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Japanese Manufacturer-Supplier Relationships in International Perspective: The Automobile Case*

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1. Introduction

In the course of long years, Japanese automobile manufacturers have developed a complex system of relationships with their suppliers in Japan. There has been a widespread conception, since some time ago, that the nature of this system must be one of major factors that have contributed to the commercial success of the Japanese automobile industry. However, the precise nature of this system began to be uncovered only recently.[1)] The first task of this paper is to investigate, through an international comparison, which elements have been relatively characteristic to the system developed in Japan, and at the same time, have constituted vital factors that enabled these automobile manufacturers to attain competitive strength in the international setting.

Things are not, however, invariant over time. To adapt to the changes that occurred in recent years in their international environments, Japanese automobile manufacturers have set out to restructure their production networks. First of all, they either launched on afresh, or significantly scaled up, their offshore production. As a result, they have been facing the task of building up supply networks for this newly added part of their vehicle production activities. A significant portion of the suppliers that come to constitute these networks have to be located in the host countries. Secondly, the same automobile manufacturers have been facing the task of adapting the existent supply networks for their domestic production, partly to the recent appreciation of yen against dollars, and partly to the political pressures urging them to increase the use of imported parts and materials. The second task of this paper is to assess whether and how the vital factors that we found in the original Japanese system can be preserved in the emerging

global networks. Are they going to be sacrificed as a price for globalization of Japanese corporate activities, eroding over time? Or, on the contrary, can they be made available in other countries as well? If Japanese automobile manufacturers are earnestly trying to bring forth such vital factors in the host countries, what will be the implications of such efforts for the suppliers that have their national roots in the host countries, and more generally, for manufacturing activities in these countries? What are the difficulties that such pursuit has faced? And, finally, are not the adjustments that have been currently taking place in Japan working toward dissipation of these vital factors in their home land?

For both of the tasks to be tackled in this paper, analysis of the developments observable in the United States regarding the automobile production in North America seems to be both indispensable and illuminative. I therefore attempt to analyze the developments in the United States first. Then, I turn to look at the situations recently evolving in Japan.

The program of this paper is as follows. In Section 2, I outline the basic characteristics of the system of relationships which U.S. automobile manufacturers had developed with their suppliers in North America up to the early part of 1980s. This serve to clarify the basic characteristics of the system developed in Japan. Then I show how, and in which direction, U.S. automobile manufacturers have been trying to change the structure of their system in recent years. In Section 3, I step into more detailed aspects of the Japanese system, spotlighting those contractual practices and structural factors that seem to have especially contributed for the automobile production system in Japan to achieve efficiency. In Section 4, I analyze the current status of international adjustments. First, I look at the situation in the U.S., discussing the problems faced by U.S. manufacturers and Japanese

"transplants." Then I turn to the situations in Japan and analyze how the relationships which Japanese automobile manufacturers had developed until recently with their traditional suppliers in Japan have been affected by changes in their international environments. Section 5 concludes the paper.

In addition to the results reported in my previous articles, this paper is based on a research that I made in the United States in 1986 visiting both U.S.-based and Japan-based automobile manufacturers, and several Japan-based suppliers. It also reflects the results that I acquired in 1988 through visiting Japanese automobile manufacturers.

As I did in my previous articles, I mainly focus in this paper on the relationships between a given automobile manufacturer, which will be interchangeably called as the "core firm," and the firms that supply parts and/or components to this core firm. The latter firms will be called as "parts suppliers," or more simply, as "suppliers," when no fear of confusion arises.

2. Basic Characteristics of the U.S. and Japanese Systems of Relationships

Before launching on a comparative analysis of the U.S. and Japanese systems of manufacturer-supplier relationships, I should note that the time period from 1980 to 1983 marks a turning point in the history of the U.S. automobile industry. Until this industry was seriously hit by an economic downturn in 1980, relatively little attention had been paid by the constituents of the industry to the structure of the relationships that automobile manufacturers in other countries had developed with their employees and suppliers. But, after this crisis, in order to revive the industry, the

Big Three, a selected portion of their suppliers, and the UAW all began to search suitable ways to restructure the relationships that they had developed with each other, initiating earnest research on the structure which corresponding relationships have taken in other countries. By 1983, several reforms had already been introduced, and a process of restructuring of the industry, which is prospected to last for a number of years to come, were triggered. As a result, the U.S. automobile industry has been proceeding toward sharing more common elements with the Japanese automobile industry, than in 1980.

It does not seem appropriate, therefore, to stylize the modes of relationships to be compared as if they were invariant over time, or as if they were entirely country-specific. Nevertheless, it seems to provide a useful foothold for our analysis to grasp, at the outset, the differences between the U.S. and Japanese systems, that were conspicuously existent in 1980 and were still more or less observable as of 1986. The following comparisons are made to construct such a foothold.[2)]

2.1 Relative Number of Parts Suppliers

It has been remarked by several writers that U.S. automobile manufacturers have tended to deal with directly far greater number of parts suppliers in comparison to Japanese automobile manufacturers.[3)] Let us begin with this issue.

To do such comparison, obviously it is necessary to determine the number of parts suppliers to each core firm for all of the core firms to be compared. But, it is not so easy a task to determine this number securing the same basis, which is required for an exact comparison. This is because a

simpler term "supplier" is often used and this term includes suppliers of non-productive materials, such as stationery and furniture for offices of the company, as well as utilities and insurances. Even if we remove this category, the rest are not necessarily parts suppliers. Since there are suppliers of raw materials, and those of tools, equipment and construction services. Further, the degree to which core firms seek recourse to marginal suppliers differs by firm, and different figures emerge as "the number" of suppliers to a given firm, as we include or remove the number of these marginal suppliers. I cite below some figures that I collected, which are not elaborate and are shown here only to give a rough picture.

Number of Suppliers per Company

As of 1986, for GM, approximately 5,500 suppliers were supplying about 80% of the dollar value of the productive materials purchased by this company for their vehicle production in North America. Suppliers of basic raw materials such as iron and steel, and of tools and plants are not included in this number.[4)] If we include suppliers of tools and plants, basic raw materials, non-productive materials, and marginal suppliers, the number of suppliers to this company reached 35,000. In the same year, for Ford, there were 2,500 "production suppliers", which are suppliers of parts and components, for the vehicle production in North America by this company. Of these 2,500, the largest 150 firms were supplying over 60% of the dollar value of purchased parts and components. Again in 1986, for Chrysler, "production suppliers" numbered roughly 2,000. If we include "nonproduction suppliers, " the number of suppliers could reach 15,000. Of the 2,000 production suppliers, 300 firms were supplying 90% of the dollar value purchased.

Let us look at the Japanese side. The parts suppliers to Toyota form an association named Kyohokai, which consists of three regional associations. Some suppliers are members of more than one regional associations. If we remove double countings of these firms, the number of member firms of Kyohokai was 172, as of 1986. Although Toyota sometimes purchases parts and components from firms which are not members of Kyohokai, the share of such firms in the monetary value of purchased parts and components seemed to be below 10% as of 1986. The suppliers of tools, equipment, and construction services to Toyota form a separate association named Eihokai, whose members numbered 61, as of 1986. If we add up the members of the two associations, and remove double countings, the sum total was 224 in this year. At the same time, we should note that suppliers of basic raw materials such as steel and oil do not participate in either Kyohokai or Eihokai.

