopt the Japanese lean production system in order to survive increasing global competition. One could argue that the success of Hyundai's transplant in the United States was possible because Hyundai has adopted a lean production system. These differences raise the question of whether the success of such transfers has to do with corporate strategy alone or with complementary features of the environment in which firms operate.

While the lean production theory predicts the convergence of production systems, the institutionalists have argued for continuing divergence of production systems. Also, the institutionalists have claimed that a production system cannot easily be adapted to distinctive circumstances around the world. They emphasize that even the Japanese transplants faced difficulty of transferability in other countries.

Given the inherent difficulty of transferring a production system to another country with different institutional environments, HMMA's outstanding performance is surprising. In particular, HMMA shows no less

superior productivity than HMC's original plants in Korea. In some aspects, HMMA has achieved even more efficient operation than the original plants. Also, it took little time for HMMA to achieve that level of productivity. HMMA achieved high productivity from the first year of its operation. Considering that Japanese automakers' transplants in the United States initially had difficulty reaching the level of productivity at their original plants, HMMA's performance is remarkable.

Our goal in this article is to explain how Hyundai has succeeded in transferring its production system to the United States. Our analysis shows that institutionalist perspectives are useful for addressing these questions. We call the unique production system that Hyundai has developed in Korea the Hyundai Production System. This system had characteristics that were easier to transfer to circumstances in the United States, in particular Alabama, than those of the Japanese lean production system. Hyundai has developed a unique production system that depends much more on technological flexibility and less on production workers' skill, while the Japanese Production System is more dependent on a skilled work force. We find that Hyundai's production system was easily transferred to the institutional environment of the US South. In particular, Alabama's flexible labor market and the lack of adversarial labor relations enabled HMMA to more efficiently operate its work organization than at the original plants in South Korea, which suffered from a hostile relationship between management and labor.

In the article, we first review the literature on transferability of production systems and lay out our analytical framework. Then we confirm the success of HMMA in terms of productivity and quality, compared to its original plant in Korea. Subsequently, we examine how the Hyundai Production System has developed in Korea since the mid-1970s and what its unique characteristics are. We then systemically explore how the Hyundai Production System was modified under different circumstances in the United States in terms of location and labor relations, compared to the original plants in Korea. We also compare the characteristics of HMMA with those of the early Japanese transplants. In the final section, we summarize our key findings and discuss some theoretical and practical implications of this study.

Analytical Framework

Research on Japanese transplants in the United States can be classified into two main theoretical perspectives. Scholars in the first group have emphasized the universality of the "lean production" paradigm. They

suggest that only the automakers that have adopted a lean production system can survive, and they predict the convergence of production systems. In the convergence model, learning is possible even in very different institutional environments.

These scholars noted the successful transfer of Japanese transplants to the United States. For them, there was no insurmountable national institutional barrier to adopting the Japanese lean production system in the United States, although firm-specific barriers might have operated in any given case. Some (Womack, Jones, and Roos 1990) showed that the performance of Japanese transplants was superior to that of the Big Three US automakers. Others (Pil and MacDuffie 1999) also argued that Japanese transplants were able to achieve productivity and quality levels similar to those in their original plants in Japan.

The lean production system is not a strictly defined concept that can be distinguished by objective criteria. It is typically defined as a production system that uses less of everything, which is contrasted with the mass production system (Liker 1998, 43).¹ The lean production system minimizes waste and is flexible and changeable on the shop floor. Thus, lean production means efficient and flexible production. The adoption of lean production was not only something that the Japanese were able to implement in the United States but one to which US firms also adjusted.

Researchers in the second group emphasize the varieties of production systems under different institutional environments. Institutionalists argue that there are national barriers to adoption of a particular production system and that automakers' production systems are formed differently under different institutional environments. These differences would show up in failed transfer attempts: transfers do not work because the local institutions cannot adapt. Or they would show up as US failure to adopt the Japanese system or to make it work effectively. Indeed, these scholars point out the failure or difficulty of transferability that most Japanese transplants encountered in the United States.

Institutionalists such as GERPISA (Permanent Group for the Study of and Research into the Automobile Industry and Its Employees) have claimed that the Japanese Production System cannot easily be adapted to distinctive circumstances around the world (Freyssenet et al. 1998). Their theory is that even when the Japanese Production System is transferred to another country, its original characteristics will be modified. Carl Dassbach (1994) shows that Japanese transplants failed to recreate the similar work environment on the shop floor. As a result, they could not ensure Japanese levels of productivity and quality in the United States.

The early Japanese transplants in the United States showed a lower level of productivity: 30 percent more hours per vehicle (Krafcik and MacDuffie 1989) and 10 percent shorter operating time (Shibata 2001, 234) on average than their original plants in Japan.

Laurie Graham (1993) questions the successful transfer of the Japanese model in her case study of the Japanese transplant, Subaru-Isuzu Automotive (SIA), where worker resistance emerged in the form of sabotage, protest, and confrontation. Matthias Holweg (2006) shows that a few cases of Japanese transplants, especially joint ventures with US automakers such as NUMMI (joint venture of Toyota and GM), located in California, and Diamond Star (joint venture of Mitsubishi and Chrysler), located in Illinois, faced considerable difficulties in overcoming the old practices of mass production in the United States.

While institutionalists stressed the difficulty of transferring production systems under the influence of different environments, and significantly modifying them during transfer, most Japanese automakers have succeeded in transferring their production systems to the United States. We recognize that the overall performance of Japanese transplants in the United States has been successful, although their labor conditions and supply relations have worsened (Liker 1998).

In this article, we focus on the importance of different institutional environments, particularly labor markets and labor relations. However, unlike the previous institutionalists who have uniformly argued for difficulty of transfer, we propose that transferability of a production system that developed in a specific country to another country depends on the specific complementarity or lack of complementarity between the characteristics of the production system and the institutional environment of the host country.

A production system can be defined as a sociotechnical system that performs its production efficiently (Susman and Chase 1986). A production system is composed of two main factors: the technological factor and the human factor. A production system functions optimally only if the two factors can meet each other's demands and the demands of the environment (Pasmore et al. 1982, 1182). While the key technological factor is production technology, the key human factor is the skill formation and organization of workers (Stevens 2008). The characteristics of a production system are determined by the way in which an automaker combines the technological factor with the human factor under specific circumstances.

The Hyundai Production System belongs largely to the broad lean production system, which is defined as a production system that mini-

mizes waste and is flexible and changeable on the shop floor (Liker 1998). The Hyundai Production System is clearly distinguished from the traditional US (mass production) system, because the work organization as well as the production technology of the Hyundai Production System is flexibly utilized to quickly respond to the changes in market demand. In contrast, US automakers have generally failed to raise the flexibility of its production system to compete with foreign automakers, even though they have introduced leanness to some extent. In the production technology, HMC operates a flexible production system that produces several models on one production line, while traditional US automakers operate a mass production system that produces one model on one production line. HMC also utilizes its work organization more flexibly than do traditional US automakers.²

Although both Hyundai and Japanese automakers have achieved high flexibility of production as they respond to changing demands, they have developed quite different production systems. In Table 1, we contrast the Hyundai Production System with the Japanese Production System. Whereas Japanese automakers have achieved flexibility of production through specialization of the labor process based on shop floor-oriented automation, Hyundai's flexibility relies on standardization of the labor process based on engineer-led automation.

