

**JAPANESE SUPPLIER RELATIONS:
A COMPARATIVE PERSPECTIVE[†]**

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September 1998

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Abstract

This paper describes major characteristics of Japanese supplier relations in a

[†] This paper is completely revised version of the paper which title is "Supplier Relations in Japan: An International Perspective."

[‡] Financial supports from Ministry of Education in Japan are gratefully acknowledged.

comparative perspective. The supplier relations in Japan, particularly automobile industry, are examined in comparison with those in the United States. The primary purpose of the study is to characterize significant features of Japanese supplier relations and to provide economic rationale for those relationships. In addition, comparing supplier relations in Japan and the U.S., convergence in the nature of those are discussed. Significant features of Japanese supplier relations are characterized: long-term relationships and commitments; forced competition among few suppliers; transaction-specific investments in plant, equipment, and human capital; significant involvement of suppliers in product development with sharing of information. Supplier relations in the U.S. are changing and moving close to the Japanese counterpart. There has been a limited, yet noticeable, convergence in the nature of U.S. and Japanese supplier relations.

Keywords: Long-term relationships; Procurement; Supplier relations; Transaction-specific investments;

JEL Classification: L14; L62

1 Introduction

Supplier relations are important areas for any firm that subcontracts portions of components and production because this creates the opportunity to enhance values of products and efficiency of production. There have been significant differences in supplier relations between Japan and the United States. U.S. automakers are more vertically integrated than their Japanese counterparts (Dyer, 1996a).¹ Even though U.S. automakers are more vertically integrated, they contract directly with more than one thousand suppliers for the parts they do not make. Product development process is heavily influenced by the traditional system in which suppliers produce parts under short-term, arms-length contracts and have little role in design and engineering. Most high value-added component development and production are done by U.S. automakers in-house using large in-house supply capability. Outside suppliers are used predominately as low-cost manufacturing platforms that are handed blueprints. Vertical integration might enable companies to enjoy all of the benefits of fewer direct suppliers and specific investments. But vertical integration removes suppliers from the discipline of the market and essentially eliminates competition because suppliers have a captive customer base. Incentives that keep both automakers and suppliers efficient and focused on continuous improvement are weak in the U.S. supplier relations.

Japanese automakers, by contrast, work with approximately one-tenth that number, purchasing more entire subsystems from each supplier.² Japanese supplier network is organized into clearly defined, hierarchical tiers with relatively large first-tier suppliers at the top taking most of the responsibility for design of subsystems and delegating responsibilities for simple parts to second and lower-tier suppliers that generally build parts according to blueprints provided to them. In Japanese supplier relations, suppliers, particularly primary ones are an integral part of the product development and manufacturing processes: they are heavily involved, assume significant responsibility, and communicate extensively and directly with product and process engineers. Japanese suppliers frequently play a significant role in designing, prototyping, and testing complex parts and subsystems than U.S. suppliers do. Suppliers in Japan are given great autonomy in designing, prototyping, and testing their components or subsystems. Both automakers and suppliers have recognized the need to be interdependent and have responded by developing mechanisms to cooperate under the discipline of the market.

¹Dyer (1996a) examines the relationship between inter-firm asset specificity and performance in Japanese and the U.S. automobile industry. The unit of analysis is the supplier-automaker relationship. The sample consists of two Japanese, three U.S. automakers. A half of sample is from partner relations, the other is from arms-length relations in supplier-automaker relations. The survey was conducted with mailed, self-administered questionnaire. The survey also shows significant differences between two countries with regard to vertical integration.

² Cusumano and Takeishi (1995) review the literature in empirical studies on supplier relations in Japan and the U.S.

Supplier relations in Japan can be characterized to have distinctive characteristics in several aspects compared with the U.S. counterpart. It is important to understand how efficiently Japanese supplier relations work, and whether the Japanese practices are unique to the peculiar circumstances of the Japanese social and cultural system or whether it can be applied in other countries. Furthermore, it is also important to understand the economic rationale of supplier relations in Japan. Yet many aspects are still left unknown about the process that unfolds between buyers and suppliers in Japan or the U.S.

This paper describes major characteristics of Japanese supplier relations in a comparative perspective. The supplier relations in Japan, particularly in automobile industry, are examined in comparison with those in the U.S. The primary purpose of the study is to characterize significant features of Japanese supplier relations and to provide economic rationale for those relationships. In addition, comparing supplier relations in Japan and the U.S., convergence in the nature of those are discussed.

In this paper, significant features of Japanese supplier relations are characterized. First, long-term relationships and commitments with close communication reduce transaction costs and eliminate inefficiencies between automaker and supplier. The practices of building trust like supplier-assistance programs, cross-share holdings, and interfirm employee transfer and having guest engineers can work effectively to create a high degree of mutual trust.

Second, forced competition among few suppliers is effective in focusing on costs, quality, and technological development. Using few suppliers can create value by providing economies of scale and benefits of experience curve that reduce both transaction and production costs. Moreover, the contest among few suppliers serves to make the supplier's reward dependent on his rivals' efforts as well as his own, while the reward is actually independent of the supplier's cost. Japanese automakers can increase incentive of suppliers for enhancing efficiency of production through contests.

Third, willingness to make significant transaction-specific investments in plant, equipment, and human capital as well as to share valuable technical information is more significant in Japanese supplier relations than the U.S. Automakers and suppliers may choose to seek efficiency advantages by investing in transaction-specific assets. These transaction-specific assets as the vehicle through which trading partners are able to generate relational quasi rents when trade partners have developed safeguards which can control opportunism at relatively low cost and task activities are characterized by a highly degree of interdependence. In Japanese supplier relations, mutual investment in specific assets creates incentives to cooperate, and the reduction in cost and improvements in quality that are gained through the cooperation outweigh the risks of opportunistic behavior from the parties involved.

Fourth, significant involvement of suppliers in product development with intensive and regular sharing of technical and cost information improves performance and reduces costs. Japanese supplier relations involve intense and frequent sharing information during the product development stage. The intense and regular sharing of technical information can be effective to improve performance and reduce cost. The long-term automaker-supplier relationships can facilitate the quality and efficiency of information exchange. Aggressive target prices are a major factor in driving supplier to reduce cost so they can make a profit at the price dictated by the customer. Since Japanese automakers also know the cost structure of their suppliers, they generally set the target price very aggressively under the assumption that suppliers will continually reduce costs over experiences of the previous model. The supplier has a great incentive to design the part so it can meet that price and still make a profit in the long run.

