Parallel Sourcing and Supplier Performance in the Japanese Automobile Industry

Author(s): James Richardson

Source: *Strategic Management Journal*, Jul., 1993, Vol. 14, No. 5 (Jul., 1993), pp. 339-350

Published by: Wiley

Stable URL: https://www.jstor.org/stable/2486821

Strategic Management Journal, Vol. 14, 339–350 (1993)

PARALLEL SOURCING AND SUPPLIER PERFORMANCE IN THE JAPANESE AUTOMOBILE INDUSTRY

JAMES RICHARDSON
College of Business Administration, University of Hawaii at Manoa, Honolulu, Hawaii, U.S.A.

Japanese auto makers are reported to enjoy high supplier performance through long-term relationships, specific investments, and sole sourcing. Quality management consultants in the U.S. have been strongly advocating adoption of these practices. But economic and management theorists would predict that the combination of a high level of relationship-specific investments and sole sourcing will lead to problems with supplier performance. In fact the Japanese auto makers use a hybrid form of organization we term parallel sourcing. We present a transaction costs model that shows how parallel sourcing provides incentives for supplier performance associated with multiple sourcing while preserving claimed benefits of sole sourcing.

In the late 1970s, Japanese auto manufacturers benefited from significant cost advantages over their U.S. competitors. By the early 1980s, U.S. auto manufacturers had significantly narrowed the cost gap. But even with competitive prices, the Japanese firms continued to gain market share. The Japanese firms had established a quality gap. In response, the U.S. firms implemented quality improvement programs. One important objective of those programs was improved component quality through improved relations with suppliers.

Suppliers have a significant role in both U.S. and Japanese auto manufacturing and therefore in the quality of the final product. But Japanese auto manufacturers are known to be substantially less vertically integrated than their U.S. counterparts. The large Japanese auto assemblers such as Toyota and Nissan rely on suppliers for both design and manufacture of components traditionally produced in-house by GM and Ford.

Key words: Sole sourcing, competitive sourcing, transaction costs, supplier relations

Evidence indicates that the Japanese auto makers had much better relations with their suppliers that resulted in lower costs, higher quality, and greater innovativeness. Indeed, MITI has attributed much of the competitive advantage of Japanese manufacturing to the 'strength of its subcontracting structure' (MITI, 1984).

Whether their relatively high degree of vertical integration put U.S. auto makers at a competitive disadvantage is an interesting question, but beyond the scope of this paper. Conceivably, such large firms as GM and Ford had reached a point where the relative transaction costs of internal production had exceeded those of external sourcing (Coase, 1988 and Williamson, 1975). Our focus here is on relations with suppliers once the decision has been made to buy rather than make.

U.S. firms looked to Japan for a model of supplier relations and began to emulate key features. During the 1980s, U.S. auto makers moved with other manufacturers to increase their use of subcontracting and build longer-term relationships with fewer suppliers (Heide and John, 1990; Lyons, Krachenberg, and Henke,

0143–2095/93/060339–12$11.00

Received 23 August 1991
Final revision received 16 January 1993

1990; McMillan, 1990; Richardson, 1993). The Japanese practice which U.S. firms have begun to emulate falls in between the archetypal cases of arms-length exchange and vertical integration. A form of quasi-vertical integration, the relationships are characterized by longevity, closeness, and exclusivity. The Japanese model seemed to be an enduring sole-source relationship with a high level of specific investment by both parties. Our central question is: how do good supplier relations result from these conditions which seem prone to opportunistic behavior?

Based on the successful Japanese model, quality practitioners in the U.S. recommend sole sourcing (Deming, 1986). But this recommendation conflicts with traditional practice as well as the strategic management literature (e.g., Porter, 1985) which generally favors multiple sourcing. Competition between multiple suppliers has been regarded as the most effective way to get low cost and high performance. The quality practitioners suggest that commitment to a long-term relationship is more effective than competition, as evidenced by Japanese practice. But closer inspection of Japanese practice reveals that competition plays an important role in their supplier relationships.

McMillan (1990) has described how Japanese practice incorporates a number of incentives for suppliers to control cost and provide good performance. Ongoing relationships, risk sharing, the form of organization, bidding practices, and pricing all contribute to the success of supplier relations in the Japanese automobile industry. Our focus is on the form of organization. McMillan (1990) cites evidence which indicates that multiple sourcing is more common, and sole sourcing more rare, than commonly thought. Meanwhile, a number studies report a prevalence of sole sourcing within the Japanese auto industry (Asanuma, 1985a, b; Smitka, 1991; Cusumano and Takeishi, 1991). We suggest that both statements are correct. Their hybrid form, which we call parallel sourcing, involves the use of multiple sole sources for each type of component.

The objective of this paper is to explain how the parallel organization of suppliers within the Japanese auto industry contributes to the success of their supplier relationships. Parallel sourcing is a potentially attractive alternative for U.S. manufacturers who are restructuring their supplier relationships to improve quality. While maintaining competitive performance incentives and other advantages of multiple sourcing, it provides benefits claimed for sole sourcing. Our analysis of parallel sourcing underscores the importance of combining supplier competition together with long-term and close relationships for realizing superior supplier performance. We begin with a discussion of the reported benefits of sole sourcing, focusing on the quality management literature which strongly advocates this practice.