Flexibility of production technology, which can arrange the ratio of its product mix or the production volume of each product, requires flexible automation of production processes. Flexible automation can be classified into "engineer-led automation" and "shop floor-oriented automation." In engineer-led automation, the engineers adopt state-of-the-art technology to enhance the flexibility of production with minimal worker participation. In contrast, shop floor-oriented automation emphasizes active participation of workers on the shop floor.

The flexibility of production technology should be matched by the skill formation of production workers. The skill formation of workers can be achieved by either "standardization" or "specialization" of labor

Table 1 The Hyundai and Japanese Production Systems

	Hyundai Production System	Japanese Production System
Technological factor	Engineer-led automation	Shop floor-oriented automation
Human factor	Standardization of labor process	Specialization of labor process

processes (Kim 2009). Standardization means that the labor processes of a plant are standardized into simple and repetitive tasks. As the standardization progresses, skill becomes less important and workers become easily interchangeable. Specialization, which means that a plant's labor consists of diverse kinds of specialized jobs, requires a high level of firm-specific skill formation. Skilled workers must have problem-solving abilities to respond to "changes" or "abnormalities" on the production line (Koike 2002). As workers upgrade their skills, they can then be transferred to different activities and tasks within a company. Hyundai's production system relies on engineer-led automation that utilizes state-of-the-art technology, but it is less dependent on high levels of skill and active participation of production workers. Workers can easily take the place of other workers (Lee and Jo 2007). Conversely, the Japanese Production System heavily depends on high levels of skill and active participation of production workers. In addition, it encourages the positive contribution of workers to enhance the flexibility of production technology, maximizing the man-machine interface (Abo 1994).³

The differences in the labor processes of Hyundai and Japanese production systems are manifested in the frequency and range of job rotation. Hyundai does not manage job rotation within a team, while Toyota systemically does so. Hyundai workers irregularly rotate their jobs, while Toyota workers regularly rotate their jobs every two to three hours (Chung 1995, 128).

We now explain, from an institutionalist perspective, how a production system formed in one country is modified under different institutional environments in another country. As Tetsuo Abo (1998) argues, during the transfer process of a production system, the technological factor is less modified than the human factor. This is because most production technology, which is composed of hardware such as machines and equipment, cannot be easily changed. If the maintenance function works well, the production technology can be easily transferred to another country.

The human factor is more complicated, because automakers need to recruit and train new employees in very different environments. In particular, the skill formation system must often be drastically modified by the influence of different labor markets and labor relations. Jamie Peck (1992) demonstrated that in the choice of industrial location, the labor factor plays a central role among other environmental factors. He argues that "firms' labor adjustment strategies are formulated within the confines of ongoing imperatives of labor control" (Peck 1992, 342), which are in turn affected by institutional factors in the host country.

We regard skill formation as central in considering the human factor of a production system. We explore here how different labor market and labor relations institutions in Korea and the United States have influenced Hyundai's strategies of skill formation and work organization, such as recruitment, training, and flexible use of labor in its original plants in Korea and its transplant in the United States, more specifically in Alabama.

For this study, we conducted a field survey of HMMA twice. First, we visited HMMA for the preliminary survey on October 23, 2007. Second, we visited HMMA to conduct the main survey during the period July 13–17, 2009, at which time we met with HMMA workers, supervisors, managers, and executives and listened to their different perspectives. See the Appendix for the details of the field survey. In addition, we communicated with the managers at HMC headquarters and HMMA by e-mail and telephone.

The Performance of HMMA

Since the purpose of this article is to explain the successful transfer of the Hyundai Production System to the United States, we are primarily interested in the performance of the Montgomery plant in terms of productivity and quality rather than Hyundai's marketing. *Harbour Report* measures the labor productivity of assembly plants by hour per vehicle (HPV). HPV is defined as the number of working hours to be used to assemble a vehicle (Wyman 2008–2009).⁴ The HMMA plant's productivity for the Sonata was ranked fourth among the midsize sedan plants in North America in 2007. Also, the productivity of the HMMA plant for the Santa Fe received good evaluation among midsize SUV plants in North America in the same year (Wyman 2008–2009). Overall, *Harbour Report* ranked HMMA second in productivity among North American auto plants in 2008 (*WARD'S Auto World* 2009).

While productivity is very important for the profitability of automakers, vehicle quality is critical for consumer choice. The high quality of Hyundai cars that were produced in the Montgomery plant was confirmed by *Consumer Reports*. In the midsize sedan segment, which is considered the most competitive in the US market, Hyundai's Sonata, produced by HMMA, received favorable evaluation among recommended vehicles in terms of owner satisfaction, reliability, and owner costs. The overall score for the Sonata was among the highest, along with a few recommended Japanese cars. The Santa Fe, Hyundai's midsize SUV produced by HMMA, also received positive evaluations among the recommended vehicles (*Consumer Reports* 2009).

Considering that HMMA started its production of the Sonata and the Santa Fe in 2005 and in 2006, respectively, these performances are very impressive. Thus, we confirm that HMMA's performance advanced it to a position as one of the top automakers in the United States. HMMA demonstrated exceptional performance in terms of vehicle quality as well as labor productivity.

More important, HMMA's performance in terms of productivity and quality is no less than that of the original plant in Asan, Korea. Easily adapting to the circumstances in the United States, the HMMA plant succeeded in reaching the performance level of the Asan plant in a short period of time. We have selected Asan as the "original plant" in Korea, because not only is Asan the newest HMC plant, it is also considered to be HMMA's archetype.

Table 2 shows the outline of the HMMA plant, compared to the original Asan plant. The production capacity of HMMA is the same as that of the Asan plant. HMMA operates its plant for twenty hours per day during the daytime and nighttime shifts—the same as at the Asan plant. The differences in the volume of production, which represent differences in market demand and not degree of efficiency, are not significant.

Table 3 compares the performance of the HMMA plant with that of the Asan plant. Even though the HMMA plant started its production ten years later than the Asan plant, HMMA's performance level is no less than that of the Asan plant. The success of HMMA can be strongly attributed to the human factor in the production system as compared to the Asan plant.

Table 2 Outline of HMMA Plant, Compared with Original Asan Plant

	HMMA Plant (Montgomery, AL, United States)	Original Plant (Asan, Korea)
History of assembly plant	Opened in 2005 Production: 251,000 in 2007 238,000 in 2008	Opened in 1996 Production: 297,000 in 2007 261,000 in 2008
Plant operation	Products: Sonata and Santa Fe Production capacity: 300,000 units/year (63 UPH) 2 shifts (day and night) 20 hours/day	Products: Sonata and Grandeur Production capacity: 300,000 units/year (63 UPH) 2 shifts (day and night) 20 hours/day
Employees composition	Hourly workers: 2,200 Salaried employees: 520 (expatriates 71)	Hourly workers: 2,200 Salaried employees: 600

Source: Hyundai Motor Company 2009.