The great majority of the parts suppliers to Nissan form two separate associations: Takarakai and Shohokai. Takarakai consists of the subsidiaries and related companies of Nissan, and medium and small sized companies which heavily depend on Nissan as the major customer of their products. Shohokai consists of those well-established parts manufacturers who supply to all major car manufacturers. As of 1983, members of Takarakai numbered 109, and those of Shohokai numbered 54. In the same year, Nissan bought approximately 55% of the monetary value of the purchases parts from members of Takarakai, 35% from members of Shohokai, and 10% from non-associated parts manufacturers.

For Mazda, as of 1982, there were 106 suppliers of processing services. Of these 106, 70 were members of Toyukai (a cooperative union of small sized local suppliers to Mazda). Besides, there were 232 parts suppliers, of which 12 were members of Toyukai, and 174 were constituting Yokokai, a nation-wide association of less dependent parts suppliers. If we include suppliers of raw

materials and of tools and equipment, including non-associated firms for all categories, the total number of suppliers to Mazda were 1, 288 as of 1982.

Overall, the figures shown so far seem to warrant the generalization that U.S. automobile manufacturers have had a significantly larger number of parts suppliers per company in comparison to their Japanese competitors.

Number of Suppliers per Plant

To cast light from a slightly different direction, let us have a glance at the number of suppliers at the level of a typical vehicle assembly plant. For GM, as of 1986, this number ranged from 300 in the case of newer plants such as Lansing Plant, to 1,200 in the case of some plants that were engaged in assembly of relatively larger number of car makes, and the typical number was 800. In contrast, for Toyota, its Takaoka Plant, one of typical assembly plants in Japan, had only 125 suppliers, as of 1983. The difference stands out all the more, if we take note of the following facts. First, a typical vehicle assembly plant in the U.S. has a capacity to assemble roughly 20,000 units per month, but representative plants in Japan such as Takaoka Plant have capacity to produce twice as large units. Second, a typical vehicle assembly plant in the U.S. has no stamping shops inside, stamped large body panels being sent from the metal fabricating plants which belong to the same corporation and are located often in places remote from the assembly plant in question. On the other hand, a typical Japanese vehicle assembly plant has a stamping shop inside to feed large body panels to the adjoining body shops.

Factors that Underly the Differences in the Number of Suppliers

The U.S.-Japan differences seen above in the numbers of suppliers at the corporate and plant levels seem to stem from the following factors.

(1) The difference at the plant level seems to show that U.S. automobile manufacturers have tended to, in comparison to their Japanese competitors, (1-a) buy a significant portion of the parts that they purchase from outside firms in relatively lower stages of assembly; and (1-b) assign, on the average, relatively smaller number of part categories to each of the sources.

(2) The difference at the corporate level seems to show that U.S. automobile manufacturers have tended to, in comparison to their Japanese competitors, (2-a) keep on the first tier relatively larger number of marginal suppliers, which receive orders only intermittently, and (2-b) have relatively larger number of local suppliers, which supply only to one single plant or at most to a few plants of a given automobile manufacturer.

Such reasonings are indeed consonant with the perception that has come to be shared widely among the executives and managers who are responsible for purchasing activities of U.S. automobile manufacturers. They have perceived that factors such as (1-a), (1-b), (2-a), and (2-b) are problematic and have to be reformed. But, why are these factors problematic? And how U.S. automobile manufacturers have been trying to reform these structural elements of their system? Before tackling these questions, we should look at another layer of the system: the basic characteristics of contractual practices that have been developed on such a structure.

2.2 Ordering Patterns

Two Types of Suppliers in the U.S.

There seem to have been basically two types of parts suppliers in the United States. One consists of those firms which have supplied relatively sophisticated components such as transmissions, axles, brakes, radios, and so forth, accumulating considerable proprietary technology. They are well-known independent firms like Borg-Warner, Bendix, Dana, and TRW, and have been supplying to each of major automobile manufacturers. The proportion of such firms in the total population of automotive parts suppliers is small. For each of the components that belong to this category, two to five firms have been competing on a nation-wide scale. The other types of parts suppliers are constituted by those firms which have supplied simpler parts with relatively less proprietary technology. Such firms are quite large in number and of relatively small size, often supplying only on a local basis.

The components supplied by the former types of suppliers do not change annually. Transmissions typically have a life of eight years, and for various engine parts the life is seven to ten years. To manufacture such components on a large scale in response to the specifications and/or blueprints issued from a given automobile manufacturer, investments in equipment specialized for the transaction often become desirable, and such investments require several years for amortization. On the other hand, there are a large number of parts like grills, trims, small stamped plates, etc., that change annually, or bi-annually, as the automobile manufacturer exercises small face liftings. These parts also require investments in specific dies, injection molds, or other toolings that are usable only for the production of particular parts designed

for a particular model of vehicle. But, usually the automobile manufacturer in question bears the money required for preparation of such specialized toolings, holds the title thereof, renting the toolings to the suppliers concerned, as long as the transaction of the same item between the parties continues.

Practice in the U.S.

According to the differences between the two categories of parts and suppliers, different contractual practices have been used at Ford. For those kinds of parts that are supplied by our second category of suppliers, the standard practice has been to set the duration of the contract as one year and, at the same time, confer the purchasing agent an option to extend the contract one more year at the end of the first year. Such type of contract has covered a great majority of the parts. But, for some portion of the parts supplied by the first category of suppliers, long-term contracts have been used, if the part in question evidently requires investments in specialized equipment. The duration of such contracts have been usually three to five years. Further, to guarantee the amortization of such dedicated equipment, a special formula has been used to adjust the price of the part according to the actual rate of operation of such machines. We should not overlook the fact that such kind of arrangements have been existent in the U.S. since before 1980.

But, the dominant tendency in the U.S. before 1980 was to set the formal effective period of the contract as one year. Moreover, the dominant policy taken at the headquarters of automobile manufacturers, especially of GM, was to urge their purchasing agents to conduct a market survey of similar parts

every time when the specified one-year period ended and, further, to seek approvals at the corporate headquarters if he or she wanted to renew the contract. Precisely because of such a policy, in many cases, the contract was terminated when its formal effective period expired, even for those parts that remain unchanged for several years. In other words, concern to secure the cheapest possible price through the mechanism of competitive bidding was given the first priority. Building up mutual trust between the parties and pursuing cost reduction in a cooperative manner through continual technological interactions between the parties would require that the relation between the parties not be terminated very easily. Such long term considerations had given way to short-term economics until the turning point of 1980-1983 came.