Supplier relations in the U.S. are changing rapidly and are moving close to those in Japan. There has been a limited, yet noticeable, convergence in the nature of U.S. and Japanese supplier relations. In the U.S., suppliers are significantly more likely than they were in 1980s to provide detailed information to their customers, have long-term contracts, and get involved in product development and manufacturing processes. These results indicate progress toward collaborative relationships, in which suppliers play an important role in solving problems and developing ideas about products and manufacturing processes.

This paper is organized as follows. Major characteristics of Japanese supplier relations are discussed in order. The next section presents transaction relationships with few direct suppliers. Section 3 discusses forced competition among limited suppliers. Section 4 describes transaction-specific investments. Section 5 discusses supplier involvement in product development. Section 6 discusses the convergence in the nature of supplier relations in Japan and the U.S. Finally, concluding remarks are presented.

2 Fewer Direct Suppliers

2.1 Long-term Commitments

U.S. automakers are more vertically integrated than their Japanese counterparts. Even though U.S. automakers are more vertically integrated, they contract directly with 1,500 to 3,000 parts suppliers for the parts they do not make. Toyota, by contrast, works with approximately one-tenth that number, buying more entire subsystems from each supplier. Reducing the total number of direct suppliers can lower costs while increasing quality. Using fewer suppliers can create value by providing economies of scale and benefits of experience curve that reduce both transaction and production costs. Transaction costs, as defined here, are all the costs associated with effecting an exchange, that is, information gathering and analysis, negotiation, contacting, physical distribution

costs, and so on.

Within most industries, as cumulative production experience in producing a product or service increases, quality is improved and costs are reduced. Japanese automakers have consolidated their business with a few highly efficient suppliers and created conditions that facilitate the suppliers to make the investments necessary to accelerate down the experience curve and to share the full advantage of this volume with the automakers. When a Japanese supplier wins a contract with a Japanese major automaker, it is essentially guaranteed four years of business or the life of the model. Moreover, if the supplier performs up to expectations, it can usually renew the contract for the next model as well. Naturally, these practices encourage long-term and transaction-specific investments. Suppliers can invest in developing ideas and plans for the next model well in advance. Engineers from the limited suppliers have long-term experiences in working together, making it easier to efficiently develop designs for the next model. When the model change occurs, suppliers continue to move down the experience curve (Dyer and Ouchi, 1993).

In contrast, U.S. automakers have attempted to keep input prices low by maintaining size and bargaining power over suppliers. By splitting their business among many suppliers and rotating them frequently, U.S. automakers have repeatedly destroyed the experience curves of suppliers by ensuring that no one supplier could enjoy the experience curve effects to accumulate decisive cost advantage. Thus, the U.S. suppliers have not developed long-term relationships and experiences with automakers. Moreover, they are unable to effectively plan long-term production and investments, which is reflected in lower average plant capacity utilization. Without long-term commitment, U.S. suppliers can not have incentives enough to make long-term investments in capital equipment, particularly transaction-specific assets. Moreover, without the ability to make long-term forecasts, it is very difficult to make maximum use of capacity and capital equipment. For example, automakers may involve suppliers to a greater degree in the product design process to utilize fully the value of present tools and equipment. In this way, the risk of tool obsolescence due to unilateral design changes is lowered. Naturally, the longer the automaker and the supplier work together under these circumstances, the more likely it is for mutual trust to be developed. Trust in this case comes from reliability demonstrated over repeated interactions, as well as the shared knowledge that the parties need one another.

2.2 Building Trust

Trust is an expectation held by an agent that its trading partner would behave in a mutually acceptable manner including an expectation that neither party will exploit the other's vulnerabilities. This expectation calibrates the set of possible actions, thus

reducing the uncertainty surrounding the partner's actions. The Japanese companies have recognized the need to be interdependent and have responded by developing facilitating mechanisms to build mutual trust. The Japanese do not rely on legal contracts heavily to protect their interests in trading relationships. Sako (1991) and Smitka (1991) argue that developing mechanisms to build trust between suppliers and customers have been critical in attenuating the hazards of opportunism in Japan.

Sako and Helper (1998) define trust as goodwill trust, that is, suppliers can rely on their automakers to help them in ways not required by their agreement with customers. Then, they find that Japanese suppliers were more trusting their customers than U.S. suppliers.³ Japanese suppliers tend to entertain a higher level of trust and a lower level of opportunism than U.S. suppliers do.⁴ Helps and technical assistance of automakers are significant in enhancing trust in Japan but not by in the U.S. Major Japanese automakers help their supplier match competitors' efforts if one of competitive suppliers offered a lower price for a product of same quality. Furthermore, the automakers provide significant helps for suppliers to reduce costs if their material costs raised. Japanese suppliers receive technical assistance from their automakers. Automaker engineers visit supplier site to aid in implementing improved procedures and processes of product development and production. Automakers provide opportunities to train personnel of supplier at automakers' sites.

Major Japanese automakers have large supplier-assistance management consulting groups with specialized expertise that work full time with suppliers to help them improve their production techniques and achieve total quality, cost, and delivery. They have engaged in disseminating technical and management techniques such as TQC (total quality control), VA (value analysis), VE (value engineering), JIT (just-in-time) production method, and so on. Providing assistance to suppliers is a highly effective method for both helping and forcing suppliers to continuously innovate and improve to stay ahead of the competition.⁵

The practice of long-term employment within one firm is important in developing trust

³ Sako and Helper (1998) collected data by questionnaire survey during 1993 from 675 first-tier automobile component suppliers in the U.S. and 472 first-tier suppliers in Japan. Respondents were asked to answer the questionnaire for their most important customer regarding one product which was typically of their company's output and with they were familiar.

⁴ Dyer (1996a) shows that Japanese supplier were more likely to trust Japanese automakers to treat them fairly and more willing to make dedicated investments based on oral agreements.