Note: UPH (units per hour) is the number of vehicles that are assembled in an hour in a plant.

Table 3 Performance of HMMA Plant, Compared with Original Asan Plant

	HMMA Plant (Montgomery, AL, United States)	Original Plant (Asan, Korea)
Wage (2008)	\$55,000 per year	\$54,800 per year
Number of irregular workers (2009)	81 (344 before the economic crisis)	950 (almost the same as before)
Allocation ratio ^a (2009)	91%	68%
Productivity (UPH) ^b (2010)	70	63
Productivity (HPV) ^c 2006	24.8	19.9
2007	20.6	19.7
2008	20.7	19.5
2009	19.9	19.3
Quality (sign-off ratio) ^d (2009)	96.0%	95.6%

Source: Hyundai Motor Company 2010.

Notes: a. Allocation ratio is the relative ratio of net assembly working hours out of total assembly working hours by production workers at the assembly plants.

b. UPH (units per hour) is the number of vehicles that are assembled in an hour in a plant.

c. HPV (hours per vehicle) is the index of plant productivity, which means the number of hours spent to assemble a car in a plant.

d. Sign-off ratio is the aggregate index calculated by multiplying acceptable rates at the four inspection spots: assembly line, final test, waterproof test, and ore-shipping test.

The production workers at HMMA received an average wage of \$55,000 in 2008, which was only slightly higher than that of the workers at the Asan plant (\$54,800) in the same year. However, the wage level at HMMA will be capped by the fixed-wage system, which permits only an inflation adjustment. The wage level at the original plant, by contrast, permits increases based on the seniority wage system. Considering the differences in compensation systems between these two plants, the wage level at HMMA will actually soon become lower than at the original plant.

Responding to the economic crisis since 2008, HMMA reduced the number of irregular workers from 344 to 81, while the Asan plant had to maintain the number of irregular workers at the same level as before the crisis. This demonstrates the high level of numerical flexibility in HMMA as compared to the Asan plant.

Allocation ratio is an index that shows the degree of effectiveness of worker allocation on the production line. In terms of allocation ratio, HMMA astonishingly shows a top level of efficiency (91 percent), while Asan shows a lower level of efficiency (68 percent). Considering that the automation rates are similar, the differences in allocation ratios are very significant.

To compare the productivity between auto plants, indexes of units per hour (UPH) and HPV are used. In the UPH index, which denotes the number of vehicles assembled in an hour, the level of HMMA (70) is higher than that of the Asan plant (63). In the HPV index, the level at HMMA (19.9) is similar to that at Asan (19.3). The gap between HMMA and the Asan plant has been decreasing since HMMA opened its plant in 2005. These indexes of productivity are astounding, because HMMA produces both a passenger car (Sonata) and an SUV (Santa Fe), while the Asan plant produces only passenger cars (Sonata and Grandeur).

In the sign-off ratio, which shows the final quality level of vehicles produced in a plant, HMMA (96 percent) is slightly higher than the Asan plant (95.6 percent). This means that the effectiveness level of the quality system at HMMA has surpassed that of the Asan plant.

In summary, HMMA improved its performance level to essentially equal that of the Asan plant in a short period of time. HMMA demonstrated an outstanding performance in terms of vehicle quality as well as labor productivity. This achievement of HMMA means that Hyundai succeeded in transferring its production system to the United States through effective management of the human factor in very different circumstances.

We note that HMMA's rapidly reaching the same, or even higher, level of productivity as its original plant in Korea is significant compared with the early Japanese transplants, which showed lower levels of productivity than achieved at their original plants in Japan. John Krafcik and John MacDuffie (1989) showed that the average Japanese transplant required 30 percent more hours to assemble a vehicle than did the average Japanese domestic plant at the initial stage of production. Hiromichi Shibata (2001) also showed that the operating rate of the production line at a Japanese transplant was lower by more than 10 percent than that at its original plant in Japan. He found that differences in the troubleshooting and maintenance skills of production workers were the main cause of this performance gap (Shibata 2001, 234).

James Womack and his colleagues showed that Japanese transplants achieved success in a short time. However, what they meant was that the performance of early Japanese transplants was superior to that of the Big Three US automakers. In fact, they admitted that in the late 1980s, the performance of Japanese transplants in North America was inferior to that of the original plants in Japan in terms of productivity and quality (Womack, Jones, and Roos 1990, 85–86). Another study also suggested that Japanese transplants in the United States had had much less success than was previously thought (Fairris and Tohyama 2002, 529).

Kazuhiro Mishina's study also provides evidence of difficulty in early Japanese transplants by showing lower levels of utilization than in their original plants. Among the Japanese transplants, Diamond-Star (Mitsubishi) struggled, using only half of its capacity, during 1993. Subaru-Isuzu also struggled at about two-thirds of its capacity. Nissan and Mazda were in slightly better shape, utilizing roughly three-quarters of their capacity. Toyota, along with Honda and NUMMI, achieved 80 percent utilization, reaching what is normally a very profitable range (Mishina 1998, 107).

However, we do not mean that Toyota and other Japanese automakers have been unsuccessful in the United States. Nor do we mean that Japanese transplants are underperforming more than HMMA in the United States. What we mean is that early Japanese transplants were generally less efficient than their original plants in Japan, while HMMA quickly achieved a higher level of efficiency than its original plant in Asan, Korea.

The Formation of the Hyundai Production System

The Hyundai Production System is a deviant of the Japanese lean production system (Lee and Jo 2007). In this section, we describe how HMC developed its unique production system under the distinctive institutional environment in Korea, even though it tried to adopt the Japanese Production System.

Beginning in the mid-1970s, HMC engineers tried to imitate the Japanese Production System, which was regarded as best practice in the auto industry. The know-how of plant operation heavily depended on the guidance of former engineers who used to work for Japanese automakers. One who played a crucial role in developing the Hyundai Production System was Seiyu Arai, former senior engineer for Mitsubishi, who had been taught by Ohno Taiichi, founder of the Toyota production system. Arai taught the engineers of HMC how to adopt elements of the Japanese Production System. He stressed the elimination of superfluity, imbalance, and irrationality on the shop floor (Kang 1986).

Why, then, did the characteristics of the Hyundai Production System evolve differently from those of the Japanese Production System? What factors have influenced Hyundai's development of a unique production system?

To understand the characteristics of the Hyundai Production System, we need to consider the institutional environment during the 1970s and 1980s in Korea. While the Korean labor market—characterized by seniority wage and lifetime employment similar to Japan's—was favorable for developing firm-specific skills, HMC did not put much emphasis on developing such skills among production workers. HMC management

did not require advanced skill levels from production workers because the quality level of the main products made by HMC was not very high at the time. The competitiveness of Hyundai's early cars relied on low prices rather than high quality, and HMC basically maintained a mass production system despite adopting some elements of lean production.

