

Alternative Component Sourcing Strategies within the Manufacturer-Supplier Network: Benefits of Quasi-Market Strategy in the Japanese Automobile Industry

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a) Executive Summary

This study examines the component sourcing strategy of the Japanese automobile manufacturers, focusing on the sourcing concentration and the sharing common suppliers with competitors. We have analyzed sourcing strategy of six Japanese car assemblers (Toyota, Nissan, Honda, Mitsubishi, Mazda, and Suzuki) regarding 95 components. We have found that firms using a broad manufacturer-supplier network tend to be more profitable. In other words, firms with a low sourcing concentration and a high supplier sharing, which are the characteristics of quasi-market strategy, tend to perform better than the other firms. Among the six manufacturers, Toyota, Mitsubishi, and Suzuki were categorized as firms that followed quasi-market strategy.

We believe that this finding is interesting because this relationship has been found in the context of the Japanese supplier-assembler relationship. The Japanese cooperative inter-firm relationship is supposed to be beneficial to suppliers, as well as to assemblers. It is commonly considered that a relatively exclusive keiretsu system facilitates these close inter-firm ties. However, the results in this study imply that a few leading Japanese automobile manufacturers may have management capabilities in benefiting from both a relatively broad supplier base and cooperative relationship with individual suppliers.

b) Research Results

(1) Research Questions

Many studies have compared supplier management practices between the U.S. and Japanese automobile industries, emphasizing the advantages of the Japanese style of management (Clark and Fujimoto, 1990; Cusumano and Takeishi, 1994; Nishiguchi, 1994; Helper and Sako, 1994). The literature has explained that, in the Japanese automobile industry, a manufacturer and a supplier coordinate to perform interdependent tasks effectively by sharing more information, investing in relation-specific assets, and relying on trust to manage the relationship. These studies and others have also implied that this type of supplier relationship is supported by the Japanese keiretsu system (Lincoln, et. al., 1992; Dyer and Ouchi, 1993).

Many studies seem to have implied that Japanese automobile firms or at least the leading ones have a keiretsu supplier group and maintain a relatively exclusive relationship within the group. However, there is actually a complicated manufacturer-supplier network across these groups. Many suppliers sell a certain type of components to multiple competing automobile manufacturers, while auto manufacturers buy most components from multiple suppliers. This study analyzes details of the network structure to determine the different sourcing strategies each Japanese assembler follows.

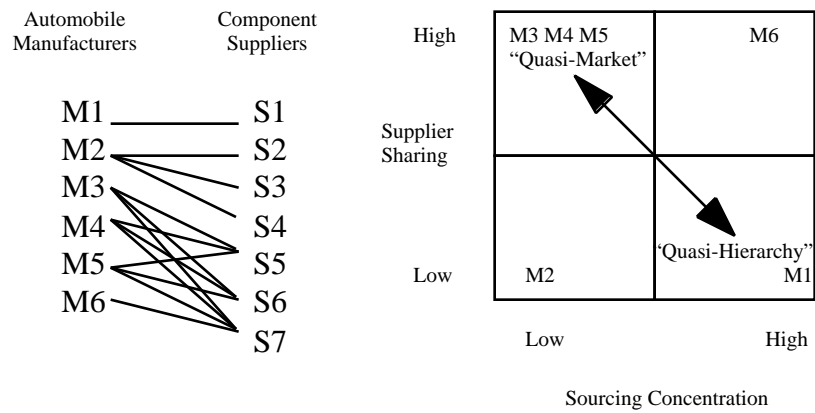
(2) Framework of Sourcing Strategy

In order to conceptualize sourcing strategy, this section develops a framework using two strategic dimensions in component sourcing. The first dimension, the sourcing concentration, determines the degree of reliance on a small number of suppliers such as on a single supplier. This dimension is similar in concept to the number of suppliers from which a firm procure a certain type of components, which some existing studies have treated as one of the important dimensions of sourcing strategy (Helper, 1991; Cusumano and Takeishi, 1991; Nishiguchi, 1994). The second dimension in this framework determines the degree of supplier sharing with competing assemblers. Some assemblers may buy a certain type of component from a supplier that exclusively sells it to the manufacturer, while others may rely on a supplier that sells the same type of component to other manufacturers as well.