Practice in Japan

In Japan, as reported by Asanuma (1984a, 1984b, 1988), the formal effective period of the contract that governs the relationship between the parties itself, the standard duration of delivery of a given part, and the established interval for price adjustment are all different. Formally, the "basic contract," which determines only broadly the general obligation of both parties, is effective only one year. But, it is automatically renewed unless either side raises an objection. Let us therefore forget this contract for the time being. How long is the delivery of a given part by a specific supplier supposed to continue? The answer is: it begins and ends with the life of a given model of vehicle. Since major model changes have been exercised every four years recently in Japan, the standard duration of delivery is four years, and interim price adjustments are made twice a year.[5)] Thus, on the whole, the Japanese system has awarded a longer duration

of delivery to each supplier, in comparison to the U.S. system. Further, as I elaborate later in this paper, the relation between the parties normally continues beyond the life of a given model. Combined with other elements of practices, this has significantly contributed to nurture the suppliers' sense of commitment and to promote their continual efforts to improve both manufacturing processes and the design of the product.

2.3 Reforms Introduced by U.S. Core Firms

For each of the aspects compared between the U.S. and Japanese systems in the foregoing two subsections, U.S. automobile manufacturers initiated various efforts to reform their traditional structure and practices.

Toward a Smaller Number of the First Tier Suppliers

As to the issue of relative number of suppliers, the core firms have sought to reduce the number both at the corporate and plant levels.[6)] Obviously, this is not a simple problem of number, but involves various processes of restructuring.

For instance, until the early part of 1980s, in GM, seats had been assembled at the site of each vehicle assembly plant, the company purchasing frames, adjustment levers, springs, paddings, and seat-covers from outside firms. But, the company changed this practice since then; currently seats are being purchased from outside. With this change, the number of suppliers in the area of seats was drastically reduced. While in the former system, typically eight to ten suppliers were respectively supplying each of the items enumerated above, they have been replaced by one seat supplier in the current

practice. One of the former suppliers has been upgraded to the seat supplier, but the rest have become suppliers to this supplier, becoming suppliers on the second tier viewed from GM. This exemplifies how U.S. automobile manufacturers have been trying to create a "system source," out of a number of suppliers of constituent parts of a "system component."

Tail-pipes constitute another example of a system component, which is made through assembly of a number of constituent parts. Previously in a plant of GM, quotations were collected from a number of suppliers for each of such constituent parts, for each of the car lines assembled in this plant. But, the plant has come to use a fixed supplier for each kind of such parts, while the assembly of tail-pipes is still done in the plant. In this case, a shift from "multiple-sourcing" to "single sourcing" has occurred.

Toward Longer and Closer Relations with the Selected Suppliers

Concerning ordering patterns, the attitude of core firms has changed to seek longer relations with their suppliers. While the form of the contracts itself remain largely unchanged, the philosophy has been significantly changed. For instance, GM has sought to base its relations with suppliers on what the officers of the company call "Cradle to Grave Philosophy." This means that the company would start from asking a supplier to participate in the development of a given part, then entrust the manufacturing of this item to this supplier, continuing to order from this firm until the model life of the part comes to end.

All of these reforms point to the following two targets.

(1) To have more selected number of suppliers who have stronger technological capabilities than heretofore.

(2) To change the way to secure reasonable parts prices from the traditional mechanisms of competitive bidding and of arms-length bargaining to something which is based on systematical pursuit of cost reductions and accompanies cooperative relations.

Closely related to the target (1) above, a slogan has been repeatedly heard from purchasing specialists in U.S. automobile manufacturers. (1a) To bring forth early involvement of suppliers in development.

But, what does this phrase exactly mean? And what kind of achievements are observable in the Japanese system regarding such goals as (1), (1a), and (2)? These questions are taken up in Section 3.

3. Characteristics of the Japanese System in More Detail

In this section, I start from a discussion on the meaning of "early involvement of suppliers in development." This serves to illuminate a characteristic of the Japanese system, which has not been noticed in the traditional literature on the Japanese subcontracting system (shitaukesei). Then I proceed stepwise to spotlight several aspects of the Japanese system which have relevance for the tasks of this paper.

3.1 Early Involvement of Suppliers in Development

To determine the exact meaning of the phrase like (1a) given at the end of Section 2, we have to study the time structure of the development process of a new model of vehicle. Figure 1 shows, based on my interview studies, major steps in the development schedule for the case of Japanese automobile

manufacturers, plotting the typical timing of each of the steps along the time scale.

As I remark earlier, the current practice in Japan is to make major model changes at four-years interval, in the case of passenger cars. The concept study for the next model starts right after the start-up of the commercial production of the present model (the point T_1 in Figure 1), 48 months prior to the target date of the start-up of the commercial production of the next model. But, this concept study is done only as a work of a tiny staff group responsible for the product planning of this particular model. The development stage as a full-scale organizational work starts typically 36 months prior to the target date (T_2 in Figure 2). By the time point T_3, which is roughly 24 months prior to the target date, determination of the detailed specifications for the vehicle, and basic specifications for the parts and components thereof, has to be done and draftings of the blueprints have to get started. By the time point T_4, the distribution of blueprints of parts or components for the first trial car is to be finished, and at T_5, which is two to three months after T_4, the first trial car is to be completed. Depending on the capabilities and practices of each automobile manufacturer and the nature of the new model, the actual location of T_5 on the time scale varies. But, on the whole, it comes to some point in the interval between 20 and 16 months prior to the target date. The pilot production at the vehicle assembly plant begins at some time between 9 and 3 months prior to the target date. Then, when the first car runs off the assembly line, the development stage ends and the commercial production stage starts up.

Now I turn to discuss when suppliers begin to participate. The time point at which suppliers begin to be involved in the development process differs according to the basic categories of the parts that I introduced in

Asanuma (1988) to classify parts and suppliers: "DS (Drawings Supplied) parts," "DA (Drawings Approved) parts," and "marketed-good type parts." Look at Table 2 in Asanuma (1988), which is reproduced as Table 1 in this paper for the reader's convenience. Subcategories I, II, and III in this table comprise DS parts, IV, V, and VI constituting the DA parts category. As the reader can see, the "DS parts," "DA parts," and "marketed-goods type parts" categories mean respectively "parts manufactured according to the blue-prints provided by the core firm," "parts manufactured according to the blue-prints that have been made by the supplier, in response to the specifications issued by the core firm, and have been approved by the core firm," and "parts offered by catalog to every core firm." Since the last of the three categories has no relevance in the present issue, I concentrate on the former two hereafter.

For DS parts, the involvement of the suppliers can only begin after the drafting of the blueprint of the part in question has been completed at the engineering division of the automobile manufacturer. Depending on the kind of the part, there are differences among various DS parts in the date of the completion of drafting. But, roughly we can say that, in terms of Figure 1, the involvement of the suppliers of DS parts begins only after the point T_4 has been reached.

On the other hand, for DA parts, the involvement can get started when the core firm transmits the basic specifications of the parts to the suppliers concerned. This is supposed to be done by T_3 in Figure 1. For some items, the process of development of the part by the supplier may begin by receiving only rough concepts from the core firm, right after the point T_2.