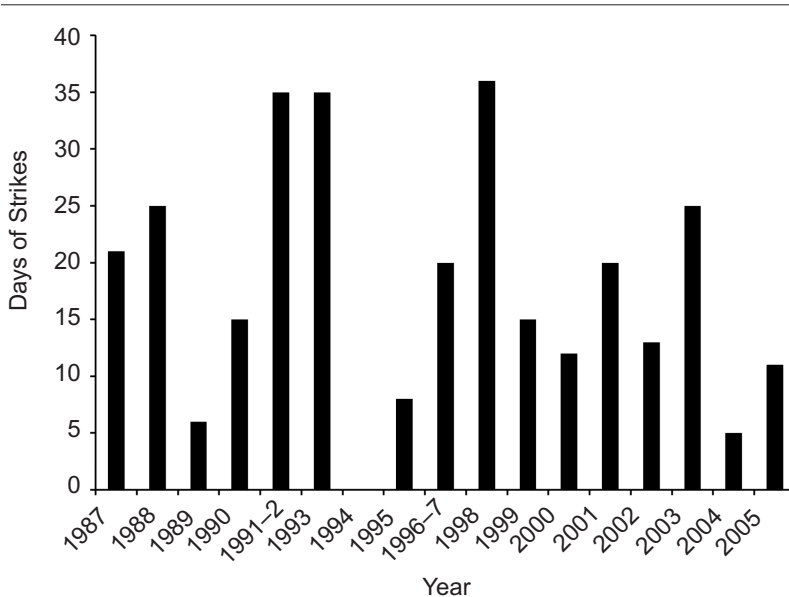
Korean employers were aided by the authoritarian government's labor control policy and were therefore able to impose low wages and harsh working conditions on workers. Therefore, the employers did not have incentives to develop corporate welfare, and labor turnover rates were relatively higher than in Japan. High labor mobility further discouraged both employers and workers to invest in firm-specific skills in the Korean labor market. The Korean government also played a far more active role in training semiskilled and skilled workers than the Japanese government did in the early period of industrialization. The authoritarian government set up vocational training institutions to supply semiskilled workers, thereby reducing the need of firms to invest in firm-specific skills (Song 2008).

As HMC attempted to produce vehicles of higher quality and respond to the changing demand of the market, it tried to develop firm-specific skills among production workers. In the early 1990s, HMC developed a plan, called the Skill Qualification System, to systematically develop the skills of production workers (Jo 2005). However, HMC gave up the plan, because it could not expect vocational training to produce positive effects under the hostile labor relations that developed after the democratic transition in 1987.

As shown in Figure 1, HMC has experienced production line shutdowns due to strikes almost every year beginning in 1987, when Hyundai workers organized a militant labor union during the Korean democratic transition.⁵ HMC has been unable to keep wages low and has failed to attract participation on the shop floor because of workers' resistance. Because HMC's management did not anticipate worker participation, it has not actively invested in worker training.

Also, the labor union has prevented management from utilizing labor flexibly and adopting performance-based human resource management (HRM) practices, given its deep distrust of management. This is a main reason why HMC has preferred state-of-the-art technology over the active utilization of workers. In this aspect, the flexible automation of HMC can be characterized as a "labour-exclusive approach" (Lee and Jo 2007).

In the mid-1990s, HMC opened the Asan plant, located in the mid-western part of Korea, to free itself from the hostile labor relations that dominated the existing Ulsan plants, located in the southeastern part of the country. Asan was a greenfield plant where the production workers had no experience with labor unions (Lee 2003). A greenfield plant is a

Figure 1 Number of Strike Days per Year at Hyundai Motor Company, 1987–2005

Source: Institute for the Development of Industrial Relations 2007.

Note: The strikes in 1991 and 1996 were extended to the next year.

plant erected on a previously underdeveloped site, in contrast with an extension or conversion of an existing plant (Black 1997, 203). However, the labor practices at the Asan plant were assimilated into those of the Ulsan plants within a few years, because the production workers who belonged to the same corporation could easily communicate with each other, and unions spread to the new plants.

When the labor market became more flexible in Korea after the financial crisis in the late 1990s, HMC's need for skill formation again decreased, because the substitutability of production workers began to rise. HMC has fulfilled a high level of flexible production, utilizing production workers with general skills combined with state-of-the-art technology led by engineers.

It is notable that HMC adopted an "independent model" strategy, compared to other automakers in developing countries. In the early 1970s, when HMC's early attempt to modify the Cortina—a Ford car model—for the domestic market failed, the company kept developing its

own models independently. The Korean government supported this strategy by subsidizing the efforts of domestic automakers to localize their parts (Hyundai Motor Company 1997). HMC's independent model strategy led by engineers has contributed to the company developing its own production system. The homogeneous market, which the Korean government protected from competition with foreign vehicles, gave HMC an opportunity to produce its models on a large scale. After HMC fulfilled its "economies of scale" on the domestic market, it extended its scope into export markets.

The flexible production system was an ambitious goal for HMC engineers, who aimed to catch up with advanced automakers in Japan and the United States. By advancing the flexible production system, HMC is able to produce two or three models on each production line in all its plants. As the proportion of exports increases, it becomes even more important to have production system flexibility that can respond to changing market situations (Lee and Jo 2007). The high performance of the Hyundai Production System, in terms of productivity and quality at the plant level, shows that the efforts of these engineers have been largely successful, even though HMC is a latecomer to the world auto industry (Jo 1993).

During the last several decades, HMC has developed a unique production system that is clearly contrasted with the Japanese Production System. In the Hyundai Production System, skill formation is of only secondary importance. In the HMC plant, most production workers are semi-skilled and can be easily substituted with other workers. Their jobs consist of repetitive actions on the shop floor. In this context, the human factor of the Hyundai Production System is characterized by the standardization of labor processes. The work organization is rigid so that it cannot respond to changing market demands. A small number of skilled supervisors and maintenance workers are supplementing the limited capabilities of semiskilled workers, who have few incentives to actively improve the productivity and quality of the labor processes (Committee 2008).

In summary, we characterize the Hyundai Production System as a combination of "engineer-led automation" in the technological factor and "standardization of labor processes," which has become less dependent on the skill formation of production workers. Even though the participation of workers has not been promoted well, HMC has succeeded in upgrading its status in the world's auto market by heavily depending on the engineer-led flexible production system to respond to changing market situations. Table 4 outlines the formation of the Hyundai Production System.

