SUPPLIER RELATIONSHIPS IN THE AUTOMOBILE INDUSTRY AND THEIR EFFECTS ON PRODUCT DEVELOPMENT

by

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Bachelor of Arts, Politics, Princeton University (1987)

Submitted to the Alfred P. Sloan School of Management in Partial Fulfillment of the Requirements for the Degree of

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Abstract

The U.S. automobile industry has fallen behind the Japanese in design capabilities. Japanese manufacturers produce more auto models with higher initial and long-term quality, they design them in half the time of American manufacturers. This gives the Japanese a strong competitive advantage.

Traditional U.S. assembler-supplier relations have been strained. Suppliers were contracted for short periods of time, based solely on cost competition. Purchasing departments controlled the relationship and kept engineers from talking with others at different companies. Since design was based on functional hierarchies, communication was difficult enough within the company.

The Japanese developed a different system, one where design is simultaneous. Teams are formed and schedules are kept. Consensus is reached up-front, and then design proceeds quickly. Suppliers are part of these teams, and are contracted for long relationships based on mutual information exchange. From this, one can see three supports for accelerated product design: an organization that promotes information sharing, make suppliers part of this system, and show commitment to R&D and change.

Three examples of change in the U.S. show the advantages and disadvantages of each approach. General Motors built a new subsidiary, and introduced new practices wholesale. However, the rest of the company still lacks such an organization. Ford has adopted many of these practices on a widespread basis, but has yet to transform its culture. Honda has built a new organization, but it has yet to show commitment by designing an all-new platform in the U.S.

Between instituting new organizational precepts, hiring new people, gaining the trust of suppliers, and designing a new car, it will take 10 years for American assemblers to fully change. In addition, obstacles must be overcome: the UAW, Japan-bashing, and the recalcitrance of some suppliers. They will need to fully accept continual improvement if they hope to match the Japanese.

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Bibliography
I. WHY SHOULD AUTO MAKERS CARE ABOUT SUPPLIER RELATIONS AND PRODUCT DEVELOPMENT TIME?

During the past decade, Japanese manufacturing techniques have attracted much attention from American industry. One aspect that has been of particular interest is the design process of Japanese automobile assemblers. They have managed to function more efficiently than American design labs, and have been responsible for one of the greatest decreases in product development time in history. While it takes six to eight years to design an American car, the Japanese can do it in three to five.

One of the driving forces in this system is simultaneous design with suppliers. Japanese firms allow their contractors to design entire systems that fit into the car, with only the body and drivetrain directly engineered by the assembler. By allowing all systems to be designed concurrently, the Japanese have jumped ahead of the Americans, who still use the sequential design method.

Why should American manufacturers care about this? Three reasons drive this need to align their system with that of the Japanese: response to market, the ability to implement quality on the line, and the cost of R&D. In all three areas, working with suppliers have given the Japanese firms an edge.

Market response has become increasingly important in the past decade. Just recently, the Wall Street Journal reported on the shrinking life cycle times of sporty cars, and the need for manufacturers to redesign them more quickly. More importantly, though, quicker design gives firms a competitive edge, as they can react to competitors and even surpass them. Since Ford introduced the Taurus in 1984, Honda has introduced two redesigned Accords, and a third will

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be sold before the new Taurus is produced. The new generations of the Accord will build on the lessons of the Taurus before Ford can react.

Shorter lead times also allow more customization of models. Companies can change models in midyear, since much of the design work can be done simultaneously by suppliers. In addition, feedback spreads more quickly through these organizations. Thus, the companies can react to market trends.\(^2\) This is further shown by the increased number of models available in the U.S. The Japanese companies flooded the market with new models, each designed to fill a specific niche.

Working with suppliers also allows quicker changes on the line, which leads to improved quality. While some of this comes from JIT and shorter production planning schedules (10 days in Japan vs. 4 to 6 weeks in the U.S.), it also comes from the incremental changes that develop out of these informational networks. Thus, changing parts or processes for quality reasons is easier.