⁵ Suppliers often feel indebted or obligated to the automakers, but they also have mixed feelings about the system. On the one hand, they sometimes feel that sharing the business with another supplier is inappropriate when they are clearly ahead in both cost and quality. Moreover, they have to share not only the business but also information or technology in order to help their competitor improve. On the other hand, since they realize that someday they may need such assistance, they view the system as insurance. Toyota suppliers rarely go bankrupt because they receive helps from Toyota if they are in financial distress. Only suppliers that are unwilling or unable to improve continuously are cut off completely, and suppliers will do almost anything to avoid such damage to their reputations

among individuals both within the firm as well as across firms. There is real personal contract between the purchasing managers of manufactures and the managers or owner of a supplying firm. Because people can develop long-term relationships with their counterparts at the supplier or buyer, it is natural that the Japanese have developed significantly greater trust across firms.

The way that Japanese firms build trust is by requiring career paths in which employees transfer from firm to firm. Employee transfers, both temporary and permanent, are common among business partners, particularly between large manufacturers and their subcontractors. In addition to permanent and temporary employee exchanges, suppliers often send guest engineers to work at their customer technical centers on an ongoing basis. Supplier and automaker engineers work jointly designing the components for a new car model.⁶ Not only do these career-path help build trust between firms, but also transferred and guest employees are better able to understand how to enhance the efficiency of the development and production processes because they know both buyer and supplier operations. Direct contact is much more important than other forms of contact in developing ways for employees to know and trust each other. Both of automakers and suppliers encourage a considerable amount of face-to-face contact between supplier salespeople and automaker engineers and between automaker purchasing agents and supplier engineers. Japanese suppliers engage in more face-to-face contact and utilize more guest engineers than do U.S. automaker parts divisions and assembly divisions (Dyer, 1996a).

Companies need credible commitments if they are going to be willing to make customized investments. Cross-share holding in Japanese trading relationships represents commitments that firms have made to each other, and in many ways, it is an arrangement that is akin to an exchange of hostages (Williamson, 1983). Japanese automakers own significant portions of shares of their major suppliers. This ownership stake builds trust and goal congruence between automakers and their suppliers. Interlocking stock ownership represents a commitment to the supplier that needs an incentive to make the customized investment automakers requires. Those suppliers can be called as subsidiaries or affiliated companies of automakers depending on the proportion of share-ownership.⁷

3 Forced Competition

3.1 Three Types of Suppliers

⁶ Dyer and Ouchi (1993) find that suppliers send guest engineers to work at their customer technical centers on an ongoing basis. Toyota had about 350 guest engineers at its main technical center in 1992. These engineers become a part of the design team and are given desks to the Toyota engineers.

⁷ Toyota and Nissan own an average of 23 percent of the stock of subsidiaries or affiliated companies, whereas U.S. automakers do not own stock in their suppliers in the sampling survey done by Dyer (1996a).

A supplier typically has contracts with an automaker both for a variety of components in a single model and for similar components in different models. There are usually several companies within the automaker's supplier group qualified to manufacture a component. The other qualified suppliers may be currently producing similar components for other models. Within an assembler's hierarchical structure of suppliers, there are two basic types - design approved (DA) suppliers and design supplied (DS) ones (Asanuma, 1985a). DA suppliers provide both design and production services to the automaker's specifications while DS suppliers produce a component from drawings provided by the automaker. DA parts usually include air conditioners, body and instrumental panels, engines, and transmissions. The survey indicates that DA parts account for 62% of total components of Japanese automakers in the late 1980s. On the other hand, DS parts account for 81% in the U.S. automakers in that period. The U.S. automakers have recently changed to relying more on DA parts (Clark and Fujimoto, 1991).

The DA suppliers are usually those with the close and long-term relationships with the automaker. Most of them are subsidiaries or affiliated companies of the automaker. First-tier and the DA suppliers have a greater number and more profitable contracts with the automaker. The automaker usually has less detailed knowledge of the DA supplier's production costs that give the supplier an advantage in price negotiation. There are many thousands of suppliers in the automaker's supplier hierarchy and only a few hundred at the first-tier.

Third type of supplier is commodity supplier who simply manufactures parts designed by the automaker, usually standardized parts such as batteries, glasses, and tires. Since such parts are not customized to a particular automaker, it can be thought close coordination for that parts may be less important than for other parts. Commodity suppliers may have long-term relationships with their automakers if the suppliers' unique manufacturing capabilities make them necessary.

3.2 Supplier Competition for Design and Manufacturing

Cusmano and Takeishi (1991) survey purchasing agents and product planners of the largest Japanese automakers, US automakers, and the U.S. operations of Japanese automakers. They find sole sourcing is not uncommon among the U.S. automakers, nor is multiple sourcing uncommon among the Japanese automakers, though on average the Japanese use fewer suppliers per part.⁸ They also find that suppliers to U.S. firms play a large role from an apparently early stage in development, though Japanese suppliers still play a greater role in design. Japanese firms usually employ a multiple sourcing policy to

⁸ Dyer, Cho, and Chu (1998) find exclusive relationships between automakers and suppliers with high level of interaction in Korean automobile industry.

force suppliers into intense competition, even though they forgo economies of scale (Asanuma, 1985b). Japanese automakers are less likely to rely on one supplier than the U.S. automakers are. On average, each Japanese automaker purchases each part from approximately three suppliers, and each supplier sells the same part to approximately three automakers (Cusumano and Takeishi, 1995). They maintain competition so that one supplier's ability to generate cost or quality improvements provides an incentive for the other supplier to keep up.

The typical production cycle for a car model begins with a lengthy design and development stage followed by a 4-year production stage. The automaker usually invites several qualified firms in the supplier group to compete for a contract to design and produce a component for a new model cycle. A DA supplier will undertake the design and development as well as tooling for production with no guarantee of reimbursement by the automaker. For DS supplier, the automaker will guarantee reimbursement for specific investments such as tolling. Whether DA or DS, the automaker makes a firm commitment to use the supplier for the 4-years production life of the model.