Table 4 Formation of the Hyundai Production System in Korea

	Predemocratization	Postdemocratization
Institutional environments	Seniority wage system; lifetime employment; repressive labor relations	Seniority wage system; flexibilization of labor market; hostile labor relations
Production system	Mass production system; engineer-led automation; standardization of labor processes	Flexible production system; engineer-led automation; flexible standardization of labor processes

Transferring the Hyundai Production System to the United States

HMC was previously indifferent toward overseas production due to its failure to manage the Bromont plant in Canada in the early 1990s. The failure of the factory was attributed to poor products and its human resource management policy (Yanarella 2007).⁶ However, as the volume of its exports to the US market increased, HMC decided to construct the HMMA transplant. This US transplant, built in Montgomery, Alabama, in 2002, started its operation in 2005. First, we examine the reasons why HMC chose Montgomery for the plant. Second, we examine how the Hyundai Production System was modified under the influence of the institutional environment in Alabama and how that environment contributed to the plant's success.

Location Decision and Plant Construction

HMC's decision to construct a transplant in the United States was not made easily because of its past failure to manage the Bromont transplant in Canada in the early 1990s. However, as the fifth largest auto exporter to the United States in the early 2000s, HMC needed to prepare for possible trade conflicts or exchange rate fluctuations that might take place in the near future. HMC also wanted to change its image as a cheap carmaker by producing the Sonata and the Santa Fe in its US transplant. The prices of these two models ranged from \$18,000 to \$30,000 (Hyundai Motor Company 2009).

The most important reason for HMC's decision to locate its transplant in Alabama was the labor factor. HMC was afraid of locating its plant in the Midwest "rust belt," where the influence of the United Auto Workers (UAW) was strong. Rather, HMC wanted to locate its plant in

the Deep South's "sun belt," which was relatively free from the influence of strong labor unions. Among the southern states, Alabama was a typical greenfield site that had little experience with union activities. According to data on union density by state for 2000, published by the US Bureau of Labor Statistics, percentages of unionized workers in the southern states were under 10 percent, including Alabama's 9.8 percent, while those in the midwestern states were about 20 percent (Hirsh, Macpherson, and Vroman 2001, 52).

According to Alabama's labor laws, labor union membership is not mandatory even when a labor union is organized within a company. However, in the neighboring state of Georgia, membership in labor unions is mandatory. Thus, Alabama was more attractive to HMC, which wanted to avoid a strong labor union and recruit compliant workers with general skills. Note that the Hyundai Production System does not require many firm-specific skills. An interview with an HMMA manager in July 2009 revealed that HMMA has still kept the "no labor union" policy. The president of HMC, Dong Jin Kim, spoke of the labor factor in the following terms: "Incentives are good, but just a portion on the top of the iceberg. The most important thing is the people—the attitude of people" (*Tuscaloosa News* 2002).

Another factor in HMC's decision to locate HMMA in Montgomery, Alabama, was the incentive package that the Alabama state government promised to provide. Competing with other state governments—including Kentucky, Mississippi, Georgia, and Ohio—for HMC's investment, the Alabama state government offered HMC an attractive incentive package that included tax abatement, a site preparation grant, and an access road and bridge. The state government also promised to provide job applicants with education and training programs. Alabama's package was worth approximately \$253 million, an exceptional incentive compared to what other state governments offered.⁷ HMC invested a sum of \$1.4 billion in HMMA, which included an engine plant as well as an assembly plant (HMMA 2009).

In 2002, HMC established HMMA as a manufacturing subsidiary plant in the United States and started construction in Montgomery, the capital city of Alabama. The Alabama state government sold 1,744 acres for the plant site to HMC for practically nothing. The total area of constructed plants is about 2 million square feet. There is also a paved road, which the state government named Hyundai Boulevard, that leads to HMMA, and the government provided HMMA with utilities for plant operation at low cost (interview with a manager at HMMA, July 2009).

Human Resource Management

As mentioned before, the human factor varies more substantially than the technological factor when a production system is transferred to another country. In this subsection, we consider the characteristics of the institutional environment that influenced the human factor at HMMA. All of these characteristics influence the skill formation in the Hyundai Production System in the United States.

Recruitment and training. HMMA recruited and trained American employees with the support of the Alabama state government. During the recruitment process, HMMA was not able to select its employees on the basis of race, sex, or physical appearance because US laws forbid any kind of discrimination based on those factors. Therefore, the racial composition of employees roughly represents the population of Alabama, especially Montgomery. For example, African Americans constitute 53 percent of the population in Montgomery and 55 percent of HMMA employees. The proportion of female employees is 23 percent (HMMA 2009), which shows a more active female participation rate in the US blue-collar labor market as compared to Korea.

HMMA wanted to recruit compliant workers with general skills that could fit with the characteristics of the Hyundai Production System. The period of training for new production workers at HMMA is only slightly longer than at the Asan plant.

Training for production workers was accomplished in two consecutive stages. First, the Alabama state government provided job applicants with a two-week orientation program. Most of the applicants had no prior experience in auto manufacturing. The training program included cultural understanding, social skills, and basic auto production job skills. After completing this program, the applicants were evaluated and interviewed for a final recruitment decision by HMMA. During the preliminary training, there was fierce competition among applicants for jobs at HMMA, because its wage level was among the highest in Alabama (interview with a production worker at HMMA, July 2009).

Second, HMMA provided the new recruits with a two-week training program. This program included moral education, basic training for physical ability and dexterity, and assembly job training. For the trainees, HMMA used HMC's working manual modified for use in a US context. HMMA also sent a small number of workers who were in line for promotion to shop floor supervisors to a pilot plant in Nam-yang, Korea, for on-the-job training (OJT) for two weeks. As a part of this program, the assembly shop sent twenty-three production workers and three engineers

to two OJT programs at Nam-yang. After returning to the Montgomery plant, the workers shared their training experiences with other colleagues at HMMA (interview with a senior manager at HMMA, July 2009).

Promotion and compensation. The basic promotion system of production workers at HMMA is similar to that at the original plants at HMC. The career path for hourly-wage workers is limited; they can be promoted no higher than to the status of group leader. This is contrasted with the career path for salaried workers, who can be promoted to senior managerial positions. The promotion of hourly-wage workers to managerial levels is virtually impossible.

However, the promotion system at HMMA is a little bit different from that of the original plants, because it partly incorporated the principle of competition into the promotion system for production workers characteristic of labor practices in the United States. HMMA was able to promote better workers to higher positions because there was no opposition from labor unions, unlike in Korea where unions opposed such practices. The Human Relations Division of HMMA utilized the competitive promotion system by evaluating employees on an individual basis. A production worker can be promoted to team leader and from there to group leader. This system has motivated workers hoping for promotion to a higher position (interview with a senior manager at HMMA, October 2009).

The wage system for production workers is based partly on the evaluation of individual performance. An unskilled worker at HMMA starts with a wage of \$15 per hour. During the first two years, the wage increases every six months depending on the evaluation process. If the worker succeeds in becoming a skilled worker after two years, he or she will receive \$24 per hour. However, there is no further increase in wages, except for adjustments for inflation. HMMA adopted a fixed-wage system that is characteristic of the labor market in the United States. This is very different from the seniority-wage system in Korea, where wages for individual workers keep rising annually as they get older.

Turnover at the plant is low. The turnover rate of production workers has been maintained at around 5 percent, because HMMA's wage levels are among the highest in Alabama (HMMA 2009).