PROS AND CONS OF SOLE SOURCING

Increased subcontracting to fewer suppliers implies greater reliance on each one. But that appeared to be the successful Japanese model. Long-term relationships with considerable specific investment by both parties are characteristic of Japanese subcontracting practice (Asanuma, 1985a; Smitka, 1991; McMillan, 1990). The common conception of Japanese practice was that the auto assembler relied on a single source for each component who in turn had an exclusive, long-term, and tightly integrated relationship with the assembler. This conception was reinforced by the increasingly influential management consulting of W. Edwards Deming.

In his Fourteen Points, Deming strongly recommends sole sourcing as the only manageable method of controlling supplier quality. Deming argues that the necessary investment in the relationship in order to control quality effectively is simply too great to consider multiple sourcing (Walton, 1986). In other words, Deming suggests that there are considerable transaction costs associated with controlling quality. From product design, through process design, initial production and full production, the concern for quality requires the buyer to work closely with the supplier. Repeating these efforts for multiple suppliers of the same component may not increase the transaction costs proportionally, but would certainly increase them. Using multiple suppliers also increases the number of sources of variation which complicates the identification and control of variations in quality.

Sole sourcing may also greatly simplify (increase the efficiency of) the assembler's production process. The Japanese auto assemblers use a JIT or similar low inventory production process that requires close coordination with the suppliers. The coordination and communication costs, i.e., transaction costs, associated with their production technique may be significantly lower with the sole sourcing of each model component.

Following their understanding of Japanese practice as well as the advice of quality management consultants, U.S. auto makers are experimenting with sole sourcing.[1] Thus the organization of suppliers in the Japanese auto industry and the economic basis for its success are topics of some interest.

The combination of a high level of relationship-specific investments and sole sourcing as a basis for good supplier relations presents a puzzle. Economic and management theorists would predict, and U.S. practice would tend to confirm, that this combination will lead to problems with supplier performance. In Porter's model of competitive forces (Porter, 1980), specific investments by the buyer in a sole sourcing relationship would increase the buyer's switching costs and enhance the bargaining power of the supplier. The New Institutional Economics (Williamson, 1988) suggests that uncertainty and specific investments lead to opportunistic behavior and troubled vertical relations between firms. The commonly cited case of GM and Fisher Body illustrates the point. Empirical studies have found that U.S. auto makers do tend to vertically integrate under conditions of uncertainty and the need for relationship-specific investments (Walker and Weber, 1987; Monteverde and Teece, 1982).

Sole sourcing would also forgo other potential benefits of multiple sourcing. Alternative sources provide the buyer with better information about supplier's costs as well as performance capabilities (Demski, Sappington, and Spiller, 1987; Riordan and Sappington, 1989; McMillan, 1990). Competing suppliers help the buyer form his expectations for supplier performance. Having several sources also increases opportunities for innovation in the supplier group.

Other factors must be present to explain the success of buyer–supplier relations in Japan based on sole sourcing and a high level of specific investments. One element, already mentioned, is the long-term commitment to the relationship. But, as we will show, the maintenance of a long-term relationship, by itself, would probably not provide sufficient incentives for performance. It is tempting to appeal to Japanese cultural traditions of cooperative social relations and a sense of obligation to buyers, and these may be relevant factors. But they cannot be easily duplicated in the U.S. A more constructive approach is to look for other elements of the relationship that provide economic incentives for supplier performance (McMillan, 1990).

Asanuma (1985a, b) and Smitka (1991) have provided detailed descriptions of the organization of automobile components supply in Japan. In fact, the Japanese auto makers use a hybrid form of sourcing we call parallel sourcing which combines specific investments and a commitment to long-term sole-sourcing relationships with competition among suppliers for expanded opportunities. Promises of increased volume, more contracts, and higher profit margins as a reward for performance provide strong incentives—strong enough to overcome the hazards of sole sourcing and specific investments given the structure of this industry.

To understand the rational basis for the parallel supplier organization in the Japanese auto industry, we construct a simple game theoretic model. We use it to demonstrate the basis for concerns about specific investments and sole sourcing. Then we show how parallel sourcing provides a beneficial combination of long-term, tightly integrated, sole sourcing with sufficient competitive incentives to get high supplier performance. Finally, we discuss elements of industry structure which contribute to the success of this practice and would affect its transfer to other industries. But first, we describe Japanese practice.

PARALLEL SOURCING IN THE JAPANESE AUTO INDUSTRY

The description provided here closely follows Asanuma (1985a, b) and Smitka (1991) supplemented by McMillan (1990). The evidence supports the notion that supplier relationships are indeed long lived. Once begun, they are rarely terminated. A supplier typically has contracts with an assembler both for a variety of components in a single model and for similar components in

[1] Probably the most extreme case is GM's Saturn which is 100 percent sole sourced.

different models. There are usually several firms within the assembler's supplier group qualified to manufacture a component. The other qualified suppliers may be currently producing similar components for other models or have done so in the past.