Thus, the phrase "To bring forth early involvement of suppliers in development" should mean: "To make a transition from a state, in which automobile manufacturers bought parts from outside firms predominantly as DS

parts, to another state, in which the automobile manufacturers buy more in the form of DA parts." Indeed, according to a purchasing manager of Ford, the following kind of change has occurred in the practice of their company. "In the past, the involvement of our suppliers began, depending on the complexities of the parts concerned, 6 months to 18 months prior to the target date of the start-up of the commercial production. But, at present, for many kinds of parts, the involvement starts 2 to 4 years prior to the target date." This description of the change clearly endorses my interpretation of the phrase.[7)]

While the stereo-typed view on the Japanese subcontracting system has characterized the system as something in which petty and dependent shitauke-kigyo (subcontractors) abound, U.S. automobile manufacturers have come to hold a different picture. Their perception is that Japanese automobile manufacturers have procuring a significant portion of the parts and components as DA parts, which in turn presupposes as a prerequisite a height of technological capabilities accumulated by the suppliers concerned; and that this must be one of the major competitive edges that Japanese automobile manufacturers can rely upon.

This perception seems to be far more realistic than the stereo-typed view. For instance, let us look back at the cases of seats and tail-pipes cited in Subsection 2.2. Japanese automobile manufacturers do not manufacture these items at their in-house plants. Instead, each of the core firms has two to three manufacturers for each of these items as their first-tier suppliers, keeping longstanding relations with each of them. When a new model of vehicle is developed, the core firm has only to present, to whichever supplier suitable to be selected in this round, rough specifications of the seat or tail-pipe required for the new model, with the target prices of that part.

Designing and drafting will be made by the supplier, keeping close contact with the core firm's staff. Meanwhile, apart from the involvement in the development of a specific model of vehicle, the suppliers, competing with each other, continually pursue improvements at their own initiative, collecting information from overseas of new materials and fashions, and doing research on new technologies themselves. The engineering division of the core firm can save such efforts. The core firm only has to maintain the abilities required for evaluation of the proposals from and performances of the suppliers.

One of the real characteristics of the Japanese system resides in the fact that Japanese core firms have been able to rely upon the suppliers of this sort to a greater degree than the core firms in other countries.[8)]

3.2 Downward Pressure on Prices and Cooperation of Suppliers

Another remarkable characteristic of the Japanese manufacturer-supplier relationships is the following aspect: the core firms have pursued, as a trend, that prices of the parts be reduced stepwise during the life cycle, and such requests have been met by their suppliers through perpetual efforts to reduce manufacturing costs.

I have mentioned in Subsection 2.2 a business practice in Japan that interim price adjustments are made twice a year. Like shunto (the spring offensive of labor unions for wage increase) and ichijikin kosho (the negotiation for the so-called bonuses), renegotiations on the prices of parts are held as a regular semi-annual events. But, it is the purchasing parties who take the offensive side at these renegotiations. At each occasion, they urge that price reductions be made by a given percentage, on average, and try to persuade their suppliers that it would bring forth happier results in the

long run for both parties. To cite an example, for an automobile manufacturer, the target average rate for price reductions was 2% at every six-months interval, during several years immediately before September 1985.

This may seem rather too demanding, but the fact is that suppliers have, on the whole, ended up each time with meeting their core firms' demand put on the table for bargaining, and in more or less cooperative manner. Underlying this outcome is a vague notion, widely held among Japanese suppliers, that they share common fate with their core firms, and that the price reduction is a kind of distribution of a fruit produced by cooperation of several parties concerned; just as they pay dividends to their stockholders, bonuses to their employees, taxes to governments and local communities, they think they ought to "pay" something to their customers. This notion seems to have been sustained by the following mechanism.

The starting price of a part is determined during the development stage through a negotiation. If we limit attention on the skeleton, the price agreed upon can be expressed as: $p(o) = (m^* + v^*)(1 + r^*)$, where m^*, v^*, r^* denote the assessed level of material cost, that of processing cost, and that of allowed gross margin, respectively. The value of r^* is historically given, but the margin $r(t)$ that the supplier can actually earn at each time point varies with time. In the early phase of the life cycle of the part, $r(t)$ is typically lower than r^*, since the actual levels of material cost and processing cost, $m(t)$ and $v(t)$, are typically higher than m^* and v^*, respectively. In this sense, the supplier has to run with "deficits" for some time. But, due to the learning effect, and improvements that the supplier makes on the manufacturing process (gorika), $m(t)$ and $v(t)$ decrease as time goes by, and will eventually go down below m^* and v^*. If, the sum of the "deficits" can be recovered well before the end of the life cycle of the part,

then, after the time point at which the recovery has been achieved, the supplier earns a kind of "surplus." This is the incentive that drives each supplier to perpetual efforts to achieve "gorika." And from the total sum of this "surplus," they "pay back" some portion to their core firms in the form of price reduction.

Note that this mechanism works for benefit of both parties, only in the case that core firms do not try to suck all of the "surplus." It is a kind of know-how required on the part of core firms, that they allow each of their suppliers to grow, on the basis of perpetual pursuit of "gorika."

3.3 Proposals by Suppliers to Improve Parts and Incentives for Such Efforts

Besides gorika, there is another route for suppliers to contribute to reduce costs to manufacture a vehicle. That is, through making proposals on possible modifications of the design or material of a given part. Frequently, a considerable reduction of the cost to manufacture the part can be achieved through such modifications, and automobile manufacturers encourage their own employees and their suppliers to make this kind of proposals.

For convenience, let us call those of such efforts which are made prior to the commercial production stage as VE (value engineering), and those which are made during the commercial production stage as VA (value analysis). As reported in Asanuma (1984 b), there are incentives for both VA and VE, in the contractual practices used by Japanese automobile manufacturers.

Suppose that, a supplier has made a proposal, which has proven to be effective to reduce the cost to manufacture a given part from 10,000 yen to 9,000 yen, preserving the performances and basic dimensions of the part intact. Then, at the nearest occasion to come for renegotiation, the core

firm would take the following action. First, the firm would give the recognition that, for this part, 10% price reduction has already been made and put it on record. Second, nevertheless, the firm would continue to pay 10,000 yen for each unit of the part for some time, making 1,000 yen as a reward for the proposal on improvement. The duration of extra payment differs according to the degree to which the core firm contributed to this proposal. For instance, the duration spans one year, if the proposal is solely based on the supplier's ingenuity; but it becomes a half year, if the core firm contributed half. This is the mechanism which confers the supplier an immediate reward.

But, at the same time, the fact that the supplier has made such a proposal has another beneficial effect for the supplier, which works in a longer perspective. It will influence the ratings that the core firm makes on this supplier, and as the cumulative ratings that this supplier receives from the core firm go up, the supplier will be conferred more favorable and/or challenging tasks. As has been analyzed in Asanuma (1988), this is the path through which the suppliers can upgrade themselves gradually and steadily.