Quality is also improved through increased manufacturability. Since the suppliers who build the parts also design them, they develop the manufacturing process. Thus, there are no flaws in production when the supplier tries to adapt its machine tools to an unfamiliar part. Instead, parts are produced correctly the first time, and since they are designed as a system, they fit together better. Thus, there are fewer defects and higher productivity.

This higher productivity will be crucial as American manufacturers attempt to introduce a wide range of new platforms. In the next five years, GM alone will introduce 22 new models. If it has design or manufacturing flaws on only a few

of these, the costs could be tremendous.\textsuperscript{3} If GM outsourced design, this would be less of a concern.

A third benefit of supplier design is a decrease in R&D costs. There are two reasons for this. First, part of the cost is borne by the supplier, which has its own R&D and CAD/CAM systems. Second, the process of integration requires much of the decision-making to be made up-front. Thus, much work is done in the first year on setting objectives and specifications, and then the work is farmed out to various teams. In this system, the number of direct design engineers required on the project declines over time, reducing cost as the project matures. In the U.S., on the other hand, the number of designers increases over time, with cost overruns as the natural result.\textsuperscript{4}

This system also saves money by keeping projects on schedule. In American design, one mistake can throw off the entire schedule, as all design work is sequential. In Japan, more cars are on time, since in simultaneous design, one mistake will not affect most of the project. Thus, budgets are more realistic, and less money is lost through delays.\textsuperscript{5}

What has been the result of these gaps? The market share of U.S. companies has continued to decline in the 1980's, and they now account for only 70% of sales in their home market. The bulk of the imports are Japanese, and all of the companies use suppliers in their design process. Can the U.S. manufacturers follow them and bring contractors into the process?

\textsuperscript{3}James B. Treece, "War, Recession, Gas Hikes... GM's Turnaround Will Have to Wait," \textit{Business Week}, February 4, 1991, p. 96.


\textsuperscript{5}\textit{Ibid.}, p. 118.
How to implement change

Three changes need to be made to allow U.S. assemblers to enjoy the benefits of improved supplier relations. The first is to change the organization of each company so that they are better able to delegate work to suppliers and promote simultaneous design. This requires change from the top down and major adjustments in how the corporation promotes information-sharing. It starts with internal delegation of responsibility, so that everyone in the organization is encouraged to acquire information for decision-making. It also means changing the processes so that goals and objectives are set up-front, with open discussions among all involved. Finally, organizations must build dedicated teams, in order to promote ownership of ideas and ensure continuity.

Organizational change must also extend beyond design labs. Manufacturing and marketing must be involved before outside suppliers can become part of the process. Design teams must be willing to share information and learn from internal units before outside units can function. In addition, these units must believe in continuous improvement, which requires constant communications between diverse specialists.

The next step is to bring in suppliers. Doing so requires controlling the number of contacts, so that design teams can communicate effectively with all of the lead suppliers. This will also facilitate melding these suppliers into the information network, which is crucial for simultaneous design. Suppliers must have access to the same information as internal units if they are to be able to function as full members of the design team. Finally, commitment must be shown to these suppliers, so that they have an incentive to participate in the process. Short-term partners will not have any drive to invest in the design capabilities required
under this paradigm.

The last step is to show commitment from the top to this change. All three American assemblers have talked about organizational change, but they have not shown the dedication that Japanese manufacturers have demonstrated for their efforts in continual improvement and supplier relations. Whether it is monetary, such as increasing R&D outlays, structural, like Ford's new computer network linking all of its designers, or organizational, as in Japanese companies naming only engineers to top executive positions, companies must show that design and supplier relations are corporate assets, not factors to be adjusted based on economic conditions.

Can this be done in the United States?