Recent evidence suggests that although the Japanese companies encourage their suppliers to make customized investments, they use forced competition with one or two competitors to make sure that their suppliers are disciplined by the ever-present threat of competition. This competition often begins at the design stage when the automaker invites guest engineers from two suppliers to work at the automaker's technical center as part of the design team. As the design work proceeds, the automaker meets with each supplier separately to review proprietary ideas and eventually decides which supplier has superior product design. The losing supplier may become a secondary supplier for that model or may simply have an opportunity to develop a design for a different model. Liker, *et al.* (1996) shows that Japanese suppliers face less competition in the design and manufacturing stage than U.S. suppliers, though Japanese suppliers do face considerable competition - about two competitors for a given design and manufacturing contract on average.⁹

The buyer can strengthen the incentives for cost or quality improvements by making the price paid to each supplier dependent on relative performance. The second-place supplier loses out on additional business and the bonus for good performance. However, the buyer does not abandon a weak supplier, but works with it to help it compete with the strong suppliers. The forced competition among the limited suppliers can be explained with the theory of principal-agent. The theory focuses on how a principal may

⁹ Liker, *et al* (1996) examines supplier involvement in design based on a 1993 survey of approximately 143 Japanese and 189 U.S. automobile component suppliers. The survey was based on mailed, self-administered questionnaires. Respondents were asked to identify their largest dollar-volume automobile component or component group. The questions were also to be answered with their largest automobile customer.

compensate an agent for works delegated. The theory deals with the design of optimal compensation scheme in order to motivate an agent to work efficiently under the situation where an agent's action is not observed perfectly. According to the literature in the use of contests to compensate multiple agents, contests among the suppliers can work as a mean for providing incentive to suppliers.¹⁰ The contest serves to make the supplier's reward dependent on his rivals' efforts as well as his own, while the reward is actually independent of the supplier's cost. It can be shown that contests outperform individual-agent-incentive schemes in solving the problem in unobservable efforts when suppliers face some degree of common production uncertainty in addition to their own uncertainty. Thus, the buyer as a principal can increase incentive of supplier, as an agent for enhancing efficiency of production through multiple suppliers.

4 Transaction-specific Investments

4.1 Investments in Specific Assets

Automaker-supplier relationships in Japan are characterized long-term and highly committed, whereas they are more likely to be governed by short-term, arms-length relationship in the U.S. One of the major benefits of the Japanese supplier involvement in design is access to highly customized design with unique features for a particular buyer's needs.

Japanese automobile suppliers develop more unique parts for their customers and make greater investments in specialized assets than U.S. suppliers do. A first-tier supplier does not usually receive a separate payment for the investment in tools, dies, molds, and jigs that are highly customized and would need to be scrapped if the automaker cut off orders to the supplier. The suppliers' specialized capital investments make them highly dependent on the automakers, with the real possibility of hold-up problems. However, automakers are also significantly dependent on the suppliers. Most DA suppliers' parts are "black box," meaning that the automaker provides only very general specifications while the supplier does all of the detailed functional specifications and blueprints. Consequently, DA suppliers have significantly more knowledge about the design and manufacture of the part than does the automaker. Because black-box parts are customized to a specific model, the automaker is highly dependent on the supplier. If the supplier did not perform as desired, the automaker would have difficulty simply shifting business to another supplier, given the product's specific nature.¹¹ Some DA suppliers claim that they do not provide the automakers with all of the specific functional

¹⁰ Green and Stokey (1983); Lazear and Rosen (1981); Nalebuff and Stiglitz (1983) have examined the use of contests to compensate multiple agents.

¹¹ Most automakers in Japan restrict suppliers to sell design specification to other companies (Fair Trade Commission in Japan, 1993).

details when they submit their design drawings for approval, but intentionally leave out certain important details such as tolerances. Because the automaker does not know the part's exact design specifications, it is difficult to change suppliers, resulting in the automaker's dependence on the supplier. Asanuma (1989) argues that the more technological initiative DA suppliers have, the more likely they are to earn from supplying relations with automakers. Automakers can respond to it by investing in technological development or starting in-house development and production, or finding rival suppliers.¹²

Under these conditions, each party makes commitment with substantial transaction-specific investments, which creates quasi rents only if the both parties continue working together. If the relationship is terminated, each party loses some portion of the rent. Thus these specialized investments create interdependence, which in turn creates incentives to cooperate. According to transaction cost economics, it may be difficult to specify ex ante precisely how the assets will be employed in production even if transaction-specific investments are entirely contractible. Once transaction-specific assets are in place, the characteristics of the transaction and the gain from trade will be determined by ex post bargaining between the buyer and the supplier. Highly transaction-specific investment should be avoided by buying commodities in the market and making customized products in-house where the hierarchy can be used to reduce transaction costs (Masten, Meehan, and Snyder, 1989; Monteverde and Teece, 1982; Williamson, 1979). By contrast, Japanese automakers have increasingly delegated responsibility for design and manufacture of more complex subsystems to a close-tied group of suppliers who are willing to make significant transaction-specific investments in developing customized parts for the buyers. Moreover, Japanese automakers seem willing to allow suppliers to development capabilities to receive the long-term advantages of cooperation. In fact, transaction-specific investment increases mutual dependence if they are made equally by both parties. Since these specific investments increase the exit costs for a party and reduce the potential for opportunistic behavior, parties are likely to be comforted and thus may increase their commitment to each other. This, in turn, creates incentives to cooperate, and the reduction in cost and improvements in quality that are gained through the cooperation outweigh the risks of opportunistic behavior from the parties involved.

Liker *at al.* (1996) shows that suppliers have a close and long-term relationship with

¹² Denso Corp. is one of the major suppliers of electronic components to Toyota. Denso supplied 50% of Toyota's total electronic component needs in 1997. Toyota maintains multiple sourcing policy. The second source can give Toyota the leverage to impose its stringent schedule of cost reduction on the primary source. But Toyota cannot find rival suppliers of Denso who could serve as alternative sources of electronics parts. Consequently, it has been decided that Toyota itself must become the rival to avoid heavy dependence on Denso for electronics (Lincoln, Ahmadjian, and Mason, 1998).

their largest customer both in Japan and U.S. automobile industry. They also suggest closer, more long-term relationships in Japan, though these differences are not as large as expected. It is observed that Japanese automakers have the most dedicated relationships with subsystem suppliers and the least dedicated with lower-tier suppliers. Japanese suppliers are considerably more dependent on their largest customer. These results suggest U.S. automobile companies are as likely as Japanese companies to out-source design, given suppliers early information about product development, and allow them to develop unique design capabilities the automakers cannot replicate.¹³