3.4 Supplier's Responsibility for Delivery and Quality

It has become well-known that Japanese suppliers have shown high reliability in keeping up with the delivery schedule and the quality requirements. Apart from the issue of general moral attitude, this has some backings in economic mechanisms. A mechanism is the contractual provisions on the obiligations of suppliers and possible penalties, provided in the "basic contract." For instance, it is explicitly stated in this contract that the core firm can claim a financial compensation, when the firm incurred a loss

owing to a delay of delivery from the supplier. Likewise, it is stated in the contract that the core firm can claim a compensation, if, within a specified period after receipt, defective parts are found either in the core firm, or after the shipment of the final products to the market. Related to the second type provision referred to above, the following fact deserves attention. Until recently, it has been a general practice in the U.S. that the core firm assumes the sole responsibility for product liability after the final products have been shipped out to the market. The supplier's responsibility ends at the interface between the supplier and the core firm. In contrast, in Japan, the supplier's responsibility extends into the final consumer's market. If a defective part is found there, the supplier should bear the costs required for recalling of the cars from the market and for the change of the parts.

This is just the other side of the same coin that a large number of parts are bought as DA parts in Japan, whereas in the U.S., most of the parts have been bought as DS parts. If the core firm provides the blue-prints, specifying materials, manufacturing methods, and ways to test, as U.S. automobile manufacturers frequently do, then it is very natural that the core firm is required to assume full responsibility for product liability. As the suppliers come to take more and more active roles in the development, inevitably they are to take more responsibility, and generally, more risks.

3.5 Longstanding Relations with Ratings and Competition

However, to promote "consummate" cooperation, as opposed to "perfunctory" one, in the language of Williamson (1975),[9] providing such contractual provisions as we have seen above would not be enough by itself. Some mechanism which resembles to internal promotion of employees seems to be

important. As I have already touched upon in Subsection 3.3 with regard to the longer term incentives for VE and VA efforts, the core firms continually exercise ratings on their suppliers, and cumulative ratings that a supplier receives from its core firm have influences on the prospect of the upgrading of this supplier in the total supply network of this core firm, and, sometimes, in the similar network of other core firms as well. For the detail of this mechanism, the reader is referred to Asanuma (1988).

Relating to this mechanism, we should note the important role that the so-called "two-vendor policy" has played in the Japanese manufacturing systems. As I touched upon in Subsection 3.1, regarding purchasing of seats and tail-pipes, Japanese automobile manufacturers have always tried to create plural -- typically two to three, but at times five to six -- sources, sometimes including their own in-house plants, for any items as far as possible. This seems to be a little different from "multiple-sourcing" which U.S. automobile manufacturers have been accustomed to, in that the core firms care to develop close, longstanding, and cooperative relations with each of the sources, rather than concentrate on the working of competitive bidding. Nevertheless, through "two-vendor policy," Japanese core firms have successfully let their suppliers compete and emulate each other.

As I remarked earlier, Japanese core firms confer a stable status to a supplier, as long as the model life of a vehicle continues, once the supplier has been selected as the source of a particular part for that model. But, it is not guaranteed that this supplier can receive the order for the same kind of part, for the next model of the same car make. At every point when the development process starts for a new model, competition among the suppliers who have capabilities to supply the same kinds of parts comes to the fore.

Just as the same rank employees compete each other for faster promotion

inside the corporate organization, the suppliers of the same kinds of parts compete each other in the same network. And to give a fresh stimulus to the incumbent suppliers, Japanese core firms at some junctures admit new members to their supply networks, if only after a careful process of screening and testing.

This kind of competitive mechanism has been grossly overlooked in the traditional literature on keiretsu, family-like corporate groupings.

3.6 Flexible Production System

Finally, I should note that Japanese automobile manufacturers have sought, as a basic philosophy, and achieved to a considerable degree, a system which might be termed "flexible production system." Below I set out a brief explanation of the system.

At the outset, we have to recognize the degree of multitude of the variations of the final product that a typical contemporary automobile manufacturer offers to the public. If we look only at the level of different car makes such as Crown, Cedric, Corona, and Bluebird, the range of the choice offered by each firm is typically not so surprisingly wide. Even the largest companies offer 10 to 20 car makes. And if we do not go beyond this level, automobile production remains to appear a typical mass production symbolized by the conventional notions of moving assembly line and repetitive, monotone works. But, within each car make, automobile manufacturers have come to offer an increasingly large number of variations, based on different combinations of body types, engine types, transmission types, degree of luxury, optional parts, and colors. For instance, while the number of variations of Crown that Toyota was able to offer was 322 as of April 1966, it became 101,088 as of

April 1978. In all probability, such proliferation of variations itself may be traced back to practices in the U.S., as its historical origin. But, what Japanese automobile manufacturers have pursued to add is building up of an elaborate system of information processing and production control, which would enable them to manufacture a specific variation of the car make after the order was put in by the dealer, and deliver that car to the user who ordered this particular car within the shortest possible waiting time.

Of course, at least some part of the production process of that car has to be initiated prior to the receipt of the final order by the automobile manufacturer. Thus the basic monthly production plan has to be set prior to the beginning of the month, fixing the monthly volume of each of the major patterns of variation determined by combinations of body, engine, transmission, and luxury types. This monthly plan provides a major framework for the monthly operation of the whole system comprised of the dealers, the core firm, and the suppliers. What the system can offer as flexibility is a possibility that it can allow details of an order, that is, choices of optional parts and colors, to be filled in at a later date. Let us denote by $\underline{x}$ the allowable time lag between the deadline for the entry of such detailed part of an order and the planned date of assembly of the vehicle corresponding to this order. Further, let us denote by $\underline{y}$ the time necessary for the delivery of this vehicle to the user. The smaller the value of $\underline{x} + \underline{y}$, the system can be said to be more flexible. In comparison to their U.S. competitors, Japanese automobile manufacturers have achieved a production system with significantly smaller values of $\underline{x} + \underline{y}$, and more specifically of $\underline{x}$. Among Japanese firms, Toyota seems to have been the top runner in achiving such a system.

To achieve a flexible production system, two factors seem to be

especially important. First, the core firm should prepare monthly production plans with sufficient carefulness, and should not change the plans drastically. This is because those plans provide the suppliers and the in-house plants basic signals according to which they determine the range of possible changes that might arise subsequently and prepare their activities. Only on the condition that such frames are kept stable, quick fine adaptations at later time points become possible. Second, the suppliers and plants have to accumulate ability to make quick responses to incoming later signals for fine tunings. Quick die-changes and practices accumulated with the kanban system became powerful components of such ability.[10)]

4. Current Status of International Adjustments

In this section, I first discuss the situations observable in the United States. Then I turn to the situations surrounding the core firms and their suppliers in Japan.

4.1 Situations in the U.S.

In Section 2, I noted two main changes that U.S. automobile manufacturing firms have been bringing into their supply networks since the period of 1980-1983. They are: (a) reduction of the number of the first-tier suppliers; and (b) change of the relations with those suppliers who survived the screening into longer and closer ones. At the end of Section 2, I listed two targets that these changes seemed to point to. To recapitulate, they are: (1) to have their first-tier suppliers develop stronger technological capabilities, and

(2) to change the way to secure reasonable prices into something based on cooperative cost reductions. Looking from such goals, there should be no wonder if U.S. automobile manufacturers seek to restructure their supply networks into the direction that the networks come to share all of the properties of the Japanese system listed in Section 3. Indeed, my perception is that they are, and will continue to be, pursuing this direction, as a basic trend. In this sense, several properties of the system of manufacturer-supplier relationships that has been developed in Japan will become not particularly Japan-specific phenomena, if only slowly and may involve processes of trial and errors. In the following, I first set out the economic rationale for such development, and then assess the current situations.

