The Invisible Handshake: The Development of the Japanese Automotive Parts Industry

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The Japanese auto industry is not only less integrated into parts production than the U.S. Big Three, but it also organizes purchasing differently. In Japan, car makers typically contract out subassembly and component manufacturing, while the Big Three primarily purchase simple parts. Thus while Chrysler may buy from 5,000 suppliers (and GM 20,000), Japanese auto companies buy from 200-300 firms--though these direct suppliers subcontract simple parts production to numerous small firms. Likewise, procurement in Japan is based on long-term "strategic" partnerships rather than the short-term contracting which has been typical of the U.S. until the past five years. One consequence is that Japanese auto firms are smaller. In 1985 Toyota and Nissan together employed a scant 120,000, while in North America GM alone employed 419,000 in 1988. This pattern is repeated across most industries; two-thirds of the entire Japanese labor force are found in small establishments, while two-thirds of U.S. workers are in large firms.

Because of this structure, managers at Japanese suppliers take over tasks which in Detroit are performed by the visible hand of middle management. In particular, Japanese managers at both suppliers and assemblers face the challenge of coordinating activities across firm boundaries. The Japanese auto industry developed innovative approaches to contracting to govern this system, which influenced practice in much of manufacturing. The parallel is obvious. While in the U.S. in the 1920s GM was one center for experimentation with the "visible hand" of internal management, in Japan in the 1950s Toyota developed an "invisible handshake" for managing strategic purchasing. The implications mirror those in the U.S.--having lowered interfirm transactions costs, Japanese companies on the margin resorted to purchasing rather than vertical integration. Management innovations in Japan led not to an increase in the scale of firms, but (on the margin) to a decrease in scale.

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Here I try to reveal the outline of the invisible handshake and its evolution. Susan Helper [6] sheds light on how the visible hand molded purchasing patterns in the U.S. My approach reflects three theoretical perspectives. First, I believe that organizational change is induced by the external environment; in general, inertia dominates--strategy is reactive, not proactive. (This is a variation of the familiar economic model of induced technical change.) Second, history matters: the particular timing and patterns of development in labor, capital and product markets have an enduring impact. (In Japan, for example, the lack of a major market downturn after 1949 was central.) Third, it also follows that adaptations can and often will be novel, and may even provide superior tools for handling generic management problems. But "better" management will not automatically be adopted elsewhere. Inferior practices persist: without severe pressures from the external environment, "best" practice may not diffuse to other firms, industries, or countries. This will be particularly true where competition is imperfect and large size makes institutional change costly, as with the U.S. Big Three.

Business history is a potentially useful undertaking--even if curiosity and fun is what actually motivates our efforts. We hope to understand why and how corporate management evolved, and hence to suggest its strengths and limitations. The visible hand helped give birth to large organizations in the U.S., but in today's rapidly changing environment these now appear to be a source of rigidity rather than a source of strength. By contrast, in Japan reliance on the invisible handshake--or what in the U.S. are now often called strategic alliances--provided strong incentives for technical change and gave birth to smaller, more flexible organizations. Both are central issues of the current competitiveness debate. (See my forthcoming book for more detail on these issues [10].)

Two further points deserve mentioning. In her overview of the evolution of U.S. contracting, Helper utilizes the exit/voice terminology of A.O. Hirschman. In contrast, I draw upon a transactions cost and principle-agent (optimal contracting) perspective. Despite differing terminology and nearly polar practices in the U.S. and Japanese auto industries, I believe our analyses of the relative strengths and weaknesses of alternative contracting paradigms are similar. Furthermore, we argue elsewhere that current practice is converging [7, 11]. The automotive industry is increasingly a world industry. Japan is no longer a high-growth, developing economy. Japanese and American producers thus face similar challenges. That was not always the case.