U.S. manufacturers have adopted a number of different practices in order to solve these problems. While some have been successful, these assemblers are still behind the Japanese in design time and quality. Thus, some argue that none have found a true recipe for success. The truth is that there is no one recipe. Each practice can be successful if the central principles are followed. They key is not to exactly copy the Japanese companies, but to find American practices that allow them to function along these principles. Thus, it is first necessary to understand the current state of U.S. assembler-supplier relations, so that one can fully understand the magnitude of the necessary change.
II. TRADITIONAL SUPPLIER-ASSEMBLER RELATIONS IN THE U.S. AUTO INDUSTRY

To understand American assembler-supplier relations, it is first necessary to look at changes in sourcing philosophy during the history of the U.S. automobile industry. There have been wide swings between full vertical integration and widespread secondary sourcing, but in all cases, a distrust of suppliers was evident. From this, one can more fully understand the state of relations between the two sides under the current system.

The two paradigms of American automobile manufacturing

The story of Henry Ford and his development of modern mass production is well known. Ford took the craft method of producing cars and transformed it into a method that allowed him to produce millions of cars each year at an incredibly low cost. He introduced the assembly line and segmented work so that each worker did one precise action. His goal was to make the entire line one precise sequential process.

Ford adopted the same attitude to components. He built a large sequential system, with individual machines and divisions responsible for one specialized function or part. Dies stamped millions of the same part, and entire plants were devoted to producing standard subsystems for the Model T.

In this system, there were no suppliers. Ford wanted precision and reliability, and he could not get these from outsiders. To become a supplier to Ford was to be a hostage, since the capital requirements were huge for these precision machines. Furthermore, Ford would become dependent on the supplier for that part, which could upset Ford's system. Thus, vertical integration was the key to
success. When Henry Ford opened the Rouge complex in the 1920's, his attempt at vertical integration reached the peak. His stated goal was to be able to bring raw iron in one gate and drive cars out the other. ⁶ He almost reached that goal.

While the Ford Motor Company benefited from this high degree of vertical integration, it also faced many of the problems that U.S. auto makers face today, but to an extent that would have staggered a company without its resources. Among the ills that Ford suffered were:

- Incentives against change. By investing in specialized equipment to make all of the Model T's components, Ford could earn a profit only by running the machines to capacity. Furthermore, transfer costs were magnified, since all of the equipment would be destined for the scrap heap once a decision was made to change models. When Ford decided in 1927 to switch to the Model A, almost all of the invested capital needed to be scrapped.

- Time. When the model switch came, it took Ford nine months to change over the factory. During that period of time, Ford produced no cars in the U.S., and finally lost its market leadership to GM.

_The General Motors paradigm_

The system developed by General Motors abandoned Ford's attempt at full vertical integration and was later adopted by all three U.S. assemblers. Thousands of suppliers are now used by all three U.S. manufacturers to supply several dozen assembly plants across the United States. These suppliers provide more than half of the the value-added in each car, and much of the resources of each company are devoted to purchasing departments which control the rela-

⁶Womack, Jones, and Roos, p.39.
tionships between the assembler and its suppliers.

In The Machine that Changed the World, the authors used the development of GM’s G-10 platform to show how this paradigm worked. First marketing worked on a list of customer needs. Then, a series of specialist engineers worked on different functional parts of the car and developed them independently of one another. After the design was finished, the project was moved to Fisher Body and GM’s assembly divisions. There, manufacturing reworked the specifications and changed many of the components in the design. After this was done, blueprints were drawn up and bids taken by suppliers for individual parts, including GM’s own internal divisions. Low-cost suppliers were chosen, but before manufacturing could begin, further changes were made, based on design needs or manufacturability constraints. Finally, after launch, further changes were made and prices were adjusted upwards. Overall, the project ran late and lost money.\(^7\)

Several issues were evident in this. First, conflict was not faced directly, but put off until after decisions had been made. Only when disagreements between design and manufacturing were finally at a crisis point was a consensus reached, with a resulting change in plans. In addition, design was sequential, not simultaneous. Finally, suppliers were not brought in until the end, and then only to produce individual components, not systems. Thus, the suppliers had no ownership in the design and no commitment to the project.