These two dimensions lead to a framework that contains four different sourcing strategies as shown in Figure 1. In order to illustrate the framework, it also shows a simple hypothetical example of a network that consists of six manufacturers and seven suppliers. In this model, six manufacturers buy a certain type of component in the

component market where seven suppliers compete. M1 is an example of a manufacturer that has a high sourcing concentration and a low supplier sharing. It buys this component from a single supplier that does not deal with any of the other automobile assemblers at least on this particular type of component. On the other hand, M2 buys the component from three suppliers. Therefore, its sourcing concentration is lower than M1. M2 does not share these suppliers with other competitors either, and the degree of supplier sharing is as low as M1. M3, M4, and M5 have a low concentration ratio and high supplier sharing. M6 concentrates only on one supplier, but the supplier sells the component to other manufacturers, which positions this assembler as the one following a high concentration ratio and high supplier sharing.

Figure 1 A Framework and an Example of Different Sourcing Strategies



By using these dimensions, this framework features a distinction between the quasi-hierarchy and the quasi-market sourcing strategies. The strategy followed by M1 forms a sourcing structure featuring one-to-one manufacturer-supplier relationship with respect to a certain type of component, which is similar to the notion of a hierarchical relationship. The opposite extreme of this dimension is called “quasi-market” (Itami, 1988; Asanuma, 1989). Quasi-market nature of the sourcing structure increases when manufacturers lower sourcing concentration and increase supplier sharing, such as M3, M4, and M5.

The following discussions consider potential influences of different sourcing strategies. With respect to the first dimension, the sourcing concentration, it is rather clear from the existing literature that too much concentration on a small number of suppliers such as M1 and M6 may be inappropriate for buyers (Itami, 1988; Asanuma, 1989; McMillan, 1990; Cusumano and Takeishi, 1991). It may prevent the suppliers from competing with each other in supplying high quality components at a low price, and provides suppliers with some monopolistic power.

Too much dispersion to a large number of suppliers may also have some negative impacts. It may deter a manufacturer from closely monitoring individual suppliers. In other words, the number of suppliers may have a curvilinear relationship with the effectiveness of manufacturer’s management of suppliers. However, Japanese auto manufacturers do not usually have a problem of too many suppliers, because they seldom buy a type of component from more than five suppliers (Itami, 1988; Cusumano and Takeishi, 1991). Therefore, this framework hypothesizes only the first part of the relationship: too much concentration may have a negative influence on the supplier management efficiency.

With respect to the second dimension, supplier sharing, there may be several advantages to buy a component from suppliers that sell the same type of component to multiple automobile manufacturers. First, suppliers could enjoy the economies of scale by selling the same type of components to multiple customers, which may, in turn, benefit each customer. The more assemblers buy the same components from the same supplier, the more the price of components decreases.

Second, multiple manufacturers that procure a component from the same supplier may benefit from quality assurance. Suppliers may obtain more information and data regarding technological drawbacks and customer needs when they apply a basic component design to components at many different manufacturers. Therefore, manufacturers that procure a component from multi-user suppliers may have a better opportunity to buy high-quality components.

Lastly, when there is an extensive “manufacturer - supplier - manufacturer” linkage, there may be a positive influence on inter-firm learning through the network. Suppliers may learn specific capabilities from transactions with various manufacturers. Therefore, manufacturers that buy components from multi-user suppliers may procure components at a lower cost. Moreover, automobile manufacturers that share the same suppliers may learn technical or management knowhow from each other through the learning network in which a supplier is positioned at the center.

(3) Sample and Data

This study uses a publicly available database (Sogogiken Corp., 1995), which contains a manufacturer/supplier transaction matrix for 235 components. The database include transactions only for production in Japan. Table 1 shows an example of the matrix on the fuel filter from the database. The data are only in units not in values. Among 235 components covered in the database, this study uses data on 95 components that satisfy the following two conditions. First, this study focuses only on car manufacturers and excludes components used exclusively for trucks. Second, components that at least one manufacturer internally sources are excluded.