Inducement to Change: The Adoption of a Subcontracting Strategy

Until the beginning of World War II--1937 for Japan--Ford and GM dominated the Japanese automotive industry. At their peak, they assembled over 30,000 units annually in Japan. Most of their output was on a CKD (completely knocked down) basis, using imported parts. There were firms which manufactured common replacement items (tires, wheels, batteries, brake linings, piston rings), but when Nissan, Toyota, and Isuzu entered the industry during 1936-1937, they found few potential domestic parts

producers, and not all of them were interested in the automotive business. Existing steel producers, for example, did not believe Toyota was viable, and refused to supply steel of the requisite types and consistency needed for large castings and forgings. The fledgling auto firms were thus forced to integrate vertically. Toyota made its own glass, electrical components, and specialty steel for castings, as well as many of its own machine tools. Nissan Motors turned to sister firms in the Nissan *zaibatsu*, including Tobata Casting and Hitachi [5]. (Silver makes this argument for other industries, countries and eras [9].)

During the war the auto firms were forced to turn out munitions, not vehicles. From August 1945 such production ceased and the facilities of many firms were temporarily designated for reparations to Southeast Asia and placed under seal. Nissan, Toyota, and Isuzu, the pre-war entrants, continued partial operations. Along with turning out pots, pans, and sundry items, they and the major aircraft producers entered or reentered the automotive industry. They repaired U.S. jeeps, made four wheel trucks and motor scooters, and turned out heavy trucks and buses. Passenger car production resumed in significant volume in 1955 and surpassed truck production only in 1967.

In response to this environment, the previous strategy of vertical integration was reversed. The Dodge Line policies of April 1949 provided the impetus and a channel through which the U.S. Occupation successfully quelled the postwar inflation. The resulting recession, however, led many large firms to reduce their work force and produced bitter labor confrontations. The three dominant truck producers--Toyota, Nissan, and Isuzu--all underwent strikes. Toyota faced bankruptcy due to inventory mismanagement, until it was bailed out by Bank of Japan. The Korean War broke out in June 1950, ending the overall recession and leading to orders for trucks and contracts for vehicle repair, paid for in U.S. dollars. But while output increased rapidly, the auto firms were reluctant to add to their work force. It was unclear how long the boom would last and memories of the confrontation with unions over layoffs were still fresh. So firms subcontracted production that had until then been carried out in-house to other, generally smaller firms. Thus, while Toyota's output rose five-fold during 1952-1957, employment rose only 12%.

Two factors enabled this shift. Because output was low, production depended upon general purpose tools and skilled workers rather than production lines or other dedicated assets. In fact, individual manufacturing steps, such as the drilling of holes and the hand deburring of castings, had long been "put out" to small workshops. Second, until the late 1950s there was significant excess capacity in manufacturing (particularly in machining and stamping), and the auto industry was small relative to manufacturing as a whole. It was thus relatively easy to find suppliers for simple parts at competitive rates. This made subcontracting doubly advantageous. By turning to outside suppliers, the auto firms were able to increase their output without new investment. Instead, they could devote their limited financial resources to final assembly, new model design, and other activities which remained in-house.

The management of the early subcontracting system was straightforward. Pricing was easy: the purchaser simply paid the going rate for that type of product. But logistics and scheduling were a nightmare and quality remained a problem. Suppliers had little incentive to invest on the auto firm's behalf because of their explicit status as a safety valve. In a recession, they fully expected the auto makers to pull work back in-house. But because prices were readily observed, existing suppliers could be offered the right of first refusal on new business, in contrast to Detroit, where orders were shifted frequently among firms. In most respects, subcontracting initially resembled the "low-tech" strategy which Helper describes for the post-World War II U.S. auto industry.

But work and workers were not periodically shifted in and out of the firm. Instead, the subcontracting paradigm shifted. Contrary to expectations, the Japanese passenger car industry saw twenty-five years of continual, indeed phenomenal, growth. Rather than facing periodic recessions, output doubled every two to three years, slowing only after 1970. The truck and three wheel vehicle markets both grew more slowly and remained more cyclical. In addition, new entry kept firms in a constant race to improve quality and lower costs--in contrast to the stable oligopoly that formed in the post-war U.S. industry. By the late 1950s the volume made it difficult to purchase parts from local job shops. Nor were such shops able to provide adequate quality.