Within an assembler's extensive hierarchical structure of suppliers, there are two basic types—design approved (DA) and design supplied (DS). DA suppliers provide both design and production services to the assembler's specifications while DS suppliers produce a component from drawings provided by the assembler. The DA suppliers are usually those with the longest and closest relationships with the assembler. First-tier and especially the DA suppliers have a greater number and more profitable contracts with the assembler. The assembler usually has less detailed knowledge of the DA supplier's production costs which gives the supplier an advantage in price negotiations.

The assembler supports the development of its suppliers, especially DS and lower tier suppliers, through transfer of technology and management skills. The assembler's objectives are both to ensure quality and to create competitive suppliers for production and eventually design services. Suppliers are given performance ratings which are used in awarding contracts. The assembler is also concerned not to let a supplier's capacity utilization fall too low. DS and lower tier suppliers work toward growth and profits that come with a more closely integrated relationship with the assembler, but the opportunities are limited. There are many thousands of suppliers in the assembler's hierarchy and only a few hundred at the top tier.

The typical production cycle for a car model begins with a lengthy design and development stage (around 36 months presently) followed by a 4-year production stage. The assembler usually invites several qualified firms in the supplier group to compete for a contract to design and/or produce a component for a new model cycle. A DA supplier will undertake the design and development as well as tooling for production with no guarantee of reimbursement by the assembler. For DS suppliers, the assembler will guarantee reimbursement for specific investments such as tooling. Whether DA or DS, the assembler makes a firm commitment to use the supplier for the 4-year production life of the model.

Asanuma and Smitka describe the typical supplier as the sole source of the component for the 4-year life of the model. McMillan reports some data that indicate sole sourcing is not as prevalent as has been suggested. In samples of components from Toyota and Honda, 28 percent and 38 percent were sole sourced respectively. Another 39 percent and 44 percent respectively had two suppliers. The remainder had three or more suppliers. More recently, Cusumano and Takeishi (1991) report an average of 1.2 suppliers per component. The extent to which these data conflict is difficult to judge. Given the parallel organization, it is perhaps understandable that different samples give different results. Sometimes a sole source is used for a component of a model at one assembly plant while another source is used at a different plant. Other components are common across models and may have multiple sources but be sole sourced for a particular model. Sole sourcing does seem to be a common practice. Asanuma's and Smitka's descriptions based on in-depth studies of supplier relationships in the Japanese auto industry suggest that sole sourcing may be a preferred practice.

A snapshot in time would show an assembler with many sole source suppliers. But a closer look would reveal that there are several firms in the supplier group who are qualified to produce a component. Some are currently producing similar components for different models while others have done so in the past. Thus the term parallel sourcing (see Figure 1). The distinctive feature of parallel sourcing is that two or more suppliers with similar capabilities are concurrently sole-source suppliers for very similar components. While using a sole source for a component, the assembler establishes parallel sources to provide performance comparisons and competitive bidders for the next model cycle.

THE COMPARATIVE ADVANTAGE OF PARALLEL SOURCING

Using a simple game model we show that parallel sourcing is equivalent to multiple sourcing in terms of the buyer's ability to influence supplier performance with a threat to switch suppliers. It is superior to multiple sourcing for maximizing the incentive effect of product performance and sales results on supplier performance. And it