Table 1: An Example of Data from the Database

Component: Fuel Filter (in thousand units per year)

Supplier	Toyota	Nissan	Honda	Mazda	Mitsubishi	Suzuki
Nippon Denso	2258			645	735	194
Kyosan Denki	564					
Tuchiya Seisakushu		1350				
Toyoroki Seizo			898			584
Tokyoroki			100	215	184	
Total	2822	1350	998	860	919	778

This study measures the first variable, the sourcing concentration, primarily by applying the idea of the Herfindahl index, which is equal to the sum of the squares of the sourcing share from each supplier on a certain type of component. In order to obtain the sourcing concentration at the manufacturer level, there are three steps of calculation. First, a Herfindahl index for each of the 95 components at each manufacturer was obtained. Second, in order to adjust for the biased influence of different types of component, the Herfindahl indices of the six firms were standardized at the component level. In this way, differences in the sourcing strategy among manufacturers at the component level can be precisely aggregated. Then, an average of the 95 standardized Herfindahl indices at each

firm was obtained. We also calculated the one-supplier ratio, which measures the ratio of components that each firm buys from a single supplier. For example, if a firm procures 10 components from only one supplier, the one-supplier ratio would be 10.5% (=10/95). Procuring a certain type of component from one supplier may, in particular, have a negative influence on the firm.

In order to obtain data on the second variable, the supplier sharing index, we first counted the number of car manufacturers to which each component supplier for a certain component sells. If a manufacturer buys the component from multiple suppliers, we averaged the numbers of manufacturers to which each supplier sells. For example, in Table 1, Toyota buys fuel filters from Nippon Denso and Kyosan Denki. Nippon Denso sells the component to four manufacturers, and Kyosan Denki only one (= Toyota). The supplier sharing index for this component at Toyota equals 2.5, an average of the two. Then, sharing indices for six manufacturers with respect to a certain component were standardized in order to adjust for different types of components. Lastly, we averaged the 95 standardized sharing indices for each firm to obtain a sharing index for each firm. We also measured the one-customer ratio, which is the percentage of components for which a manufacturer does not share any suppliers with its competitors.

For the performance measurement of the automobile manufacturers, this study uses the annual operating profit divided by sales in multiple periods ending in March 1994 and March 1995 (Kaisha Shikiho, Fall 1995).

(4) Results

Table 2 summarizes results from the data analyses. This table shows that there are two distinct groups of manufacturers with respect to the sourcing strategy, those that follow the quasi-market strategy and those that follow the quasi-hierarchy strategy. One group consists of Toyota, Mitsubishi, and Suzuki, which all shows both a low sourcing concentration and a high supplier sharing. On the other hand, the second group including Nissan and Honda shows the characteristics of the quasi-hierarchy strategy including both a high sourcing concentration and a low supplier sharing. Mazda seems to be positioned between the two.

Table 2: Summary Table

	Toyota	Nissan	Honda	Mazda	Mitsub	Suzuki	Av.
Sourcing Concentration	LOW	HIGH	HIGH		LOW	LOW	
Herfindahl Index (Std.)	-0.09	0.13	0.14	0.03	-0.09	-0.12	0
Herfindahl Index (Raw)	0.68	0.72	0.72	0.72	0.68	0.66	0.70
One-Supplier Ratio	25.26	31.58	28.42	17.89	17.89	24.21	24.21
Supplier Sharing	HIGH	LOW	LOW		HIGH	HIGH	
Sharing Index (Std.)***	0.14	-0.44	-0.16	0.03	0.05	0.39	0
Sharing Index (Raw)***	3.45	2.87	3.08	3.35	3.36	3.62	3.29
One-Customer Ratio (%)***	7.81	28.12	29.69	15.62	9.38	9.38	16.67
Avg. Number of Suppliers***	2.22	2.12	2.01	2.38	2.45	2.12	2.22
(Minimum/Maximum)	(1/6)	(1/5)	(1/5)	(1/5)	(1/6)	(1/4)	
Operating Profit/Sales (3/94)	0.94%	-1.02%	0.75%	-2.50%	1.63%	2.17%	0.33%
Operating Profit/Sales (3/95)	2.52%	-2.20%	1.29%	-2.10%	2.55%	2.94%	0.83%