But rather than vertically integrate--and increase direct employment and bank borrowings--the auto plants changed the content and method of subcontracting. Assemblers thus increasingly relied upon their suppliers for not only simple machining but also for the manufacture of parts and gradually of entire subassemblies. On the one hand, in the face of the rapid increase in output, suppliers shifted from general-purpose machine tools to proper production lines. In some cases subassembly lines were physically shifted to the factories of the more reliable suppliers. In others, the auto firms encouraged their suppliers to grow in scale and sophistication by providing assurances of continued orders. On the other hand, assurances of future orders had to be given merely to obtain the interest of suppliers. The overall Japanese economy was growing, and the entrepreneurial owners of small subcontractors needed a positive incentive not to move elsewhere. By 1960 both the content of subcontracting and the nature of the relationship had shifted. Toyota, the most successful of the early entrants, set the pace in the mid-1950s. Later entrants, such as Mitsubishi, changed only in the early 1960s.

With the shift to the subcontracting of more complex operations, the nature of the contracting relationship also evolved. Contract continuity, as noted above, was used to encourage investment and to lock in supplier capacity. But as dedicated tooling and even production lines became widespread, it was no longer possible to switch orders at low cost. Indeed, in the short run the purchaser became dependent on the existing supplier, and suppliers, generally small firms, were likewise dependent on their automotive customer for an ever-increasing share of their sales. Furthermore, as production volume was still low compared to that of the

U.S., economies of scale worked against multiple sourcing, even for relatively simple parts.

As the transaction cost literature stresses, the auto firm and the supplier of a part thus found themselves in a bilateral monopoly [13]. Contracting in this one-on-one environment was fraught with potential disputes over pricing and other details; a supplier could hold out at the last moment for a price increase, or the purchaser could threaten to take the business elsewhere or (in Detroit) pull it in-house. Furthermore, it was ideally an ongoing relationship, requiring investments and manifold adaptations over time. An inability to manage such contracting relationships is widely held to lie behind the bias in the U.S. toward vertical integration [8]. (But see Helper's chapter and [4, pp. 44-46].) In any event, written contracts were inadequate; transactions were simply too complex to specify in much detail, and the court system too unwieldy to resolve disputes. A new framework was required if the strategy of subcontracting complex parts production was to be maintained over the long haul.

Innovation: Managing Interdependence

In their attempt to cope with interdependency--and to develop more capable suppliers--managers in the Japanese auto industry were forced to innovate. In the U.S., as Helper discusses, Ford and GM combined vertical integration and the purchase of simple parts, relying upon hierarchy and contracts respectively. In Japan, however, the auto industry avoided vertical integration while relying upon suppliers for complex parts, and thus had recourse to neither market nor hierarchy. Instead they developed a hybrid mechanism for governing transactions that relied crucially upon trust. Personal trust alone was inadequate for governing the complex interactions of two firms, but it provided an important starting point. For interdependency to develop, both parties had to place themselves at risk. Personal relationships provided the assurance needed to initiate subcontracting. But the purchasing relationship also evolved gradually as volume, variety, and complexity of subcontracted work all slowly increased. Second, over time norms for pricing, delivery, quality, and other details were developed which lessened room for dispute. Third, well-specified mechanisms for interfirm communication ("voice", as Helper would call it) helped prevent incipient disputes. Finally, conscious investments were made to build and maintain reputation. In a multi-firm, repeated contracting environment, this helped provide sanctions for both sides to remain faithful. Thus a very complicated relationship evolved, in which trust, reputation, and interdependency made commitments credible, while the norms and expectations that arose helped delineate the implicit terms for transactions.