In summary, HMMA has recruited and trained compliant workers with general skills as a result of the favorable labor relations environment in Alabama. HMMA has adopted a human resource management policy that combines certain aspects of both the competitive promotion system and the fixed-wage system that are characteristic of the US labor

market. HMMA's human resource management has been relatively successful, with little objection from workers. These favorable labor relations significantly influenced the skill formation and work organization of production workers at HMMA.

Skill Formation and Work Organization

How was the skill formation of the production system at HMMA influenced by the different labor market and labor relations in the United States?

Due to the low turnover rate, the average tenure of HMMA workers was 3.7 years as of July 2009, 4.2 years after the plant opened in May 2005. As production workers have gained more experience, their skill levels have increased, although they are still relatively low. HMMA has not invested much to develop firm-specific skills, because the Hyundai Production System does not require them. Most workers are semiskilled, which requires just two to three months of OJT.

HMMA has commonalities with the Asan plant in that they manage a work organization composed of teams and groups. The simple job classifications and relatively low skill levels of production workers at HMMA resemble those at the original plant in Korea. In addition, these two plants share the same characteristics in the sense that the limited abilities of workers are supplemented by the support of multiskilled supervisors and maintenance workers within their work organizations.

Neither the Korean nor US plants have induced active participation of workers. At HMMA, despite the absence of hostile labor relations (as opposed to in Korea), workers have not shown their abilities in problem-solving activities. Recently as the work experience of employees has increased, HMMA began small-scale job rotations, with employees rotating between two to three jobs. However, the skill levels and problem-solving abilities of production workers have not improved substantially. HMMA managers have stated that they do not expect a significantly positive effect on productivity from such activities (interview with a manager at HMMA, July 2009).

The most striking difference from the Asan plant is that the HMMA work organization is very flexible in its utilization of production workers. The flexible labor market and the absence of labor unions enabled the HMMA to exploit both internal and external numerical flexibility. *Internal numerical flexibility* refers to the flexible adjustment of employee work schedules within the firm. The more adaptable operation of HMMA work organization is not due to a higher rate of automation, but to increased

internal flexibility in its utilization of production workers. When the HMMA plant's production line happens to stop, managers make use of their workers' idle time by assigning "total preventive maintenance" or "workplace innovation" activities related to cleaning, energy saving, and safety. Managers even use their idle time for lunch breaks if the production line stops near the lunch hour. In other words, the managers can easily reallocate idle time to various activities that enhance the efficiency of HMMA. This flexibility is in stark contrast to the situation in the original plant, where managers cannot change the work scheduling without prior agreement from the labor union (interview with a senior manager at HMMA, July 2009).

HMMA also utilizes *external numerical flexibility*. This refers to the flexible adjustment of the number of workers from the external labor market (Atkinson 1984). In Table 3, we confirm the contrasting degree of external numerical flexibility at these two plants. Since the economic recession in 2008, the number of irregular workers at the Montgomery plant has decreased from 344 to 81, while the Asan plant has maintained that number at 950 (interview with a manager at HMMA, November 2009). This shows that HMMA utilizes a higher level of external numerical flexibility where the number of workers can be easily adjusted according to changes in market demand. The characteristics of the Hyundai Production System in which production workers can be easily substituted with other workers are better realized at HMMA than at the Asan plant.

In summary, HMMA makes full use of both internal and external numerical flexibility as a result of flexible labor markets and the absence of unions, while the Asan plant can use neither form of flexibility because of strong opposition from the labor union. Thus, the dream of HMC management to increase the standardization of labor processes to the maximum has been realized at HMMA. The difference in numerical flexibility between these plants is clearly confirmed by the allocation ratio, as shown in Table 3. In terms of the allocation ratio of net assembly working hours to total working hours by production workers, HMMA showed a much higher level of efficiency (91 percent) than the Asan plant (68 percent).

Production Technology

As noted earlier, the technological factor is typically influenced relatively little by institutional characteristics of the country in which the trans-plant is located. At the beginning stage of plant construction, however,

engineers at HMC headquarters had an ambitious dream for HMMA. While the Asan plant that they had constructed in 1996 was considered to be HMMA's archetype, engineers wanted to upgrade the production technology at HMMA beyond the level of the Asan plant by adopting state-of-the-art technology. Their ambitious project was not fully successful because HMC's management style for new plants in Korea did not work smoothly under US labor market conditions.

A major obstacle to the successful operation of the new HMMA plant was the limitations of maintenance workers. HMC engineers had to give up the original plan to upgrade the automation ratio of production processes because the high level of automated facilities would not be efficiently operated if the maintenance function did not work properly (interview with an engineer at HMMA, July 2009). Hence, HMC engineers modified their ambitious plan into a modest one suited to the circumstances in Alabama. Consequently, HMMA had to adopt a level of production technology similar to that at the original plant after it had experienced US adaptation of the Hyundai Production System by trial and error. In the end, the automation ratio of HMMA was comparable to that of the original plant in Asan.

During the initial stages of the HMMA plant in 2005–2006, the limitations with respect to the maintenance function were offset by the introduction of hundreds of Korean managers and engineers called “expatriates.” Hundreds of senior production workers from Korea also supplemented the limited ability of local workers in the operation and maintenance of the production line. Since the mass production of the Sonata and the Santa Fe has stabilized at HMMA, the number of Korean expatriates and senior workers has continually decreased. However, seventy-one expatriates and dozens of senior workers are still maintaining their roles in supplementing the limited ability of HMMA employees. Without the presence of expatriates and senior workers who were sent from Korea, HMMA would not have been able to operate at the same level.

In summary, when we compare the performance of HMMA with the original plant in Asan, what really matters is the human rather than technological factor. The automation rates at the two plants are almost the same. By contrast, the HMMA utilizes the numerical flexibility of production workers to the maximum, making use of different human resource management features, including the fixed-wage system and competitive promotion system under the cooperative labor relations in the flexible labor market in Alabama. Table 5 compares the Hyundai Production System as it has evolved at HMMA with the system that is in place at the original plant in Asan.

Table 5 Transfer of the Hyundai Production System to the United States

	Original Plant in Korea	HMMA Plant
Institutional environments	Seniority wage system; flexibilization of labor market; hostile labor relations	Fixed-wage system; flexible labor market; cooperative labor relations
Skill formation and work organization	Flexible standardization of labor processes; irregular job rotation of production workers; low level of numerical flexibility	Flexible standardization of labor processes; little job rotation of production workers; high level of numerical flexibility
Production technology	Engineer-led automation; flexible production	Engineer-led automation; flexible production; essential role of expatriates from Korea

Is the production system of HMMA qualitatively different from the original Hyundai Production System or is it just a slightly modified form of it? The HMMA production system keeps the basic characteristics of the Hyundai Production System and combines the “engineer-led automation” in the technological factor with the “standardization of labor processes” in the human factor. The lack of adversarial labor relations and the ease of using numerical flexibility in the flexible labor market enabled HMMA to more flexibly operate its work organization. HMMA’s production system is a slightly modified form of the Hyundai Production System. But the slight modification helped HMMA increase its efficiency, and that modification was possible largely because of the different institutional environment in the United States.