4.2 Investments in Customized Assets

Japanese suppliers dedicated some of capital investments to their primary customer that these customized physical assets that could not be re-deployed if the customer terminate to purchase from them. Clark and Fujimoto (1991) suggested that dedicated physical assets play an important role in the improvement of product integrity and thus in overall product quality. It generally requires various types of investments in customized assets by one or both firms in order to make the production and physical distribution more efficient. Dyer and Ouchi (1993) identify three types of customized investments employed in supplier relationship: (1) site-specific investment; (2) physical investments; (3) human capital investments.¹⁴

(1) Site-specific investments: Site specificity refers to the situation whereby successive production stages that are immobile in nature are located in close proximity to one another to improve coordination and economize on inventory and transportation costs. Plants are located so that they are dedicated largely to a particular customer in order to improve coordination and economize on inventory and transportation costs. Supplier relations in Japan involves building a supplier plant within fifteen miles of the customer plant to reduce transportation costs, improve delivery, and generally improve coordination. It allows supplier engineers to work daily at customer technical centers with customer engineers in designing new products.

(2) Physical investments: Manufacturing equipment such as tools, dies, molds, jigs, machinery, information system and so on is customized. Physical specificity refers to transaction-specific capital investments. Physical asset specialization allows for developing unique feature of product and may improve quality by increasing product integrity.

(3) Human capital investments: Dedicated design to manufacturing requires engineers

¹³ Korean automakers demand a high degree of loyalty from their suppliers. Suppliers make highly customized investments and coordinate closely with their automakers (Dyer, Cho, and Chu, 1998).

¹⁴ Asanuma (1989) identified that transaction-specific investments are prevalent in supplier relations in Japan, and developed the notion of "relation-specific skill."

to develop significant customer-specific knowledge. Human capital specificity refers to transaction-specific know-how accumulated by trade partners through long-term trading relationships.

Mutual human capital increases as trade partners develop experiences working together and accumulate specialized information, language, and know-how that allows them to communicate efficiently and effectively. It involves transferring the buyer's executives or employees to the supplier to work on a temporary or permanent basis, and sending consultants to work with the supplier to improve production methods, implement just-in-time delivery systems, or assist in solving other problems.

Dyer (1996a) shows greater transaction-specific investments are sunk in Japanese supplier relations than those in the U.S. Japanese automakers are more effective at coordinating the supply-production system. Greater mutual human capital gives Japanese companies the ability to rapidly disseminate information and to improve interfirm communication, thereby coordination in supplier relations. Japanese suppliers are much more likely to share key task-related information with automakers, notably technical information and information on their production costs. Furthermore, Japanese automakers are providing more information to assist affiliated suppliers in reducing costs, increasing quality, and improving delivery.

4.3 Relationship between Transaction-specific Investments and Performance

Dyer (1996b) examines the relationship between inter-firm asset specificity and performance in the automobile industry. The survey consists of two Japanese automakers and all three U.S. automakers and a sample of their suppliers. The unit of analysis is the supplier-automaker relationship. Toyota and Nissan's supplier indicated that approximately 21 percent of their capital equipment investments were not re-deployable, compared with 20 percent for Ford suppliers, 14 percent for GM suppliers. On virtually every assets specificity measure, Japanese automakers and their suppliers were more specialized than their U.S. counterparts. Moreover, with regard to site and human asset specificity, Toyota's supplier group was more specialized than Nissan's supplier group. More specifically, it examines the extent to which differences in supplier-automaker asset specialization may explain performance differences between Japanese automaker and the U.S. The findings indicate a positive relationship between supplier-automaker specialization and performance. In particular, the data suggest a positive relationship between inter-firm human capital specificity and both quality and new model cycle time. Moreover, site specialization is found to be positively associated with lower inventory costs. The findings suggest that in the automobile industry a tightly integrated production network characterized by proximity and a high level of mutual human capital specificity will outperform a loosely integrated production network

characterized by low level of inter-firm specificity.

A firm may choose to seek efficiency advantages by creating assets, which are specialized in conjunction with the assets of a trading partner. These transaction-specific assets as the vehicle through which trading partners are able to generate relational quasi rents. Although investments in specific assets boost productivity, the incentive to make transaction-specific investments is tempered by the fact that the more specialized a resource becomes, the lower its value in alternative uses. The contingent value of a specific resource exposed its owner to a greater risk of opportunism than the owner of generalized resources. According to the transaction cost economics perspective, if trade partners make transaction-specific investments, then they must safeguard against the hazards of opportunism. Source of advantage is contingent on the costs associated with safeguarding those investments. Transaction-specific investments are more likely to result in high performance when trade partners have developed safeguards which can control opportunism at relatively low cost and task activities are characterized by a highly degree of interdependence.

It would be misleading to suggest that asset specificity is the only, or even the primary, factor that contributes to performance differences among automakers. Undoubtedly numerous other factors not captured in the model contribute to performance differences. The optimal level of inter-firm asset specificity will depend on the costs of safeguarding specific investments. If the safeguard costs are particularly high then the gains from specialization may be outweighed by the costs. The fact that *kankei gaisha* (affiliated suppliers) exhibit greater asset specificity than U.S. in-house division is intriguing. Trust may be a highly effective and low-cost means for safeguarding transaction-specific investments. One can argue that constraints on opportunism within the Japanese institutional environment allow Japanese companies to generate relational quasi rents more effectively (Dyer, 1996b).

The efficient level of specificity between trading partners is likely to be contingent on the task activities and degree of interdependence. Generally speaking, the greater the interdependence, the more both parties will benefit from investments in specialized assets. The findings suggest that when working activities are highly interdependent as they are in the automobile industry, the Japanese automakers are more efficient than the U.S. These transaction-specific investments create substantial buyer and supplier switching costs and, once sunk, make the two parties highly interdependence. This interdependent relationship can create potential contracting problems if the parties do not completely trust each other. Toyota's just-in-time (JIT) system is a good example of how customized investments can create value. Just-in-time system was designed to reduce complexity and costs by eliminating inventories and work in process and to ensure that there was no redundant buffer stocks, distribution facilities, or quality

inspections. However, to implement JIT efficiently, Toyota and its suppliers had to make customized investments in information systems, plants, and flexible manufacturing systems that created mutual dependency.