Trust and norms were exactly the sort of problems, for instance, that Mitsubishi Motors (then Central Japan Heavy Industries) faced in 1958-1959 at its Mizushima Plant [10, Chapter 2]. The firm, which at the time made three-wheel trucks, pulled work in-house during the 1958 recession. A boom followed and the firm had difficulties finding suppliers. Other firms already had faced and overcome similar problems with subcontractors. Mitsubishi was therefore able to call in outside consultants in 1961 to help

turn around its subcontracting system. These consultants from the Nagoya area were familiar with Toyota's supplier management practices, which were systematized between 1952-1954. In line with their recommendations, Mitsubishi committed itself to suppliers, developing a long-term purchasing plan to help convince them that it would not pull work from them in the future. It also clarified the responsibility for interactions with suppliers internally and revised pricing policies. These helped the firm make a start at setting norms and rebuilding trust.

An important tool of the new policy was the supplier cooperation association or *kyoryoku kai* which Mitsubishi set up, following the example of Toyota. One function was to maintain reputation. The association brought the management of all local suppliers together on a regular basis, and so all suppliers would soon know of any deviation by Mitsubishi from its stated policies. But the cooperation associations also facilitated efforts by each auto firm to bring a measure of organization to its supplier network. The associations thus helped the auto firms achieve the advantages of coordination which are typically seen as the peculiar province of internal organization [3]. For example, through the cooperation associations the auto firms discussed future product strategy and sales forecasts with suppliers, coordinating investment plans across firms. They also discussed changes in product design and automotive technology which might make current suppliers' capacity redundant or require new entry. Finally, as detailed below, they were the institutional locus through which the auto firms taught suppliers better management and production methods. By working closely with suppliers, an auto assembler could focus its attention on new model development and other strategic decisions, while leaving adaptation and implementation to others.

The poor technical and managerial capabilities of suppliers led the auto firms to develop their suppliers. Through the cooperation associations the auto companies ran seminars and workshops on a wide variety of topics for supplier engineers and managers. Early efforts focused on the industrial engineering techniques needed to set up and run production lines and on the cost accounting to monitor them. Along with bringing in consultants, the auto firms involved their own engineering staff, sometimes seconding them for a half-year or more. Labor relations techniques (e.g., QC circles), statistical quality control, and just-in-time (JIT) process control were all taught in this way. (Note that the development of JIT was induced by the logistical problems mentioned earlier.) Finally, in the 1970s, the auto firms stressed the use of value analysis (VA) and value engineering (VE), industrial engineering methodologies for coordinating the systematic examination of design parameters by cross-functional teams in order to improve value and/or decrease cost. VA/VE programs enabled suppliers to undertake more of the initial design process and retain greater control over costs and quality. In fact, Japanese auto firms can neither manufacture nor design a new car now without the input of their current suppliers. The cooperation associations were thus central in introducing improved management methods and better production technology, and in coordinating design across firms.

Finally, norms for pricing were crucial in making subcontracting workable. While purchasing took place on an on-going basis, all the auto firms produced multiple models, and hence could purchase similar parts from two to three different suppliers. But the auto firms did not rely upon direct rivalry among these firms. Instead, suppliers were required to submit bids with cost breakdowns by process, and not just a quote on the final unit price. Since at any given time many suppliers used the same manufacturing process--stamping, boring, plating--detailed comparisons at the process level were possible across firms and (the current method) across time [1, 2]. The bid system thus provided a relatively objective starting point for price negotiations. But the bid also provided detailed information which helped pinpoint the source of high costs and hence to direct engineering efforts to problem areas. In turn, low bids for a given process could signal new techniques which the auto firms would then try to ferret out and teach to others. The pricing mechanism thus not only helped firms to avoid disputes but also encouraged technical and management innovation.

While there was rivalry among suppliers, it was restrained and often indirect; the current supplier for a part typically would have the right of first refusal for the equivalent part when a new model was introduced. This provided the assurance firms needed to invest in plant and equipment without having to front-load capital costs onto the work at hand. (U.S. automotive suppliers often require a two year payback on any significant capital investment, due to past bitter experiences with work being pulled in-house by the Big Three [7, and my own interviews].) But in addition, the pricing formula meant that a firm which implemented innovations faster that its rivals earned high profits, and firms were explicitly compensated for design innovations stemming from their VA/VE programs. Failure to remain competitive resulted in lost orders. While innovative firms were quite profitable, many parts firms exited in the 1960s and early 1970s. There were thus many incentives, positive and negative, for the parts firms to improve their operations.