How Detroit chooses suppliers

These failings begin in the selection process for suppliers, which is based as much on controlling suppliers as in working with them successfully. First, the

\(^7\)Ibid., pp. 104-109.
American assemblers make no effort to limit the number of companies with which they work. GM contracts with 12,500 companies, while Ford and Chrysler also work with several thousand. Each of these companies can bid on a part, with the lowest bid winning the contract. No information is exchanged beyond this price figure until the contract is awarded, which is usually for a one-year period. Thus, the glut of bidders and the lack of information makes the process very price-intensive, and gives much power to the assembler.

The bid process also is biased against process improvement and other efforts at continuous improvement. With contracts that last only one year, there is little incentive towards any effort that reduces NPV. Most suppliers use a one-year payback method to set price, and then push for price increases if they are wrong.

The last aspect of this process is the competition that it puts into inter-supplier relationships. Companies have no incentive to share information, since any company can take over a contract when the annual competition arises. Thus, process information is not shared, even among companies that are not direct competitors. Information which could be used to improve the cars remains proprietary, reducing efforts to improve quality.

The ongoing relationship

Just as the bidding process produces an antagonistic environment, methods of

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controlling the relationship between assemblers and suppliers produces a high level of conflict that promotes arms-length transactions instead of teamwork. Nowhere is this more evident than in the renegotiating process for component prices. Most companies bid low, expecting to be able to adjust prices as needed to make a profit. The assemblers have encouraged this process by devoting large staffs to this process. However, these negotiations are solely price-based, with each side trying to get extract money from the others. Instead of working on continuous improvement, the parties involved are more concerned with hoarding information so that they can improve their negotiating positions.¹¹

This arms-length perspective is strengthened by the number of assemblers with which each supplier works. In the U.S., 60% of component manufacturers work for at least three assemblers, and 30% work for seven or more.¹² They often play one assembler against the other, much as the assemblers do with suppliers. Thus, there is again little incentive to improve the relationship.

Relationships are not helped by the purchasing departments of the assemblers. Their incentives are based on reducing cost, and not on fostering better communications or continuous improvement. Most communications are one-way, from the assembler to the supplier, and involve monetary concerns. Thus, there is little opportunity to share process or product information.

Finally, quality standards are low. Just as a "rework mentality" exists at the assemblers, so to do they expect a good deal of defective parts from their suppliers.¹³ Ill-fitting parts and defects are part of the process, not a major concern. With no incentive from the manufacturers to improve quality, the suppliers

¹¹Womack, Jones, and Roos, pp. 143-144.
¹³Womack, Jones, and Roos, pp. 57-58.
make little effort to improve their own quality control or design capabilities.

Thus, the relationship between American suppliers and assemblers does not foster the information flow that would promote simultaneous design. The relationship is antagonistic, and little process and product information is shared. Competition is key, and a company that cooperates risks losing its contracts. The relationship is based on control, with both sides trying to get an edge over the other. With this lack of organizational ties and commitment, suppliers have been cut off from the design labs of assemblers for most of this century.
III. AN ORGANIZATIONAL PARADIGM FOR IMPROVED PRODUCT DEVELOPMENT

Until the early 1980's, there were few efforts made by the U.S. automobile manufacturers to alter the supplier system that they had built. They controlled the system and were able to extract great profits from it. On the other side, the suppliers also had little incentive to change. While cut off from much of the design process and somewhat bullied by the Big 3, they were still in an enviable position. Since it was easy to work for all three assemblers, suppliers moved from one contract to another. Moreover, the huge demand for vehicles in America made it extremely profitable to be in the auto components industry. Until 1974, profits for suppliers grew at a rapid clip.

1974 was the first sign of change. In the face of a recession and the oil embargo, sales of American-build cars declined drastically. Faced with reduced demand and rapidly increasing costs, Detroit reacted by shrinking orders from many suppliers and cutting others off. With a drastic reduction in profits due to this exercise of the assemblers' power (many suppliers went into red ink), suppliers began to demand changes in the relationship.¹⁴

While the relationship between U.S. suppliers and assemblers worsened during the 1970's, Japanese companies made steady inroads into the U.S. auto market. During the 1980-82 recession, Japanese companies prospered while U.S. auto firms were left weakened. It was in the wake of this crisis that U.S. auto makers finally were pushed to change the way they communicate with their suppliers. They began to look for a new paradigm in assembler-supplier relations, and

many turned to the Japanese as a model.