Comparison with Japanese Transplants in the United States

The ease with which the Hyundai Production System was transferred to the United States can be more clearly understood when it is compared with the earlier experiences of Japanese automakers’ transplants in the United States. Ohno Taiichi called the characteristics of Toyota’s automation “autonomation,” which meant automation with a human touch (Monden 1993). Japanese automakers developed a production system that emphasized skill development and active participation of production workers. In our analytical framework, we characterize the Japanese

Production System as a combination of shop floor-oriented automation in the technological factor with the specialization of labor processes in the human factor. In the original plants in Japan, the role of the human factor has increased since the mid-1950s because the institutional environment has been favorable to the development of firm-specific skills and active participation of workers. Due to cooperative labor relations, the seniority-wage system, and lifetime employment, Japanese automakers have invested heavily in developing firm-specific skills and have encouraged active participation of workers.

To successfully transfer the Japanese Production System to the United States, Japanese automakers needed skilled workers, especially at the initial stage of the Japanese transplant operations in the United States. To secure a steady supply of skilled workers, Japanese automakers located most of their plants in the Midwest to tap into a pool of unemployed but skilled workers who had previously worked for the Big Three US automakers. As of the late 1980s, five out of the seven Japanese transplants were located in Michigan, Ohio, Illinois, and Indiana. These states were where the Big Three had historically produced vehicles. This suggests that securing highly skilled labor was a primary factor when determining the locations of early Japanese transplants.

However, the transfer of the Japanese Production System to the United States was challenging. Specialization of labor processes required firm-specific skills on the part of production workers, which was difficult to achieve in the US context, characterized as it was by a fixed-wage system and a flexible labor market. The characteristics of labor relations were confrontational, compared to Japan. In this environment, Japanese automakers found it very difficult to secure or train a skilled workforce that would actively participate in the transplants in the United States, because the production workers had few incentives to develop their skills.

Studies about Japanese transplants report that it typically took around five to six months to recruit workers sufficiently skilled to employ in their plants (Hill 1989; Graham 1993). The hiring process included testing for social aptitude and functional ability. After being hired, workers were required to undergo additional training that ranged from three weeks to three months (Perrucci 1994, 116).

How was the Japanese Production System modified in the United States during its early stages? According to Tetsuo Abo (1998), the Japanese Production System was significantly modified in the United States in the late 1980s. Human resource management practices in the wage, promotion, and supervising system in the Japanese transplants fell halfway between the practices of the Japanese domestic plants and those

of US automakers. Frits Pil and John MacDuffie (1999) show that Japanese transplants in North America were not able to adopt the same elements of human resource management, such as lifetime employment and the seniority-wage system, that exist in Japan.

Job rotation and training also reflected a hybrid model between the two systems (Table 6). While Japanese transplants attempted to attract active workplace participation and to raise the skill levels of US workers, the degree of their job rotation was significantly lower than at the original plants in Japan (Kenney and Florida 1993). This indicates that the skill formation system of Japanese automakers was not easily transferred to the United States. The transfer of the Japanese Production System experienced substantial modification because of the different institutional environment in the United States. The difficulty of transfer as well as the substantial modification of the Japanese Production System in the United States explain the relative underperformance of early Japanese transplants as compared to their original plants in Japan.

In contrast, the transfer of the Hyundai Production System to the United States was done relatively easily in a short period of time because

Table 6 Modification of Production System in the United States

	HMMA (South)	Japanese Transplants (Midwest)
Institutional factors (labor market and labor relations)	Flexible labor market; consideration for congenial labor climate in southern region	Flexible labor market; consideration for recruitment of skilled workers in Midwest region
Human resource management	Fixed-wage system; numerical flexibility	Fixed-wage system; functional flexibility
Skill formation	Standardization of labor processes; low skill levels of workers; irregular and short range of job rotations	Specialization of labor processes; highly skilled workers; frequent and wide range of job rotations
Work organization	Simple job classification; passive participation of semi-skilled workers	Simple job classification; active participation of skilled workers
Performances	High performances (productivity, quality, utilization); no less than the original plants	High performances (productivity, quality, utilization); a little less than the original plants

HMC had developed a unique production system that was less dependent on the skill formation of production workers than was the Japanese Production System. Due to its adversarial employee relations in Korea, HMC had not been able to develop high-skilled workers and had failed to mobilize their participation in production activities since the late 1980s. Ironically, this was the reason why HMC could easily succeed in transferring its production system to the United States with relatively little modification.

While most Japanese transplants located themselves in the Midwest where skilled workers were available, HMMA located itself in Alabama, which had not been heavily industrialized. HMMA wanted to hire new, low-skilled workers who had no experience of union activity. The human factor characteristics that HMMA needed were not functional flexibility, but numerical flexibility. HMMA wanted to recruit low-skilled compliant workers who could be easily replaced. Therefore, HMMA's human resource management strategy was not to develop a high level of firm-specific skills in workers, but to develop numerical flexibility in the sense that the number of hired workers or the working schedules could be easily adjusted in response to changing market demands.

The characteristics of the Hyundai Production System are confirmed by the fact that the time for recruitment and training of new workers at HMMA was much shorter than for Japanese transplants. HMMA provided new employees with two weeks of preliminary training during recruitment and another two weeks of additional training after hiring. Without any experience of working in auto plants, the workers were expected to follow the instructions of managers with no objection to rescheduling or reallocation of their jobs. This is characteristic of the Hyundai Production System at HMMA, which is distinguished by the combination of flexible production technology and numerical flexibility with respect to workers.

We compare the modification of production system at HMMA and at Japanese transplants in Table 6. The flexible labor market and cooperative labor relations in the US South were favorable to Hyundai's pursuit of flexible *standardization* of labor process. Hyundai succeeded in transferring its production system with minor modifications to the southern part of the United States. However, the flexible labor market and hostile labor relations in the US Midwest were not so favorable to the flexible *specialization* of labor processes that characterized the Japanese Production System. Japanese automakers generally succeeded in transferring their production system to the Midwest, but with some initial difficulty and extensive modifications.

In summary, we find that the degree of production system modification was higher for Japanese transplants than for HMMA. The Japanese Production System was significantly modified under the very different institutional environment in the United States. Specifically, the skill formation system as well as human resource management in the Japanese transplants had to be adjusted to conform with institutions in the United States, particularly labor market institutions, and ended up as a kind of hybrid between the Japanese domestic plants and the US Big Three automakers. Conversely, the Hyundai Production System required little modification. In the absence of labor unions, HMMA could utilize the characteristics of the Hyundai Production System even better than HMC could at its original plant in Korea.⁸

Conclusion

In this article, we have tried to explain how the Hyundai Production System was successfully transferred to its US plant in Alabama. The success of HMMA was possible largely because the flexible labor market and cooperative labor relations in Alabama were suitable to the characteristics of the Hyundai Production System, which depended less on skill formation and more on numerical flexibility of production workers. Given the different institutional environment of the United States, HMMA developed a slightly modified form of the Hyundai Production System, but one that even increased the standardization of labor processes. HMMA has utilized the internal numerical flexibility as well as external numerical flexibility of workers to the maximum without any resistance from workers. As a result, HMMA reached a performance level equal to, or even higher than, that of its original plant in Asan—and within a short period of time—while the early Japanese transplants showed inferior performance compared to plants in Japan.