*** Difference significant at the 0.001 level (ANOVA)

First, with respect to the sourcing concentration, the Herfindahl Indices (Std.) of Nissan and Honda are 0.13 and 0.14, respectively, which are higher than those of Toyota, Mitsubishi, and Suzuki. Even though the ANOVA test did not show that the inter-firm differences were statistically significant, t-tests revealed some significant differences. For example, the difference between Nissan and Suzuki is significant at the 5% level, and the

one between Nissan and Toyota at the 10% level. The differences in the supplier sharing indices among the six firms are large and statistically significant. There are also two distinct groups with respect to this dimension. The standardized sharing indices of Toyota and Suzuki at 0.14 and 0.39 are much higher than those of Nissan and Honda, which are -0.44 and -0.16, respectively. That of Mitsubishi is in between at 0.05. However, because the one-customer ratio of Mitsubishi is similar to those of Toyota and Suzuki, we may be able to categorize Mitsubishi into the group with a high supplier sharing index.

In Table 2, manufacturers that follow the quasi-market strategy are the three best performers with respect to the profit/sales dimension in both years. Table 3 shows results from the rank-order Spearman correlation among the sourcing concentration, the supplier sharing, and operating profit/sales. There are statistically significant relationships among these variables. Firms with a low sourcing concentration and a high supplier sharing, which are the characteristics of quasi-market strategy, tend to perform better than the other firms.

Table 3: Results for Rank-Order Spearman Correlation Analyses (n=6)

Significant at: **5% level, *10% level	Operating Profit/Sales 1994.3/1995.3	Herfindahl Index (Std.)	Supplier Sharing Index (Std.)
Operating Profit/Sales	1.00	-	-
Herfindahl Index (Std.)	-0.77*/-0.83**	1.00	-
Suppl. Sharing Index (Std.)	0.77*/0.89**	-0.89**	1.00

Table 2 contains several other interesting data regarding the manufacturer-supplier structure in the Japanese automobile industry in general. With respect to the degree of sourcing concentration, the data are compatible with findings in existing studies. For example, the average number of suppliers from which each manufacturer procures for various types of components range between two and three, and there are, at most, only five or six suppliers. It is also interesting to see no influence of the production volume on the number of suppliers. The two largest firms, Toyota and Nissan, do not necessarily deal with more suppliers than other smaller firms.

One of the most interesting data in Table 2, though, is that one-customer ratios for firms in the first group, Toyota, Mitsubishi, and Suzuki, are all less than 10%. With respect to more than 90% of the components, these firms share at least one supplier with competitors. This data indicate that the supplier relationship in Japan may be characterized, in general, as “quasi-market” transactions, rather than “quasi-hierarchical” transactions. However, at the same time, this study shows that there are considerable differences among Japanese manufacturers regarding this dimension.