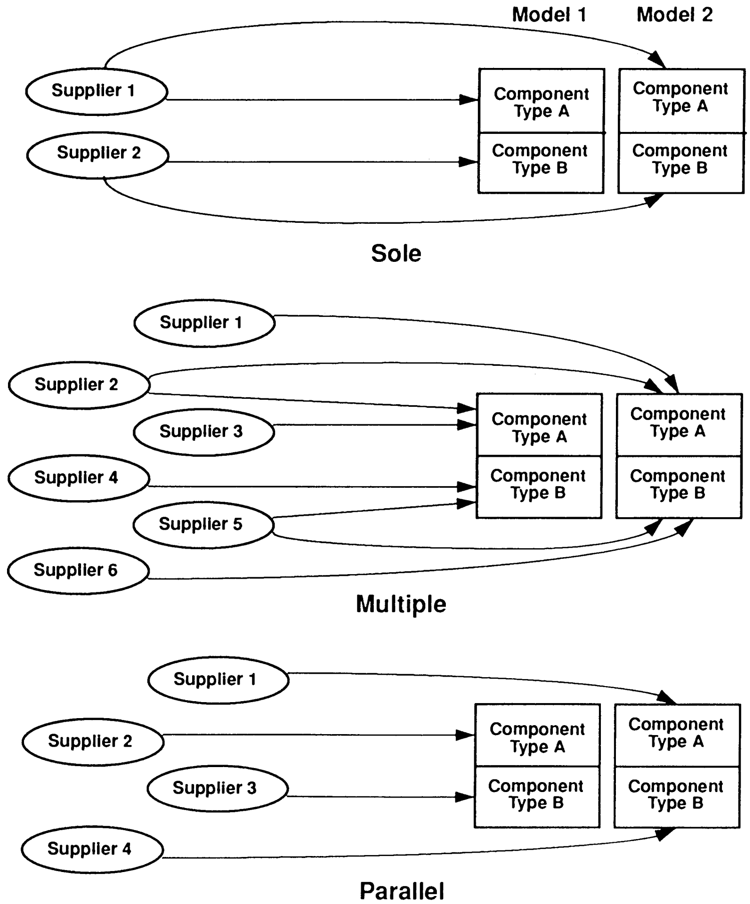

Figure 1. Alternative sourcing strategies

retains benefits of reduced transaction costs attributed to sole sourcing. Note that this model is not intended to capture all the possible factors influencing supplier performance. We use it only to illustrate the common concerns about sole sourcing and how parallel sourcing is equivalent to multiple sourcing in dealing with these concerns.

The purpose of the game formulation is twofold. First, it makes explicit where the interests of buyers and suppliers are aligned and where they conflict. Solutions of the game yield predictions of behavior given relative strengths of these competing interests. Second, the game framework enables us to be clear and consistent in our use of terminology (Camerer, 1985).

The model describes supplier performance under single, multiple, and parallel sourcing. The term supplier performance is used generally to cover quality, timeliness, responsiveness to changes in quantity, innovativeness and all other nonprice aspects of the exchange. The model does not deal with the relative bargaining power in price negotiations of a single source vs. multiple sources.

The Japanese auto assemblers have several methods of controlling supplier prices described in McMillan (1990). Briefly, there is competitive bidding to select the supplier, though it is usually limited to a few qualified suppliers in the existing supplier group. The effectiveness of the bidding is enhanced by the assembler's practice of sharing technology among all its suppliers, making them more equal competitors. The importance of competitive bidding and alternative sources is lessened by the assembler's usually detailed knowledge of the supplier's technology and production costs. Prices are negotiated prior to production and there is considerable rigidity in adjusting for subsequent supplier cost increases.

This commitment to price also serves to reward the supplier for investments and innovations that result in cost reductions.

In the model we distill many factors affecting buyer–supplier relations into three variables: trading costs, competitiveness costs, and switching costs. Many elements of industry structure, product characteristics, and firm attributes affect the buyer–supplier relationship. We argue that these factors affect the relationship through the three types of costs.

Trading costs, competitiveness costs, and some switching costs would be included under the general heading of transaction costs in the transaction costs literature (Coase 1988; Williamson, 1975). We find it useful to consider them separately. Transaction costs are the friction that often occurs in making exchanges. They result from such things as information asymmetries, uncertainty, and opportunistic behavior (Williamson, 1988). The fixed part of transaction costs we refer to as switching costs. They include search costs and supplier development costs such as training and technology transfer. Further, we divide the variable part of transaction costs into two portions—trading costs and competitiveness costs. Trading costs refer to the ongoing costs of coordinating exchanges as they occur, e.g., ordering, scheduling delivery, receiving, monitoring quality, and contract enforcement. Competitiveness costs are lost sales that result from poor supplier quality, unreliable delivery, and so on. Trading costs increase unit costs and may reduce profit margins but have no direct impact on sales.

Setup and switching costs

Setup costs are the fixed cost of establishing a buyer–supplier relationship. Setup costs are specific investments which are sunk and have little value outside the relationship. Because they are relationship-specific, setup costs result in costs to switch suppliers. For example, an auto assembler incurs a cost to transfer technology and management skills which enable a supplier to meet performance requirements and build design capability. Such supplier development costs are specific and sunk. They have little value to the assembler if the relationship is terminated. Switching suppliers means incurring these costs again. While we refer to setup costs as fixed, some of these costs decidedly increase over time. For example, supplier development costs are unlikely to be a one-time investment for the duration of the relationship. Product and process changes may require additional investments in suppliers over time. The distinction is that such costs are fixed relative to the short-term level of production.

Many of the factors which affect the relative bargaining power of buyers and suppliers in Porter's (1980) model, do so through switching costs. When there are a number of potential suppliers with low differentiation, the cost to switch to a new supplier may be as little as the effort to obtain catalogues and prices. When differentiation is high or the buyer has special requirements, switching suppliers may require substantial search, adaptation, or development costs as well as a great deal of time. Contracting costs for specialized items might be substantial. A lead time may be necessary for the supplier to increase capacity or modify production processes. Highly concentrated suppliers, e.g., a monopoly, lack of substitutes, and specific investments can make switching costs extremely high. When no alternative supplier can be found or developed, the switching cost is essentially infinitely high.

There may be experience curve effects for a buyer–supplier relationship which create switching costs. Over time, the two firms develop an understanding of each others' needs and capabilities that results in a more efficient transaction. The time and efficiency losses incurred by switching to a new supplier and moving back on the experience curve are a switching cost.

Threats of backward integration by the buyer or forward integration by the seller hinge on switching costs. A buyer who integrates backward is switching. The types of costs incurred can include investment, administrative, and others associated with going into the business, as well as possible efficiency losses if the supplier benefitted from economies of scale which are not available to the buyer. A supplier who threatens to integrate forward presents a threat of entry as well as a possible forced switching of suppliers.