The crucial difference between the Hyundai Production System and the Japanese Production System was in the human factor. The institutional environment of a flexible labor market and cooperative labor relations in the US South were favorable to Hyundai's pursuit of numerical flexibility required for flexible standardization of labor processes, while the flexible labor market was unfavorable to the Japanese pursuit of skill formation required for flexible specialization of labor processes.

Toyota and other Japanese automakers did not fail in the United States as both Japanese automakers and Hyundai succeeded in transferring their production systems. But Hyundai faced less difficulty in the early years

of operating its US transplant than their Japanese counterpart did and made few adjustments in its core strategy.

The requirements of the Hyundai Production System were different from those of the Japanese system. The Japanese Production System required industry- or firm-specific skills, and their successful transfer relied on recruiting skilled workers in the US Midwest, which proved difficult. The Hyundai Production System required numerical flexibility of production workers, and the US South provided ideal conditions to exploit numerical flexibility to the maximum. When Hyundai's own production system faced difficulties as labor relations changed with democratization, oddly, the US South, with its more authoritarian origins, was almost more suited to this system than was Korea itself.

The HMMA case has important implications for the study of production systems. This study casts doubt on the convergence model of technology and globalization; a model that stresses only technology or replication pressures predicts convergence around a single production system. Our case study demonstrates that divergent production systems develop under different institutional environments rather than converging to a uniform lean production system under the pressures of globalization. Moreover, we have demonstrated that even within a single firm there are differences that result from location-specific factors such as distinctive labor relations. The study also shows that the transfer of a production system that is qualitatively different from the Japanese Production System can be equally successful, if not more so, under certain institutional conditions.

While confirming the usefulness of the institutionalist arguments, we also contribute to the broadening of this perspective. Traditionally, institutionalists have emphasized the difficulty of transferring a production system to different institutional circumstances. However, our study indicates that the transferability of production systems varies, depending on the characteristics of the production system and the new institutional environments.

The findings in our study have also significant implications for the "varieties of capitalism" literature, which maintains that there are varieties of capitalism based on the coordination of different institutions (Hall and Soskice 2001). There should be a production system that fits with a specific type of capitalism because of institutional complementarities. One of the findings from the varieties of capitalism literature is that firm-specific or industry-specific skills are better rewarded and developed in coordinated market economies, while universal skills are better rewarded and developed in liberal market economies. Japanese automakers have been able to develop their production system, which depends heavily on

firm-specific skills and active participation of the workforce, in Japan's typical coordinated market economy. It is not surprising that they faced difficulties transferring their production system to the United States, a typical liberal market economy where there are not many incentives for firms and workers to invest in firm-specific skills.

Although Korea's developmental state traditionally had features of a coordinated market economy, the gradual processes of liberalization that started in the 1980s and accelerated after the 1990s made the Korean economy resemble more a liberal market economy than a coordinated market economy in some respects. In particular, the adversarial labor relations that began after the 1987 democratic transition and the labor market liberalization that advanced after the 1997 financial crisis gave the large firms with militant unions, like HMC, disincentives to invest in firm-specific skills and to rely on active worker participation on the production line. Interestingly, the US South is now an attractive location for a middle-income country like Korea, because its labor markets are more rigid and contentious than those of the United States. Since the Hyundai Production System did not depend heavily on the skilled labor force, Hyundai did not face much difficulty when its production system was transferred to the United States.

Finally, we want to raise a question regarding the sustainability of the HMMA model. We are not sure if HMMA's success in the absence of labor unions can be continued in the long run. While a high level of numerical flexibility contributes to the success of HMMA, it also means heavy pressure and strain on workers. Workers at HMMA do not have communication channels through which they can exercise collective voice, other than the petition channel at the individual level. Considering that in another HMC transplant at Chennai, India, a labor union was recently organized, HMMA needs to develop a broad communication channel through which workers can voice their demands collectively.

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Appendix: Schedule of Field Survey for HMMA

	Interviewees	Contents
July 13, 2009	President and vice-president Personnel relations managers	Company history Production and sales Local environments
July 14, 2009	Production management managers and engineers Information system managers	Automation and information system Factory operation
July 15, 2009	Suppliers management managers Executives of four supplier companies	Outsourcing and modularization Parts and components logistics Suppliers management
July 16, 2009	Managers of assembly shops Managers of body shops US managers and production workers	Shop floor management Skill formation Work organization
July 17, 2009	Human resource managers	Vocational training Promotion and compensation

Notes

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1. *Lean production* is a term that was devised by a research group at MIT to express a universal characteristic of the Japanese Production System. More specifically, we regard Toyota's production system as the model of the lean production system.

2. For more information on the characteristics of the traditional US production system, see Jürgens, Malsch, and Dohse (1993).

3. The Hyundai Production System may look like the traditional mass production system of US automakers because production workers do simple, repetitive jobs. However, the Hyundai Production System is clearly distinguishable from the traditional US mass production system, because the work organization and the production technology are flexibly utilized to respond to changing market demands.

4. Although these data are weak in the sense that they cannot consider the differences in the degree of automation, outsourcing, and modular production, we can still approximate the status of automakers based on their productivity levels.

5. In Korea, workers have been organized primarily at the firm level rather than at the industrial or the national level. HMC's labor union is largely characterized as a corporate union, which primarily pursues the economic interests of

the HMC employees. Even though it was formally converted into a member of an industrial union in 2006, it still maintains its characteristics as a corporate union.

6. The reason why Hyundai's transplant in Bromont, Canada, failed in the early 1990s can be understood as a combined result of the technological factor and the human factor. At that time, Hyundai did not have the technological ability to compete with the advanced automakers. For example, the Stella model that the Bromont plant used to produce was a midsize car in appearance, but it had a subcompact car engine. Hyundai also failed to manage Canadian workers by not adopting an appropriate human resource management approach. Hyundai simply had not reached the present level of its production system in the early 1990s.

7. Then governor of Alabama Don Siegelman attracted billions of dollars of investment from Toyota and Honda besides HMC to build major assembly plants in Alabama during his governorship (1999–2003).

8. Beginning in late 1990s, Japanese automakers located some of their transplants in the southern part of the United States, where labor unions were weak or absent. Honda constructed its transplant at Lincoln, Alabama, in 2001. Nissan constructed its transplant at Canton, Mississippi, in 2003. This suggests that Japanese automakers considered a new strategy of training new recruits rather than experienced workers, even though it takes longer.

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