Implications and Extensions

Supplier operations improved rapidly. This was critical for the success of the industry, since purchases by the auto makers comprised 70% of manufacturing costs. From 1958-1965, when costs fell by half, lower parts prices accounted for 54% of the reduction (and lower steel and materials prices for 16%), while only 32% accrued from internal cost savings of the auto makers themselves [10, Table 3.7]. In 1955 the Japanese passenger car industry was competitive in neither cost nor quality with imported vehicles despite significant trade barriers. It is now competitive throughout the world, in large measure through the mobilization of outside suppliers. The industry achieved this not through hierarchy or market, but by developing a sophisticated and efficient mechanism for coordinating activities with independent suppliers.

The systematic reliance on strategic alliances was not restricted to the auto industry. The postwar business environment encouraged Japanese firms in many sectors to avoid vertical integration. In the assembled goods

industries, this was achieved by developing close ties with suppliers, drawing in part upon the automotive example. As Helper argues [7], a partnership with suppliers is not unknown in the U.S., and even the auto industry is making halting efforts to change its strategy [11]. Coordination is not important in all industries and in such cases pure market purchasing is adequate. Similarly, in some instances it is not possible to maintain a semblance of rivalry, which underlies the viability of the Japanese pricing mechanism. Thus Japanese auto firms make their own engine blocks and large body stampings. But where coordination is needed the Japanese auto example suggests that partnerships with suppliers *can* be managed so as to maintain order, without resort to bureaucratic coordination under vertical integration.

Why is the strategy not more widespread? The primary barrier, particularly when a strategy is adopted widely, is that it cannot always be reversed. In the Japanese case, the widespread utilization of subcontracting encouraged the growth of small firms. Machining districts, reminiscent of the garment district in Manhattan, are still widespread. One career pattern of an ambitious youngster, in fact, is to apprentice in a series of small shops and then set up on his own. Historically, many foremen left large firms to become suppliers to their former employers. Because of this there remains a large reservoir of entrepreneurs who can be turned to as subcontractors--though the auto industry is no longer prized as an end customer. In the U.S., vertical integration limited the growth potential of small firms, and the low tech parts purchasing strategy relegated them to stagnant and unstable lines of business. In many American industries there are thus few capable suppliers, rendering it difficult to adopt a subcontracting strategy. On the other hand, Japanese firms cannot readily begin pulling work in-house, as it would threaten the cooperation on which their entire system depends. Several Japanese consumer electronics firms rely upon mom-and-pop stores for the majority of their sales and are finding it hard to shift to discount distributors.

Another reason why the strategy is not more widespread is that business culture is molded by strategy. In Japan trust and reputation are well understood. The Japanese equivalents of Dun & Bradstreet are careful to list key suppliers and customers, while the owner/operators of small firms (and their counterparts in large ones) are schooled in running cross-firm partnerships. In the U.S., hardball contracting practices have left a legacy of distrust, and American business culture lacks images of and presumed familiarity with partnerships. Once adopted, therefore, vertical integration and non-integration may both be equilibrium strategies--even if they become dysfunctional.

Continued research on Japanese business history promises many interesting extensions. In the Japanese legal environment the court system is not a viable means of conflict resolution. Part of the reliance on trust in subcontracting may thus represent an adaptation to the inability to enforce contracts. Accounting also appears to have developed in a divergent direction: formal capital markets have been unimportant, and so reporting requirements have not been relevant for most firms. Instead, management accounting has been more central [12]. Little has been written on this

topic, even in Japan. The area of corporate services differs; small firms utilize neither accountants nor lawyers. Some services are provided by their customers and suppliers, but there is an array of business consultants in Japan which has yet to be described in English. Finally, how precisely do firms communicate with each other? I have sketched two key areas above, the bid system (for pricing) and value analysis (for technical change). There are clearly other techniques that help the invisible handshake of small firm managers and their customers to substitute for the visible hand of middle management.

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