Trading costs

Variable transaction costs between buyers and suppliers are associated with the coordination, communication, and decision making around exchanges (Coase, 1988). They include the administrative costs of purchasing and receiving, monitoring supplier performance, and enforcement of contracts. They also include such things as the cost of haggling over contract modifications and correcting deficiencies in supplier performance. Deming's coordination costs for controlling supplier quality, discussed above, represent trading costs.

Competitiveness costs

Competitiveness costs are reduced sales the buyer suffers because of poor supplier performance. For example, poor quality from the supplier which cannot be corrected at a reasonable cost or passes undetected could adversely affect the buyer's ability to compete in its product market.

Supplier performance with a sole source

A two-period model (Figure 2) illustrates the concerns about sole sourcing. The sequence of moves is as follows. Initially a contract is agreed upon (for two periods of exchange) spelling out terms of price and performance (quantity, quality, delivery schedule, and so on). The supplier agrees to supply q items per period at price p. Next, the supplier performs in a way that either meets the buyer's expectations (High) or does not (Low). Prior to the second period of exchange, the buyer decides whether or not to switch suppliers (the choice of switching following High performance is not interesting and not shown). The resulting pay-offs are shown in Figure 2 using the following notation.

k(·): the supplier's unit cost which varies with supplier performance.

S: the set-up cost the buyer incurs to initially establish a supplier relationship.

T(·): the trading costs to the buyer as a function of supplier performance.

C(·): the competitiveness cost to the buyer which varies with supplier performance.

S(2) denotes the set-up cost for two suppliers. The notation T(H,H) means trading cost with High performance in period 1 and High performance in period 2. Similarly for C(H,H). Note that the buyer is attempting to minimize costs while the supplier is maximizing profit. We assume that:

S(2) > S: It costs more to set up two suppliers than one.
k(H) > k(L): It costs a supplier more to provide High performance than Low performance.
T(H,H) < T(L,H) < T(L,L): The trading

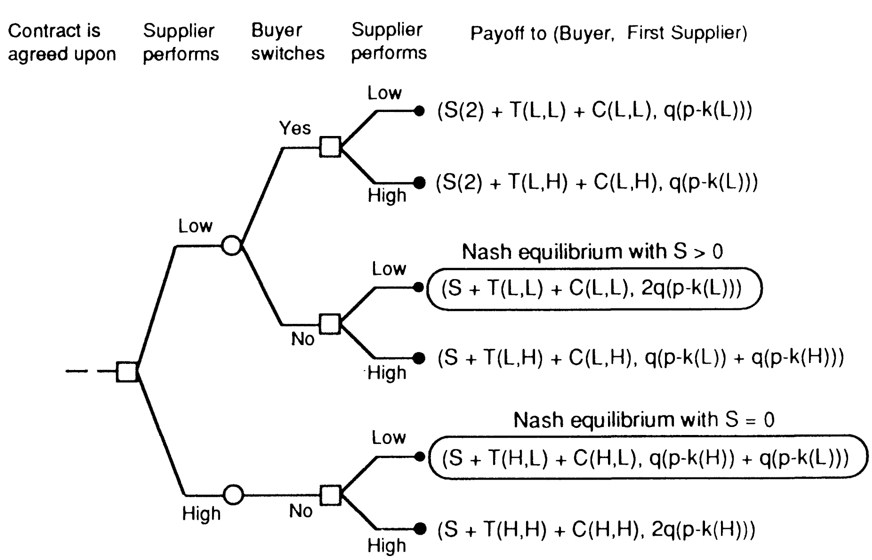

Figure 2. Performance with a single supplier

costs for the buyer are greater under Low supplier performance because of increased costs for quality control, contract enforcement, scrap, rework, warranty claims and service.

C(H,H) ≤ C(L,H) ≤ C(L,L): Low supplier performance may cause the buyer to be less competitive in his product market because of *low quality or late delivery.*

In a two-period model, any supplier will perform Low the second period. The supplier earns more by performing Low and has no incentive to do otherwise at the end of the relationship. The buyer cannot get High performance the second period by switching to a different supplier. All potential suppliers face the same relative costs and therefore will have no incentive to perform High in the last period. However, the buyer may be able to influence the supplier's first period performance by a threat to switch suppliers prior to the second period.

When switching (setup) costs are zero, the buyer can induce High supplier performance the first period by threatening to switch suppliers. As long as the supplier earns positive profits when he performs High, $q(p - k(H)) > 0$, he will prefer two periods of exchange to one, that is $q(p - k(H)) + q(p - k(L)) > q(p - k(L))$. By announcing that he will switch suppliers if first period performance is Low, the buyer can get High performance the first period. The threat to switch is credible, because the buyer does no worse by switching. He still gets Low performance from the new supplier in period 2, but switching is costless. Hence the (subgame perfect) Nash equilibrium (see e.g., Tirole, 1988) will be two periods of exchange with the same supplier who performs up to expectations the first period and below expectations the second period. If we extend the game to a larger but finite number of periods, the result will be the supplier performing High every period except the last, and Low the final period. Again, no switching occurs.