4.1.1 Economic Rationale for the Transformation of Relationships

The fundamental driving force for such development is the basic trend found in the contemporary industrialized society. To meet with needs and tastes of the consumers, the firms have to prepare ever wider assortments of variations of the goods and services that they offer, and have to deliver a specific one of the variations to a specific user, responsively as orders are put in. Further, probably at increasingly shorter intervals, they have to exercise model changes, or add new product lines. In all of these, the firms have to struggle for creating some elements that serve their needs to differentiate their products, and to achieve such purpose effectively, the parts for these products have to become increasingly customized. Thus, both the final products and the components thereof are no more the standardized goods of the kind that the neoclassical economic theory presupposes for the applicability of its notion of the auction type market.

If the part in question is a standardized good, the "marketed-goods type part" in my word, its development can be done solely as the enterprise of its supplier, and the purchasing firms can concentrate its concern on prices and availability of the volume required for a specified period. For this kind of part, the workings of the spot market, the tactic of multiple-sourcing on the part of buyers, pursuit of economies of scale on the part of sellers via seeking after ever wider market of the same homogeneous good, and the function of inventory as buffers, all apply. But, as the parts become increasingly customized, and intervals for redevelopment become more frequent, such classical devices decrease their applicability. The basic reason is that importance of the "relation-specific skill," as defined by Asanuma (1988), comes to the fore. To develop and rely on such kind of skill, development of close inter firm relations, with due care to incentives and competitive stimuli, becomes indispensable. This is the economic rationale for the transformation of inter firm relationships the has occurred in Japan,[11] and are being sought in the United States.

4.1.2 Assessment of the Current Situation

Basic Stance of Japan-Based Firms

Traditions and business practices in the United States are in many respects different from those in Japan. For instance, regarding the issue dealt with in Subsection 3.2, the practice in Japan to provide occasions for price adjustments twice a year may well be tracable to the deep rooted tradition of having vacations and clearances of debts twice a year, at the Bon Festival (the Buddhist festival for the dead held in summer) and at the New

Year's Day period. And perhaps the post-war inflation made such frequent readjustments, of parts prices as well as wages, necessity for survival of the parties concerned. In any event, in the United States, intervals for wage and price adjustments have been longer. For parts prices, as we have noted, it had been one year until recently. For wages, the duration of a typical wage agreement had been three years, but it used to contain automatic adjustment clauses like COLA, until recently. To cite another example of differences in business practices, the price agreed upon for a part is supposed to contain freights in Japan, while F.O.B. prices are used in the United States.

For many of such differences, the Japanese "transplants" in the United States are ready to adapt to practices established in the host country. Further, differences in the geographical conditions make it difficult for them to use the exactly same version of the methods for production control that they practiced in Japan. For instance, the straightforward application of the kanban system may become impossible when the distance between the supplier's plant and the core firm's plant has to be long. Again, to such conditions, the Japan-based core firms can made adaptations. They can substitute telecommunications for the kanban, or "action-plate" in Nissan's language, as the physical device to carry the message.

But, for philosophy, they seek to reproduce, with necessary modifications, as many of the essential properties of the Japanese system as possible in the host country.

Below, I briefly overview the problems that such attempts by Japan-based firms, and similar attempts by U.S. core firms, face in the United States, in the order that I discussed characteristics of the Japanese system in Section 3.

Willingness and Ability to Develop Customized Parts

One common complaint heard from Japanese automobile manufacturers is as follows. Many of the U.S. suppliers who seek business with them tend to emphasize that they have been already supplying some items to U.S. automobile manufacturers and want to sell these items as they are.

But, for Japanese core firms, the same window-wipers, for instance, which may be quite fitting for some of GM cars, cannot be used for their cars. Japanese automobile manufacturers have long years sought to have ever lighter, thinner, shorter, and smaller parts for their cars. In addition, each of the companies has sought to procure parts customized to their own company needs, and, frequently, different between car makes in the same company. From this viewpoint, U.S. suppliers are often less ready to undertake development in response to the specific needs of a core firm, than Japanese suppliers. We shall come back to this point at the end of this subsection.

Attitude toward Price

As I noted in subsection 3.2, Japanese core firms have constantly put downward pressures on prices, and their suppliers in Japan have somehow managed to meet this requirement. More specifically, Japanese core firms have not allowed their suppliers to pass on increases in wage costs to prices. They have insisted that the increases in wage costs be absorbed through reductions of necessary man-hours, based on gorika ("rationalization", or purposive efforts to improve manufacturing processes).

In contrast, until recently, suppliers in the United States were allowed by U.S. core firms to pass on increases in wage costs to prices through some kind of escalator clauses. U.S. core firms have recently been trying to

terminate such practices and begin to ask their suppliers to achieve price reduction based on systematic efforts to reduce costs. But, probably it will take years to reverse the past tendency.

VE and VA by Suppliers and Incentives for Such Efforts

Obviously U.S. core firms will be pleased, if there suppliers exercise efforts to make VE or VA proposals. But, as of 1986, I found that the precise structure of the mechanism through which Japanese core firms reward such efforts, which have been reported by Asanuma (1984 b) and summarized in Subsection 3.3 of this paper, were not known by U.S. automobile manufacturers.

For such a gigantic firm like GM, the seer size of the market that the company has a potential to offer may have worked as an attractive incentive for suppliers. But, if the company launches on hereafter systematic pursuit of stepwise price reduction of the kind described in Subsection 3.2, then, the company will have to consider adoption of the incentive scheme similar to the schemes used by Japanese core firms, which are closely liked with the scheme to assess prices.

On the Notion of the Supplier's Responsibility

It is an attitude commonly held Japanese automobile manufacturers that they demand an organizational commitment of each of their suppliers to achieve and keep reliability in delivery and quality. In other words, they demand that a coherent understanding of the nature of their supply be made and held throughout the entire organization of the supplying firm.

They emphasize this point, since in the United States they at times come

accross a situation in which the manner of supply or the product policy drastically changes with the change of executives or managers concerned.

There were some cases in which the suppliers suddenly terminated a product-line, and therefore the supply to the core firm, as a consequence of a merger. In contrast, Japanese firms are accustomed to the notion of a responsibility to keep relations -- relations both to their customers and suppliers.

This is one of the cultural gaps that Japanese "transplants" have faced in the United States.