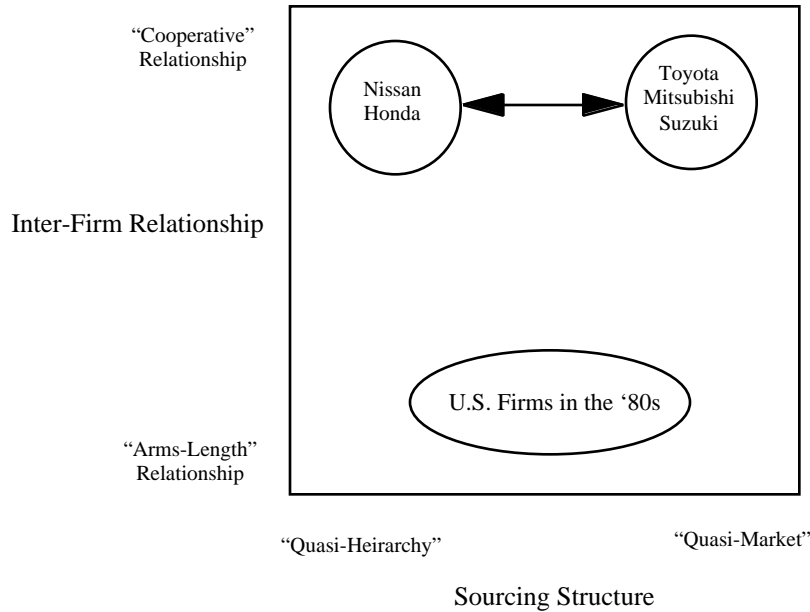
c) Implications

(1) Quasi-Hierarchy/Quasi-Market and Inter-Firm Relationship

Many studies on the Japanese supplier relationship have mostly focused on the nature of the inter-firm relationship (Asanuma, 1989; Helper, 1989 and 1991; Nishiguchi, 1994). This study, on the other hand, has proposed a sourcing structure dimension that considers the manufacturer-supplier relationship as part of the entire network of relationships. This study has provided evidence that supports the existence of a sourcing strategy dimension that ranges from quasi-hierarchy to quasi-market characteristics. The distinction between the two groups of firms, Group 1: the quasi-market strategy (Toyota, Mitsubishi, and Suzuki) and Group 2: quasi-hierarchy strategy (Nissan and Honda), is actually the difference between firms that benefit from market characteristics and those that do not. Firms that follow the quasi-market strategy may be able to enjoy both the

competitive mechanism of the market by reducing one-supplier concentration and the benefits of network externalities by sharing common suppliers with competitors.

Figure 2: Sourcing Structure and Inter-Firm Relationship



It is important to distinguish this dimension from the inter-firm relationship dimension. The framework in Figure 2 distinguishes the sourcing structure dimension from the inter-firm relationship to determine the manufacturer-supplier relationship from both perspectives of these dimensions. The inter-firm relationship dimension ranges from “cooperative” to “arms-length”, while the sourcing structure dimension ranges from quasi-hierarchy to quasi-market. These factors do not necessarily determined by the sourcing structure such as degrees of supplier concentration and supplier sharing. Even when manufacturers and suppliers form a quasi-hierarchical relationship, inter-firm relationship could be either cooperative or arms-length depending on the nature of management.

With respect to the inter-firm relationship, based on the empirical results of other studies, this study assumes that most Japanese transactions are through cooperative relationships, compared to those in the U.S. at least in the 1980’s (Helper, 1991; Helper and Sako, 1994). With respect to sourcing concentration, existing studies have already argued that Japanese automobile firms concentrate on a few suppliers to maintain a cooperative relationship with them, and yet try to avoid concentrating on a single supplier. Among the six manufacturers in the sample, three are firms that are more successful in dispersing reliance into multiple suppliers than the others. These three firms have also achieved a higher profitability than the others. This finding implies that as long as there is a cooperative relationship and careful monitoring, manufacturers should enhance competitive mechanism among a limited number of suppliers using the quasi-market strategy.

A unique contribution of this study is that our data have also supported the theory that there may be another type of benefit of the quasi-market mechanism, which is related to sharing suppliers with other firms, again as long as cooperative relationship is maintained. The data have shown a positive relationship between the common supplier sharing and assembler’s performance. Firms could enjoy various types of benefits related to the positive network externalities by sharing common suppliers.

(2) Benefits of Sharing Common Suppliers

This section further discusses the benefits and potential hazards behind the benefits. First, manufacturers, by buying the same type of component from common suppliers, can benefit from the scale economies in the supplier. In our interviews, an engineering manager at Suzuki, which is the smallest firm with respect to production and still has a reputation as a low cost manufacturer, seems to be most enthusiastic in sharing similar components with its competitors. He says that Suzuki often tries to find a component that has already been used by other manufacturers. Suzuki, for example, shares almost the same automatic transmission components with Mitsubishi, Daihatsu, and Fuji for most of its mini-cars by sharing the same supplier, Aishin Seiki, with these firms. Honda, on the other hand, does not share the same automatic transmission design with them for its mini-cars and cannot benefit from similar scale economies that the other firms are enjoying.