When switching costs are greater than zero, the supplier can no longer be influenced to provide High performance in period 1 by the threat to switch. In the two-period game, the buyer cannot make a credible threat to switch suppliers prior to the second period. It would never be in the buyer's interest to switch once that point is reached. He expects Low performance the second period from any potential supplier, so he only hurts himself by incurring the switching cost. Now the Nash equilibrium is two periods of exchange with the same supplier who performs Low both periods.

Extending the game to a larger but finite number of periods, the result will be no switching *and Low supplier performance every period. To* see this, start from the last period and back up. We have the result for the last two periods. Backing up one more period, the buyer will have no credible threat of switching prior to the second to last period. The buyer expects Low performance the last two periods. Switching only results in added costs. So the supplier will perform Low the third to last period. Continuing to back up, the game 'unravels.' The buyer never has a credible threat to switch.[2]

Our simple model illustrates how the presence of switching costs can have a powerful effect on the relationship. With no switching costs a sole-source can be induced to High performance by the threat to switch suppliers. No switching costs means no sunk specific investments and the presence of equivalent sources. When the buyer makes sunk specific investments in a sole-sourcing relationship, he creates switching costs and is exposed to opportunistic supplier behavior, i.e., Low performance. Note that this result is not affected by the size of the increased trading costs or competitiveness costs the buyer may suffer. Nor would a switching cost for the supplier to move to a different buyer (or even lose the business) change the outcome. The buyer will never switch and the supplier knows this.

Supplier performance with multiple sources

A strategy of retaining multiple suppliers can induce competition among them to raise the level of performance in the presence of switching costs. The buyer promises a larger share of the business as an incentive. However, retaining multiple suppliers means incurring the startup costs with each of them and increased trading costs of dealing with multiple suppliers. Incurring

[2] Infinite horizon or supergames can yield cooperative equilibria, i.e., High performance. But in such games, any outcome can usually be supported as an equilibrium, making the prediction less interesting (Tirole, 1988).

the setup cost with multiple suppliers can be viewed as a commitment to switching by the buyer. Having incurred the setup cost, he can credibly threaten to 'switch' suppliers if one does not perform up to expectations.

The simple multiple sourcing strategy is illustrated in Figure 3. Here T(HH,LL) denotes the trading cost when both suppliers perform High in period 1 and Low in period 2. Similarly for C(HH,LL). We assume that

T(HH,LL) < T(HL,LL) < T(LL,LL): Trading costs are greater with Low supplier performance for reasons cited above.

C(HH,LL) ≤ C(HL,LL) ≤ C(LL,LL): Competitiveness costs may be greater with Low supplier performance for reasons cited above.

In the model, two suppliers have equal shares of the production in the first period. If one performs Low and the other High, the buyer shifts a portion α from the Low to the High performer. The portion shifted must be large enough to make total profits earned with Low performance in the first period less than with High performance. This is possible as long as positive profits are earned with High performance. Then the Nash equilibrium will be both suppliers perform High in period 1 and Low in period 2. No shifting occurs. Again, extending the game to a larger but finite number of periods results in both suppliers performing High every period but the final one.

Supplier performance with parallel sources

The Japanese auto maker's parallel sourcing works like multiple sourcing to give the buyer a credible threat of switching suppliers even with switching costs. Parallel sourcing can be modeled using the game in Figure 3 with some redefinition of terms. Let a period correspond to the 4-year production life of a model. And let the supplier's profit be a sum of profits from a number of contracts for which the supplier is qualified to compete. At the end of period 1, the High performing supplier is rewarded with additional contracts won from the Low performer. As with the simple multiple sourcing model, the Nash equilibrium is for the suppliers to perform High in all but the final period.

Choosing the superior sourcing strategy

If multiple and parallel sourcing are equivalent in overcoming switching costs and inducing High performance, why then would the auto maker prefer parallel sourcing to simple multiple sourcing? The answer is that within parallel sourcing, the sole sourcing of each model's components retains several benefits of sole sourcing. One benefit is to economize on the communication and coordination aspects of transaction costs, as Deming suggests. In the model, lower trading costs with sole sourcing would be expressed as T(H,L) < T(HH,LL). Another potential benefit is the added performance incentive for the supplier who receives the full gains and losses from the buyer's sales results. Above, the total quantity ordered per period from the supplier(s), q, was independent of supplier performance. But suppose the buyer could suffer a competitiveness cost of a drop in sales as a result of Low supplier performance. The potential reduction in q may give the supplier incentive for High performance. This incentive is strongest with sole sourcing. Sole sourcing also maximizes the incentive for the supplier to innovate methods of lowering cost while maintaining quality. Such efforts are strongly favored by the auto assemblers (Asanuma, 1985a).