Longstanding Relations with Competitive Stimuli

As I noted in Section 2, U.S. core firms have turned to seek longer and closer relations with their suppliers. It is at times observable that the pendulum is swinging into other direction. For instance, sole sourcing is at times advocated or rationalized in view of a tendency adopted by U.S. core firms toward larger production runs of fewer models. Obviously, several kinds of economies of scale would be made available through following such a direction. But this may involve a risk to make the whole system less flexible and less dynamic in comparison to a system in which "two vendors" compete, and small lot productions on the basis of moving assembly lines are systematically sought.

High Volume vs. Small Overhead Cost

The philosophy of economies of high volume has been deeply rooted in American Society, and in the minds of academics and policy makers of every

country. Based on this philosophy, sizable investments in specialized equipment are often rationalized, and gigantic global organizations are often envied. There is no doubt that, for Japanese firms as well, economies of high volume are important. But, after all, the real target to be achieved is the least possible unit cost. A simplistic version of the philosophy of economies of high volume would dictate that ever growing volume of the same homogeneous commodity be pursued, taking the size of overhead costs as given. But, there is a possiblility to achieve the same level of unit cost through a systematic reduction of overhead costs, holding the size of production volume at a modest level. This is the possibility that Toyota and other Japanese firms have pursued with zeal. And they had no other choice, since, at least in the beginning of 1960's, when motorization in Japan started, they were seriously handicapped in the size of the market, in comparison to U.S. automobile manufacturers. Thus, quick die changes and systems like the kanban system were sought after with extraordinary eagerness. On this basis, at later stages, increasing degree of customization of parts and the system what I termed Flexible Production System were made possible.

As to this aspect, the basic philosophy of Japanese firms is yet to be more fully understood by U.S.-based manufacturers and, more generally, to be appreciated by academics and policy makers including those of Japan. As has been remarked earlier, Japanese firms often meet U.S. suppliers who are not prepared to supply parts customized to their needs. This stems from the discrepancy between the two philosophies.

But another remarkable aspect of the U.S. situation is that, as a potential, for most kinds of parts, there is a possibility for core firms to secure competitive sources. Based on this condition, I foresee that, in due course of time, there will be a considerable number of U.S.-based suppliers,

as well as Japan-based suppliers, who are willing to take orders of various kinds of customized parts, on similar conditions that Japanese core firms employ for their cooperation with their suppliers in Japan.[12)]

4.2 Situations in Japan

In Subsection 2.1, for three Japanese automobile manufacturers, I cited some figures that relate to the composition of suppliers to each of these firms. The figures for Mazda show that, in comparison to Toyota and Nissan, this company was relying on, as of 1982, a greater number of suppliers of parts and processing services. Further, the same figures reveal that, of these suppliers, a significant portion is comprised of small firms, which supply elementary processing services, rather than parts, on local basis. In contrast, on several occasions I have heard from managers of Toyota that all of their suppliers are supposed to supply more or less assembled parts or components, not elementary processing services. Further, we can estimate that a substantial portion of Toyota's supplier have been supplying parts as DA parts. In other words, in terms of an evolutionary analysis, automobile manufacturers that are late comers and are on lower echelons of the industry still have to operate with supply networks that are in relatively more primitive stages of evolution.

Well before September 1985, they were already facing the task of restructuring their networks in their efforts to catch up the forerunners. They were trying to invite more established and capable suppliers to join the nation-wide association that they relatively recently organized, and at the same time, were urging their traditional suppliers to develop capabilities to join development processes of vehicles in earlier stages. Some of their less

able suppliers were to be persuaded to leave the first tier to become one of the second-tier suppliers. Irrespective of the changes in the foreign exchange ratio, these core firms had to tackle these problems. Then, the process of drastic uprises of yen against dollars was triggered by the G5 agreement made in September 1985. What happened to their networks since then? I visited a couple of automobile manufacturers of the intermediate rank recently, to find answers to this question.

Somewhat surprisingly, little changes have occurred in the membership of their networks. Especially, for one of the two core firms, an explicit assertion was made that all of their local suppliers that were to be classified as engaging in the supply of processing services, rather than parts, survived the turmoil triggered by the G5 agreement. For another core firm also, except only quite a marginal portion of the suppliers, who had to be reassigned to the second tier sooner or later, most of the local incumbent suppliers survived and were still actively supplying on the first tier. How was the survival possible? In Subsection 3.2, we have seen that, in a case of a certain Japanese automobile manufacturer, their suppliers were being required to make, and were actually making, on the average, 2% price reductions at every six-month intervals, based on their efforts to reduce costs, during several years immediately before September 1985. In other words, if we take a three-year period, they were able to achieve 12% reduction of the starting prices already before the G5 agreement. They simply cut through the period of crisis that they faced after September 1985, with amplifying such efforts to reduce costs.

For established and highly capable suppliers like Nippon Denso and Mitsubishi Electric, there were little that the core firms had to do to help them. These suppliers took care of themselves. For local suppliers of the

so-called shitauke-kigyo kind, it has been known that the core firms are used to provide technical assistance. After September 1985, the core firms just increased the frequency of contacts for such assistance, and at the same time, increased the number of personnels sent from the core firm for such recurrent visits to the suppliers' plants. Each of these shitauke-kigyo kind suppliers made substantial investments in machines for automatization, achieving impressive degrees of cost reductions during the period of turmoil. It has been reported that, in other industries such as electronics and apparel, Japanese core firms have significantly shifted their supply bases to NIES and other developing countries. But, in the area of automobile production, such kind of drastic reformation of supply networks have not been made, at least by the two core firms that I visited. There seem to be two basic reasons for this remarkable difference between the industries. One is that, in comparison to electronic parts and apparels, automotive parts are relatively heavy and hence cannot be economically transported by air. The other is that even such processing services and parts that are supplied from shitauke-kigyo kind firms require a considerable degree of learning and skill to be handled efficiently, keeping up with finely tuned delivery schedules and various other requirements imposed by the core firm. The low labor cost advantages expectable in developing countries, amplified by the yen appreciation, were outweighed by the fear of loss in the above kind efficiency -- possible loss in "relational quasi-rent" in the theoretical term used in Asanuma (1988) -- plus the consideration of transportation costs.

An additional-factor is that, generally speaking, the automotive parts industry in NIES and other developing countries is still underdeveloped, even in comparison to the vehicle production in these countries. For instance, Korean automobile manufacturers have to import a substantial portion of the

parts that they use, especially of key-components, from overseas. Suppliers in Korea do not seem to have much room for assigning their capacities to export.[13] It is anticipated that, only after a period of investments in physical capacities and learning, suppliers in NIES and other developing countries will gradually gain capabilities to supply parts to Japanese automobile manufacturers. At the present stage, the main items imported from these countries for the automobile production in Japan are dies, jigs, and other toolings. These items seem to constitute the point of initiation for suppliers in these countries for the supply to and the learning from Japanese automobile manufacturers.

What about the import of automotive parts from developed countries? At the present stage, the main items being imported to Japan share a common characteristic: they are either actually belonging to or very close to "marketed-goods type parts" in my language. Aluminium wheel caps, tires, seat coverings, electric bulbs and the catalysts used for abating exhausts are main examples. To supply DA parts, it will become necessary for the suppliers to have their plants in Japan and to have their R & D personnels engage in development of the parts concerned keeping close contacts with the core firms.