5 Supplier Involvement in Product Development

5.1 Suppliers' Roles in Product Development

One of the key features of Japanese supplier management is the substantial involvement of suppliers in product development. The early involvement of suppliers in product development is instrumental in reducing lead-time and avoiding costly production problems in automakers (Clark and Fujimoto, 1991). Clark (1989) finds that gains of Japanese automakers from having close relations with suppliers with superior capability in product development is a great proportion of unique parts without substantially increasing their own engineering costs. Kamath and Liker (1994) examine supplier-management used in product development practiced by major Japanese automakers. They observed closely coordinated buyer-supplier relationships in product development. It is widely believed that Japanese automakers treat virtually all their primary suppliers who deal directly with the automobile assembler as close partners. In fact, they typically regard only a handful as partners and assign more limited roles to the rest. Nor do buyers and suppliers work together in free-flowing teams to develop new products. Rather, Japanese automakers design their development programs tightly and use targets and prototypes to keep suppliers in line. Managed correctly, suppliers can help their automakers reduce lead times and manufacturing costs, and can aid the design process.

Japanese automakers assign suppliers different roles and give even first-tier suppliers varying levels of responsibility for the product development. The Japanese hierarchical structure simplifies communication between buyers and suppliers: first-tier suppliers coordinate the activities of the second tier and so on down the hierarchy, allowing customers to focus scarce communication resources on the top tier. Still, with 100 to 200 first-tier suppliers, an automaker cannot easily work with all of them as partners in product development. Successful partnerships depend on the right balance among supplier's technological capabilities, an automaker's willingness to share information, and both companies' requirements. There is a range of postures that automakers and suppliers can adopt within a long-term cooperative relationship. Suppliers may play different roles for different buyers. Each posture carries fundamentally different responsibilities during product development, and the automaker-supplier relationships vary considerably in closeness and intensity.

Primary suppliers top the hierarchy. These selected first-tier suppliers can also be thought of as full-service providers and DA suppliers. Primary suppliers are responsible for entire subsystems such as heating, ventilating and air conditioning. They often

participate in planning a new model even before the concept stage. Their understanding of their products and processes are superior to those of their buyers, and they suggest solutions to meet their buyers' price and performance objectives. They do their own testing and may even be responsible for testing other suppliers' parts. One of the major partners is Denso, which has grown to become an independent supplier of a broad range of components approaching to Toyota in size.

One type of DS suppliers refers to as a full-system supplier designing and manufacturing complex assemblies. Because they lack the technological capabilities of partners, they have less influence on design. The automaker gives these suppliers critical specifications for performance, interface requirements and space constraints. These suppliers then develop the systems on their own. Moreover, these suppliers take on major testing responsibilities: an automaker might not even verify the test data these suppliers submit along with its prototype.

Another type of DS suppliers has even less influence on design specifications. They may participate as consultants in meetings with the automaker during the concept stage, but the buyer determines in explicit detail the specifications for the part. The responsibilities of these suppliers include working out the detailed of the design and building and testing prototypes. But the automaker often conducts critical tests internally to assess the performance of the supplier's parts. Communications are not very intensive in the concept stage but intensify during prototyping, though not to the same degree as with primary suppliers.

Commodity suppliers simply manufacture parts designed by the automaker, usually standard parts. This role is appropriate when a customer chooses to supplement its own internal ability to design those parts with a commodity supplier's manufacturing capacity. Commodity-suppliers and their buyers may communicate frequently during the late-prototype and production-preparation stages, though communication is less intensive than it is in the other roles. These suppliers may have long-term relationships with their customers if the suppliers' unique manufacturing capabilities make them necessary or if the automakers' just-in-time manufacturing schedules are so tight that they require them. Suppliers and their customers become increasingly interdependent as they work together and their trading relationship grows. The buyer depends on the supplier's know-how and relies on the supplier to deliver on time and on target. Committed ever more heavily to the customer, the supplier depends on it for its future business.

Japanese automakers manage product development tightly. They set clear, understandable goals and communicate them consistently to suppliers, and they use targets and prototypes to enforce those goals. It is a simple, rigid process, much like an assembly line. Suppliers must keep the line moving as a highly regimental role. With a

highly structured and routinized product-development process, Japanese suppliers know exactly where they fit in and when, and this arrangement allows them to be innovative within clearly determined boundaries. Japanese automakers give marching orders to suppliers through carefully considered targets for price, delivery date, performance, and space constraints. Then the suppliers go off and design to those targets. There is usually little room for missing them because a deviation by one supplier will have implications for designers of mating components systems. Suppliers are expected to work hard to meet targets on time. Although buyers generally understand if supplier cannot meet a target, they are unsympathetic if the supplier shows signs that it has not worked very hard. The automaker is responsible for avoiding arbitrary and capricious changes in targets, because they would reverberate throughout the system and could disrupt other suppliers' design work.

Liker, et al. (1996) show that Japanese suppliers have more responsibility and a greater percent of subsystem suppliers designed parts themselves rather than jointly with their customer. There is a high level of supplier involvement in product development in both countries for the early stages of design, particularly among suppliers of major subsystems. Compared to the Japanese, U.S. suppliers are involved as early in the concept stage, take comparable levels of responsibility for design, analysis, prototyping and testing; are as likely to influence the requirements for their component and communicate even more frequently with their customer in the early stage of design. The U.S. automakers seem to be giving suppliers the responsibility and opportunities to exploit advantages of asset specificity and customer dependence on the supplier, without the same level of control as we see in Japan. They do not hold equity in the supplier, they do not represent as large a volume of the supplier's sales, they have less internal capability to design the parts themselves, and they are not repeating supplier's tests as frequently. There is no evidence in these data that Japanese suppliers are given greater responsibility for prototyping in Japan than in the U.S. Nor is there evidence that Japanese companies expect more complete prototypes and trust their suppliers enough not to replicate their component test. In fact, there is a significantly greater likelihood in Japan that supplier prototype tests are replicated. Japanese automakers are closely monitoring their suppliers' design.