Given the need to make specific investments in a supplier relationship, the three forms of sourcing present different trade-offs to be made in determining the least cost approach. Table 1 summarizes our conclusions but also shows there is no clearly superior form. Sole sourcing provides the lowest setup costs simply because fewer suppliers are set up. Parallel sourcing has lower trading costs than multiple sourcing because it is less costly to coordinate with one source for each input. Parallel sourcing should have lower trading costs than sole sourcing because of lower supplier performance under sole sourcing. Similarly, parallel sourcing and multiple sourcing should have lower competitiveness costs because of poor supplier performance under sole sourcing.

Parallel sourcing seems to dominate multiple sourcing. Whether parallel (or multiple) sourcing is superior to sole sourcing depends on the size of the setup costs for a parallel source vs. the lower trading and competitiveness costs

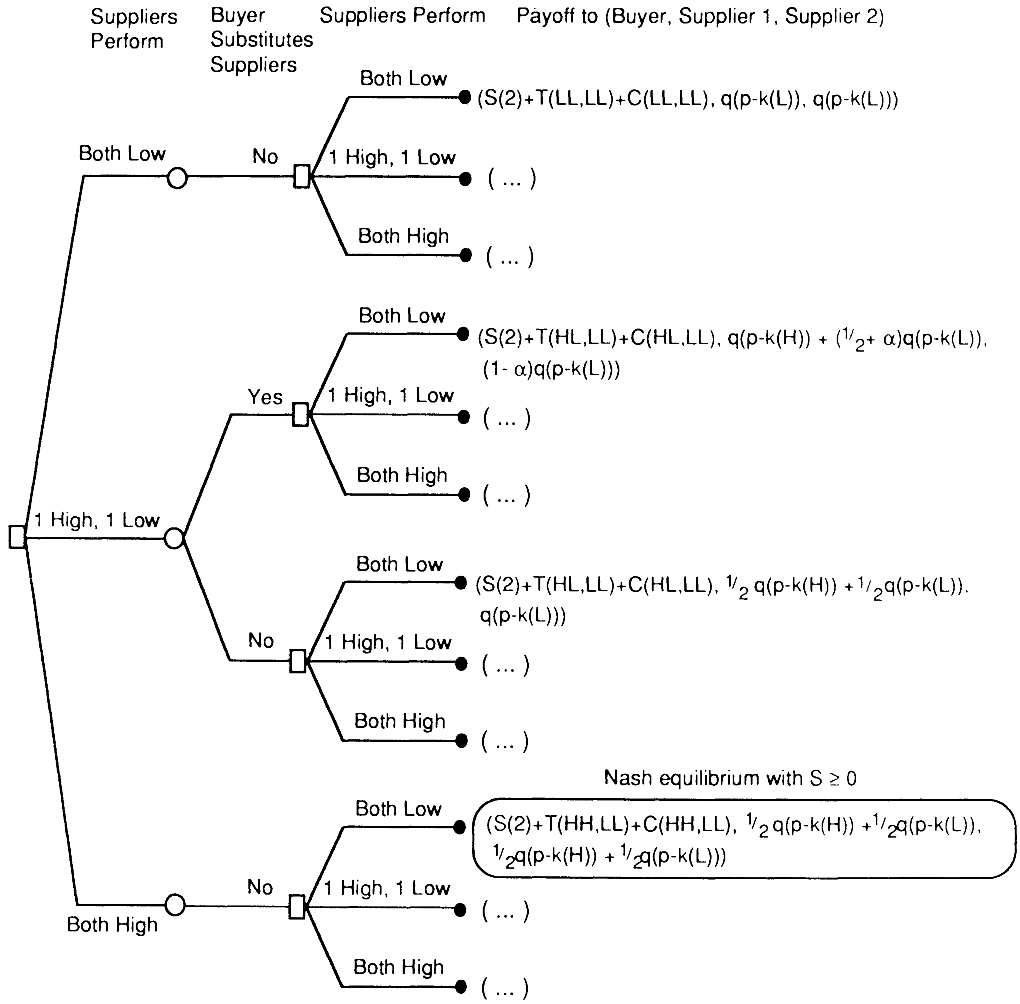

Figure 3. Performance with multiple suppliers

Table 1. Summary of relative sourcing costs with specific investments

Transaction cost	Form of Sourcing Ranked by Cost (1 is least) Sole	Parallel	Multiple
Setup costs	1	2	3
Trading costs	2 or 3	1	2 or 3
Competitiveness costs	3	1.5	1.5

resulting from higher supplier performance under parallel sourcing.

CONCLUSION

We have seen how the practice of parallel sourcing works to provide competitive incentives for supplier performance while at the same time providing the benefits of sole sourcing, principally reduced costs for communication and coordination associated with both quality control and JIT production. The buyer incurs the setup cost for several similarly qualified suppliers to reduce trading costs and competitiveness costs of opportunistic supplier behavior. Overall, the practice could minimize transaction costs, i.e., the sum of the buyer's setup (switching), trading, and competitiveness costs.