5. Concluding Remarks

From the arguments made and the findings reported in this paper, we can derive several generalizations. Among such possible generalizations, I list the following four.

(1) In comparison to other industries such as electronics and apparel, the automobile industry seems to have the follwoing characteristic. Once a

vehicle assembly plant is set up in a country, relatively a greater portion of its supply network has to be located in the same country. And the geographical locations of the constituent plants and firms of the supply network cannot be very easily reshuffled in response to fluctuations of the foreign exchange ratios.

(2) The more the amount of relation-specific skill accumulated in the supplying firms, the more strongly the assertion made in (1) will become applicable.

(3) The higher the level of flexibility achieved by the total production system, the more strongly the assertion made in (2) will become applicable.

(4) To achieve a flexible production system, developing close and longstanding relations between the constituent firms of the system, with an appropriate degree of competitive stimuli and proper forms of incentives, seems to be an indispensable prerequisite.

These propositions seem to contain useful implications for industrial policies of all countries.[14)]

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Footnotes

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1) The structure of contractual framework and related practices has been studied by Asanuma (1984 a, 1984 b, 1988). Production control and related inter firm coordinations, including the coordination through the kanban system, has been illuminated by Monden (1983) and Shiomi (1985 a, 1985 b). A system of information processing named "order entry system," which relates dealers' activities to production control has been investigated by Monden (1983) and Okamoto (1985). Functions of the information network spanned by a given core firm and its affiliates, which includes the order entry system, has been analyzed by Asanuma (1986).

2) For earlier attemts to analyze the U.S. automobile industry with some comparisons to the Japanese automobile industry, see Altshuler et. al. (eds.) (1984), Cole and Yakushiji (eds.) (1984), Mori and Yui (1982), and Nishiguchi (1988).

3) See Mori and Yui (1982), and Nishiguchi (1988). The same point is also implied by the analyses made at several places in Cole and Yakushiji (eds.) (1984).

4) Mori and Yui (1982) cited the figure of 12,500 and Nishiguchi (1988) cited the figure of 12,000 as the number of suppliers of productive materials to GM. But, at my interview made in 1986 with high officials in purchasing of GM, I was unable to get a confirmation of the figure of 12,500. They remarked that this figure seemed to contain the number of suppliers of tools and plants.

5) Some of the parts used for a model of vehicle change at the minor model change, which is made two years after the introduction of the new model to the market. There are also some other parts that change at shorter intervals with face liftings of the vehicle. But, the general notion held among the parties is that the standard duration of delivery is four years.

6) For instance, the number of the production suppliers to Ford as of 1986, cited in Subsection 2.1, has been decreased to 2/3 in comparison to the corresponding number in 1979.

7) The "DA parts" in my word is often called the "black-box" type parts in the practices in the U.S. automobile industry.

8) Based on interviews conducted in 1985 with managers of respective companies, Ohta (1985) has reported for four automobile manufacturers the following kind of breakdown of the parts purchased from outside firms. Of the total value of the parts purchased from outside firms, Nissan bought 90% from "suppliers" and 10% from "subcontractors." The "supplier" in his paper corresponds to the "DA supplier" category in my word, and the "subcontractor" to my "DS supplier." The similar breakdown ratio was 60:40 for Honda, 67:37 for Mitsubishi, and 57:43 for Suzuki. See, Ohta (1985), pp. 71-73.

9) See Chap. 4 on Understanding the Employment Relation.

10) The information processing side of the "flexible production system" described in this section is called as the "order entry system." For further details of this system, see Okamoto (1985). Also, see Monden (1983), Shiomi

(1985 a, 1985 b), and Asanuma (1986) for more details on the topic of this subsection.

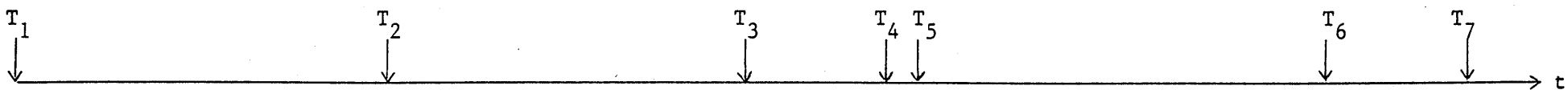
11) For manufacturing industies in general, Minato (1987) has posited that the turning point for the Japanese manufacturer-supplier relationships was 1930's. According to him, subcontracting system in Japan had been more or less of the spot market type nature up to the former half of 1930's. Longstanding relationships started to be formed in 1930's and were reinforced during the war time. Focusing on the history of the Japanese automobile industry, Ono (1981) also has posited that Japanese automobile manufacturers turned to build stable and longstanding relations with a relatively fixed set of suppliers since 1936.

12) Separate from the issue of parts supply, but in closely related areas, Japan-based core firms in the U.S. have faced some problems with their suppliers. One of the problems that seem to be worth mentioning here is that procurement of dies from outside firms in the U.S. needs significantly longer lead time and incurs higher costs in comparison to the situation in Japan. Another is that rust-proof steel of the kind that Japanese steel firms have developed jointly with Japanese automobile manufacturers has not been available in the U.S.

13) For details on these points, see Chushokigyo Kin'yukoko Chosabu (1987).

14) For other industries including electronics and apparel, more detailed studies along the line adopted in this paper seem to be necessary and useful for policies. For instance, if we let aside the question of transportation

costs, I anticipate that the amount of relation-specific skill accumulated in and the degree of flexibility required to the production system would have similar effects to each industry as those found in the automobile industry.



T_1: Initiation of the Concept Study for the New Model.

T_2: Release of the Basic Concept. Full Scale Organizational Activities for Development Begin.

T_3: Detailed Specifications Determined.

T_4: Release of the First Blueprints finishes.

T_5: Completion of the First Trial Car.

T_6: The Pilot Production at the Vehicle Assembly Plant Starts.

T_7: The Commercial Production of the New Model Starts.

Source: based on my interviews with major Japanese automobile manufacturers and suppliers.

Figure 1 Major Steps in the Development of a New Model

	parts manufactured according to specifications provided by the core firm ("ordered goods")						parts offered by catalog ("marketed goods")
	parts manufactured according to drawings provided by the core firm			parts manufactured according to drawings provided by the supplier			
	I	II	III	IV	V	VI	VII
criterion for classification	the core firm provides minute instructions for the manufacturing process	the supplier designs the manufacturing process based on blueprints of products provided by the core firm	the core firm provides only rough drawings and their completion is entrusted to the supplier	the core firm provides specifications and has substantial knowledge of the manufacturing process	intermediate region between D and F	though the core firm issues specifications it has only limited knowledge concerning the process	the core firm selects from a catalog offered by the supplier
example	small parts assembled by firms offering assembly service	small outer parts manufactured by firms offering stamping service	small plastic parts used in dashboard	seat	brake, bearing, tires	radio, electronic fuel injection systems, battery	

Table 1 Classification of Parts and Suppliers according to the Degree of Initiative in Design of the Product and the Process