5.2 Information Sharing in Product Development Stage

The Japanese supplier management suggests suppliers are trusted enough to be given model information relatively early in the design process - often at the concept or pre-concept stage - and suppliers, particularly the DA, are expected to participate in the development, beginning at the concept stage. Japanese DA suppliers wield significant influence over the process of defining customers' requirements so that the product

designs exploits the suppliers' unique manufacturing capabilities. Liker *et al.* (1996) indicate that almost all of the subsystem supplier in Japan receive early vehicle concept information from their customers although they do not necessarily have a great deal of influences over the setting of specifications for their subsystems. Contrary to the current literature that suggests Japanese automakers provide broader specifications that allow the supplier greater freedom to innovate, there were no Japanese-U.S. differences in the degree of specificity of the customer requirements. Japanese automakers were as likely as their U.S. counterparts to include actual dimensions in the requirements.

Japanese automakers provide early new model information to primary suppliers as the product concept is forming and issue only the minimum critical product requirements. U.S. automakers are thought to provide much more detailed specifications to their suppliers, allowing suppliers little latitude on specifying the design. Japanese supplier management involves intense and frequent communication during the product development cycle, particularly in the early stages when the product is being defined. This includes the intense and regular sharing of technical information to improve performance and reduce cost. Because these are long-term automaker-supplier relationships, the quality and efficiency of information exchange is significantly higher than it would be in new relationships. Thus mutual human capital investment enhances information sharing and communication between automaker and supplier.

There was considerably more frequent exchange of design information reported in the U.S. compared to Japan at all tier levels and all stages of the development process. The frequency of communication does not necessarily reflect the quality of communication. The Japanese relations have a long and continuous history of working together with their suppliers on design that they can communicate quickly and easily between them. Direct communication and relationships developed over a long period of time have made detailed and explicit written communications largely unnecessary. The result of this emphasis on communication is greater efficiency, faster product-development cycles. The greater frequency of information exchange about product development between automakers and suppliers in the U.S. may reflect less effective communication and decision making. Japanese suppliers are given specifications formally, asking to go off and do the design and return with a prototype on time. Communication has been streamlined so it is less frequent than in the U.S. The Japanese supplier relations can be thought to involve intense and frequent communication during the product development cycle, particularly in the early stages when the product is being defined. This includes the intense and regular sharing of technical information to improve quality and reduce cost. When a supplier gets a notice that the concept session for a specific vehicle model is being scheduled, there is no ambiguity about what the supplier must bring to the session; approximately when the first, second, and third prototypes will be due; and what

the buyer's expectations at each of those milestone events will be. One can find clear and consistent communication between suppliers and automakers in the Japanese relations.

5.3 Cost-reducing Efforts

Japanese automakers use a prolonged target-setting process to further explore the design and improve cost and quality. For example, Toyota gives them targets shortly after the 36-month presentation. Usually, maximum/minimum targets are generally expressed in terms of improvements over an existing product or the prototype in the presentation: Toyota is likely to want about 4 percent reduction in cost, or about 5 percent improvement in power output. During the months that follow, the suppliers diligently strive to meet the targets through design improvements. If the targets are met or exceeded, this eventually becomes the specification; if not, in negotiations, the supplier demonstrates with test data that the target is impossible, and the both parties compromise on a target. Toyota's engineers typically set targets on each component higher than really necessary by as much as 20 percent. They realize that, with production variations, this ensures a comfort zone so parts out of tolerance will actually be quality parts. They also want the suppliers to stretch; if the targets are too easy, the supplier will relax and not try to continuously push possible boundaries. If the supplier cannot achieve the very challenging goal, there is still room for negotiation (Ward, *et al.*, 1995).

Along with specifications for a component, Japanese automaker gives suppliers a target price (Asanuma, 1988b). The automaker decides what price the market will bear for the total vehicle and works back, roughly allocating costs to major subsystems and components. It then gives that cost to the supplier as a target at the beginning of the design process. When the Japanese automaker hands design specifications to its suppliers, these specifications include a target price, whereas U.S. automobile companies tend to rely more on direct market forces to control costs. Aggressive target prices are a major factor in driving supplier to use value engineering and reduce cost so they can make a profit at the price dictated by the customer. In fact, Japanese automakers also know the cost structure of their suppliers and generally set the target price very aggressively under the assumption that suppliers will continually reduce costs over experiences of the previous model. Supplier which are dependent on a principal customer have no choice but to reduce cost aggressively or risk losing the affiliation with that customer which could mean going out of business. The supplier has a great incentive to design the part so it can meet that price and still make a profit. Although there seems to be less flexibility in the target prices, there is much greater opportunity to explicitly consider trade-off between cost, performance in the early design stage (Ward, *et al.*, 1995).

Liker, *et al.* (1996) shows the data to support the more widespread use of target pricing in Japan and the greater prevalence of competitive bidding in the U.S. However, there is also considerable evidence that U.S. automakers are using target pricing. More than half of both the U.S. and Japanese suppliers said the use of competitive bids was a major way to set prices. Value engineering has become an institutionalized practice in these companies. The term used for identifying ways to reduce cost in the product/process development stage is value engineering. In fact each buyer has a formula for splitting the cost saving suppliers have achieved through value engineering between the customer and suppliers.

6 Convergence

Supplier relations in the U.S. are changing rapidly and are moving close to those in Japan. Cusumano and Takeishi (1991) present the results of a questionnaire survey to a sample of automobile manufactures in the U.S. and Japan during the spring of 1990. The survey provides evidence that U.S. automakers and suppliers have adopted at least some practices traditionally associated with the Japanese, thus indicating a possible convergence toward the Japanese supplier relations. The evidence shows that U.S. automakers appeared to move close to the Japanese model during the 1980s in several areas. It is found that decreases in the number of suppliers per part for the U.S. automakers during the late 1980s and early 1990s.

Liker, *et al.* (1996) find little support for the expected differences between Japanese and the U.S. automakers in supplier involvement in the design process. U.S. automakers have been increasing levels of supplier involvement in product development rivaling the Japanese. U.S. automakers are as likely as the Japanese to be more dependent on suppliers in design, give suppliers early information about product development, and allow them to develop unique design capabilities that automakers cannot replicate.

Once contracts were short-term, arms-length relationships, now contracts have increasingly become long-term in the U.S. Helper and Sako (1995) shows that U.S. suppliers provide buyers with detailed information about their processes, and buyers talk of partnerships with their suppliers. 87 percent of Japanese suppliers, compared with 68 percent of U.S. companies, thought that their customer's commitment would last more than four years, the typical duration of a model cycle. The actual record of trading with the same customer was significantly longer in Japan than in the United States.