When considering alternative supplier arrangements, firms must take into account the relative bargaining power of their suppliers. In the Japanese auto industry, there are a number of industry, firm, and product characteristics that contribute to the success of the parallel sourcing strategy. Most importantly, auto makers are large high volume manufacturers who produce a variety of models with similar components. This characteristic enables parallel sourcing and provides the opportunities for supplier growth within the relationship. The Japanese auto industry has been growing at a strong pace, again providing opportunities for supplier growth within the relationship. The auto makers are highly concentrated relative to the suppliers. The business of any one auto assembler is likely to be important to a supplier, even when the relationship is not exclusive. This is especially true for those suppliers who do not do business outside the auto industry. The technologies in auto manufacturing are not so sophisticated or unique to the auto industry that the assemblers are unable to find or develop parallel suppliers with a reasonable amount of effort. Finally, the volume of business is high enough to attract new suppliers and give them incentive to develop to meet the assembler's needs.

Even with these favorable conditions and relatively high bargaining power, the Japanese auto assemblers use parallel (and multiple) sourcing. This indicates the importance of giving suppliers the added incentive for high performance that comes from a credible threat to switch. Under less favorable conditions, i.e., greater supplier bargaining power, manufacturers will certainly want to provide competitive incentives for supplier performance.

The development of more tightly integrated, longer-term supplier relationships based on the Japanese model seems to be based on well founded and sound advice. But simple sole sourcing may be ill-advised. As buyers make larger specific investments in such relationships, they inevitably become increasingly dependent and open to opportunism. Our model suggests that specific investments in a sole source will expose the buyer to opportunistic behavior in spite of a relatively high importance of the relationship to the supplier. On the other hand, the practice of parallel sourcing shows that commitment to a long-term relationship through specific investments combined with a credible threat to switch suppliers can be the basis for successful supplier relationships.

REFERENCES

Asanuma, B. (Summer 1985a). 'The organization of parts supply in the Japanese automotive industry', *Japanese Economic Studies*, **15**, pp. 32–53.

Asanuma, B. (Summer 1985b). 'The contractual framework for parts supply in the Japanese automotive industry', *Japanese Economic Studies*, **15**, pp. 54–78.

Camerer, C. (1985). 'Redirecting research in business policy and strategy', *Strategic Management Journal*, **6**, pp. 1–15.

Coase, R. M. (Spring 1988). 'The nature of the firm: Meaning', *Journal of Law, Economics, and Organization*, **4**, pp. 19–32.

Cusumano, M. A. and A. Takeishi (1991). 'Supplier relations and management: A survey of Japanese, Japanese-transplant, and U.S. auto plants', *Strategic Management Journal*, **12**, pp. 563–588.

Deming, W. E. (1986). *Out of the Crisis*. MIT Center for Advanced Engineering Study, Cambridge, MA.

Demski, J. S., D. E. M. Sappington and P.T. Spiller (Spring 1987). 'Managing supplier switching', *Rand Journal of Economics*, **18**, pp. 77–97.

Heide, J. B. and G. John (February 1990). 'Alliances in industrial purchasing: The determinants of joint action in buyer–supplier relationships', *Journal of Marketing Research*, **27**, pp. 24–36.

Lyons, T. F., A. R. Krachenberg, and J. W. Henke, Jr. (Spring 1990). 'Mixed-motive marriages: What's next for buyer–supplier relations?', *Sloan Management Review*, pp. 29–36.

McMillan, J. (Summer 1990). 'Managing suppliers: Incentive systems in Japanese and United States industry', *California Management Review*, pp. 38–55.

Ministry of International Trade and Industry (1984). *Annual Report on Small Enterprises* (in Japanese), MITI, Tokyo, p. 401.

Monteverde, K. and D. J. Teece (Spring 1982). 'Supplier switching costs and vertical integration in the automobile industry', *Bell Journal of Economics*, **13**, pp. 206–213.

Porter, M. (1980). *Competitive Strategy*. Free Press, New York.

Porter, M. (1985). *Competitive Advantage*. Free Press, New York.

Richardson, J. E. (1993). 'Restructuring supplier relationships in U.S. manufacturing for improved quality', forthcoming in *Management International Review*.

Riordan, M. H. and D. E. M. Sappington (Spring 1989). 'Second sourcing', *RAND Journal of Economics*, **20**, pp. 41–58.

Smitka, M. J. (1991). *Competitive Ties: Subcontracting in the Japanese Automotive Industry*. Columbia University Press, New York.

Taylor, G. S. (1991). 'Parallel inter-firm systems: The quality movement and tiered supply infrastructures in the automobile industry in Japan and North America'. Unpublished Ph.D. dissertation, Graduate Program in Administrative Studies, York University, Toronto.

Tirole, J. (1988). *The Theory of Industrial Organization*. MIT Press, Cambridge, MA.

Walker, G. and L. Poppo (1991). 'Profit centers, single-source suppliers, and transaction costs', *Administrative Science Quarterly*, **36**, pp. 66–87.

Walker, G. & D. Weber (1987). 'Supplier competition, uncertainty, and make or buy decisions', *Academy of Management Journal*, **30**, pp. 589–596.

Walton, M. (1986). *The Deming Management Method*. Pedigree Books, New York.

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. Free Press, New York.

Williamson, Oliver E. (Spring 1988). 'The logic of economic organization', *Journal of Law, Economics and Organization*, **4**, pp. 65–94.