Second, each manufacturer can buy a quality component from a multi-user supplier. Even when a supplier sells a similar component with minor variations to multiple users, it should test different applications individually in the context of different vehicle models. A manager at Daido Metal, which sells the engine metal to all six manufacturers in the sample, mentioned that they have accumulated much more testing data than its competitors that sell the same type of component to fewer users. The accumulation of the data also contributes to high-quality components in the following periods. Related to this perspective, an engineer at Toyota also pointed out that when Toyota knows that a certain component has already been used by other car manufacturers, Toyota could sometimes simplify internal testing processes.

Third, effective usage of common suppliers may enhance inter-manufacturer learning. For example, an engineer at Toyota mentioned that Toyota used to buy clutch unit mostly only from Aishin Seiki, a Toyota keiretsu supplier, but it was considering to add a foreign supplier. One of the reasons for this strategic change was that Toyota wanted more information about technologies that its competitors and their suppliers were developing. The engineer said that it is risky, with respect to effective information collection, to exclusively rely on a Toyota keiretsu supplier that deals with only one or a few limited customers.

In spite of these advantages, there are disadvantages in the supplier sharing strategy. Sharing common suppliers leads to information spillover that some manufacturers may want to avoid. There are two factors related to influences of the information spillover. First, when changes in technology are rapid, spillover would be a big problem for a technically leading firm. Second, spillover is beneficial to technological followers, while it has a negative impact on leaders. When a firm wants to avoid any spillover, it may think about internalization. Therefore, spillover problems may be more related to the make-or-buy decision, which this study does not focus on.

We, however, realize that the strong positive influence of sharing common suppliers this study found may also be attributed to the timing of data collection especially with respect to the performance measurement. Since the booming economies ended in the early 1990's in Japan, competition among the automobile firms have been based on product price as opposed to technical features (Fujimoto and Takeishi, 1994). If competition were based more on technical innovations with respect to the sample components, there would be stronger negative impacts from the technical spillover that is associated with the supplier sharing strategy. In that case, the benefits of sharing suppliers in some firms could be traded off by the technical spillover to competitors.

Finally, we would like to briefly discuss the strategy at Honda. The data regarding Honda do not perfectly fit with our conclusions. Honda, like Nissan, has followed the quasi-hierarchy strategy and yet does not perform as poorly as Nissan. Honda is the manufacturer that has been focusing on its unique technologies in its competitive strategy. A purchasing director at Honda acknowledged in an interview that Honda tends to stick to its proprietary technologies and avoid sharing common suppliers with its competitors (JAPIA, 1995, pp. 68). Honda's differentiation strategy and its engineering capabilities to

implement it may have fitted with the quasi-hierarchical approach, in which Honda avoids technology spillover to its competitors. However, Honda's uniqueness in technologies seems to have been fading and the competition in the industry also seems to have become based less on unique technologies. The director at Honda actually adds a comment in the same interview that under the "borderless" age in terms of keiretsu system, Honda also needs to change its strategy to procure more components from other suppliers in order to be competitive in cost. Therefore, we believe that at least in the Japanese automobile industry, benefits from the network externalities may surpass those from procuring from proprietary suppliers for most components.

d) Future Research

This study has proposed many potential research areas that need to be studied further. First, we would like to analyze data at the component level, which would provide us with sufficient data points, even though it is difficult to collect performance data at this level. In addition, further study needs to be done in other industries to modify and generalize our findings. As discussed earlier, in industries where technological changes are fast, the quasi-hierarchy strategy at a technically leading firm may perform better because the strategy is appropriate to limit information spillover. Alternatively, however, benefits of the network externalities such as enhanced standardization and inter-firm learning could still surpass the benefits regarding the limited spillover. The personal computer industry seems to be supporting the latter case.

Secondly, in order to analyze the benefits with respect to common supplier sharing, further studies need to be done to analyze more details regarding its positive mechanisms. Specifically, three competitors, Toyota, Mitsubishi, and Suzuki, have formed a network containing common suppliers and seem to benefit from the network. It is important to analyze firms and relationships as part of the network of relationships, rather than relationships only at the dyadic level (Granovetter, 1985; Takeishi and Cusumano, 1995). It is also important to see the mechanism by which Nissan and Honda have been positioned outside the network. Historical studies may be needed to answer this question.

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