In the U.S., more suppliers provided their customers with a detailed breakdown of the steps in their production process, an increase that is compatible with a trend toward

collaborative relationships between 1984 and 1993.¹⁵ More and more U.S. suppliers have given their customers a detailed breakdown of process steps, so that the gap between U.S. and Japanese companies was eliminated by 1993 in this respect. At the same time, automaker commitment, measured by either past record or suppliers' future projections, remains higher in Japan than in the U.S. In joint problem solving, suppliers' expectations of cooperation have increased in the U.S. but declined in Japan. In the U.S., suppliers are significantly more likely than they were five years ago to provide detailed information to their customers, have long-term contracts, believe that their customers are serious about product quality, and have defect-prevention systems in place.¹⁶ These results indicate progress toward cooperative relationships, in which suppliers play an important role in solving problems and developing new ideas about products and processes. Despite the movement toward the Japanese supplier relations in the U.S., suppliers with U.S. automakers do not feel that their customers are more trustworthy than were five years ago, do not receive much assistance from them in reducing costs or adopting new technology. One of the reasons behind seemingly contradictory trends can be the significant differences in purchasing policy among U.S. automakers. Therefore, there has been a limited, yet noticeable, convergence in the nature of U.S. and Japanese supplier relations.

Sako and Helper (1995) also show that there has been a considerable convergence in the methods of supplier relations towards those consistent with closer and longer-term relationships in Europe, the U.S. and Japan.¹⁷ An increasing proportion of European and U.S. suppliers have provided their customer with a detailed breakdown of process steps, so that the gap between European and the U.S. on the one hand and Japan on the other in this respect is eliminated by 1994. At the same time, customer commitment, measured either by past record or by suppliers' future projection, remains higher in Japan than in Europe or the U.S. Suppliers' expectations of joint problem-solving have increased in

¹⁵ Frey and Schlosser (1993) present a case of the Ford-ABB Oakville paint-finishing project that shows how cooperative and innovative buyer-supplier relationships can be achieved in the U.S. automobile industry.

¹⁶ Helper (1991) conducts survey of U.S. automobile suppliers and finds that automakers have increased the length of the contracts they offer, and suppliers are more likely to provide process information. However, suppliers still feel a lack of automaker commitment, since their level of trust in the automaker does not increase. Suppliers do not receive much assistance in reducing costs or adopting new technology. Moreover, performance improvements often come at the suppliers' expenses.

¹⁷ Sako and Helper (1995) conducts mail survey of first-tier parts suppliers in the U.S., Japan, and Europe during the period 1993-94. The findings are from responses from 1416 suppliers.

Europe and the U.S. but declined in Japan.¹⁸

7 Conclusion

Supplier relations are important areas for any firm that subcontracts portions of component design and production because this contributes to enhance value of product and efficiency of production. There have been significant differences in supplier relations between Japan and the U.S. Supplier relations in Japan can be described to have distinctive characteristics in several aspects compared with the U.S. counterpart. It is important to understand how efficiently Japanese supplier relations work and whether it can be applied in other countries. Furthermore, it is also important to understand the economic rationale of supplier relations in Japan.

In this paper, major characteristics of Japanese supplier relations are described in comparison with those of the U.S. Economic rationale for those relationships are provided. Furthermore, comparing supplier relations in Japan and the U.S., convergence in the nature of those are discussed. Significant features of Japanese supplier relations are characterized as follows: (1) long-term relationships and commitments with frequent planned communication, which reduced transaction costs between buyer and supplier; trust-building practices like supplier-assistance programs, owning stock, and keeping employees' personal ties that create a high degree of mutual trust; (2) forced competition among few suppliers focusing on improvements in costs and quality; (3) significant transaction-specific investments in plant, equipment, and human capital as well as to share valuable technical information; (4) substantial involvement of suppliers in product development with intensive and regular sharing of technical and cost information to improve quality.

Supplier relations in the U.S. are changing rapidly and are moving close to those in Japan. In the U.S., suppliers are becoming significantly more likely to provide detailed information to their customers, have long-term contracts, make efforts in improving costs and quality. These results indicate progress toward collaborative relationships, in

¹⁸ In the U.K. automobile industry the traditional buyer-supplier relationship was promised on stable, high volume, low variety production; relationship was one of close competition, with any new business secured by one supplier being won at bidding; price was the primary criterion on which contracts were awarded. Today, one can notice that several automakers are trying to shift toward reducing costs, and resolving scheduling problems, technical difficulties and the like through a process of cooperation rather than competition. The new relationship was characterized by far greater dependency as it involved suppliers in design, research and development work, and quality control, and this in turn facilitated more commitment from suppliers by allowing them to engage in more forward planning. Reducing the supplier base is one feature of the current transformation, long-term collaborative contracts awarded to a limited number of suppliers, and buying more assembled component systems rather than individual components. However, the structure of the U.K. vehicle industry presents severe technology transfer and to the close collaboration between buyers and suppliers. There is a largely independent and common first-tier of suppliers, as well as a common secondary/tertiary tier, which are shared by a number of vehicle assemblers (Turnbull, *et al.*, 1992).

which suppliers play an important role in solving problems and developing ideas about products and processes technology. Therefore, there has been a limited, yet noticeable, convergence in the nature of U.S. and Japanese supplier relations.

Despite many empirical studies on supplier relations, particularly in automobile industry, many empirical and theoretical problems are still left unknown. Can we identify same characteristics in supplier relations across industries in Japan compared with the U.S. counterpart? Whether can the Japanese practices be unique to the peculiar circumstances of the Japanese social system? Future research needs to provide empirical analysis based on different perspectives to gain insights.

How efficient Japanese supplier relations can be? Research need to combine the viewpoints of both automakers and suppliers. This analysis could lead to a better picture of how supplier relations as a whole affect efficiency and innovation in product development and production of automobile industry. Furthermore, theoretical models can be required to explain how efficient those relations can be.

To what extent can the nature of supplier relations in different countries converge? We know that each automakers attempt to seek more efficient way to manage supplier relations that work effectively in different countries. We need to continue to study how the circumstances affect characteristics of supplier relations in different countries to calibrate the likely patterns that supplier relations will converge in the future. Generalizations on a convergent pattern of supplier relations need longitudinal studies with multiple perspectives.

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