They were not alone. Theorists have described the Japanese practice as superior to those in the U.S.\textsuperscript{15} It allows faster development time and higher quality. In addition, it has proven to be resilient, lasting far beyond its origins in the post-World War II scarcity of the Japanese economy. Many have argued that U.S. assemblers should adopt many of these practices wholesale.

There are reasons to doubt that simply imitating the Japanese will work. There are many practices in Japanese industry, such as cross-ownership in keiretsu, that are illegal in the U.S. Moreover, there is much in the practice of Japanese manufacturers that is tangential to the goal at hand: improving product development. Thus, instead of importing all Japanese practices, it is worthwhile to first analyze them. Then, after the important points have been isolated, a model of supplier relations can be built that is applicable to U.S. industry. To prove this, the example of European assemblers will show that when key parts of the organization are missing, the development process does not accelerate.

The Japanese model of product development and supplier relations

To understand the Japanese design practice, one must first understand the role of the design team in Japanese companies. All design projects are undertaken by dedicated, cross-functional teams. Unlike the U.S., where engineers are officially assigned to a functional organization, Japanese designers report directly to their team leader and secondarily to their functional chief. All information pertinent to the project flows into the team, and all team members have access to all information.

\textsuperscript{15}One well-known group is the International Motor Vehicle Program (IMVP) at MIT.
There are several reasons why these teams work so well. First, compared to U.S. firms, they are small. While the average U.S. and European vehicle design team has 900 engineers, the average Japanese team has around half that number, while the smallest teams have only 300 members. These team members stay together as a unit for the life of the design project. The company benefits, as expertise is built and information is shared through informal networks that grow from working relationships. The workers benefit, in turn, by having the opportunity to gain recognition through their contact with the project. When a design project is successful, the entire team receives promotions and recognition. Thus, while each engineer may be assigned to the same job for as long as four or five years, he (teams in Japan are almost always all-male) will receive the benefits of a successful project.\textsuperscript{16}

Truly able engineers and managers are eventually promoted to the role of \textit{shusa}, or team leader. While Japan is known for consensus management, each \textit{shusa} has powers far greater than those of design managers in the U.S. \textit{Shusas} assemble their teams, and often choose the members personally. While they work hard to build consensus, they have ultimate control over the specifications of the vehicle, and they set the schedule. In return, projects become associated with the team leader. While in development, the car is often known by its \textit{shusa}'s name, and the team leader's future status within the corporation is directly tied to the fortune's of his design project.\textsuperscript{17}

The best \textit{shusas} are those who have broad experience in many functions. They can interact with marketing and manufacturing, and are expected to be as

\textsuperscript{16} Womack, Jones, and Roos, pp. 113-115.

\textsuperscript{17} Ibid., pp. 109-112.
capable in setting a capital budget as they are in reading blueprints. However, these skills are easy to build in a Japanese firm, for it is expected that engineers will work outside of their own specialty. Before they even join a design team, engineers work in a factory. They start with up to a year on the assembly line before they move into process engineering, and only after that experience can they join a design team. Since no shusa would pick a team member without a strong track record at the firm, it is extremely rare to circumvent this process.

Some companies go even further. Honda’s designers in Japan spend six months as salesmen in the company’s dealerships. The company believes that they will be more able to judge changes in the market, while simultaneously they learn the entire process involved in making and selling vehicles. For most Japanese companies, the second point is as important as the first. They believe that an understanding of the entire process is crucial to excellence in design.

This cross-functionality extends to the design teams themselves. While Detroit has used feedback from marketing departments, Japanese design teams have salesmen on them. In some cases, they report current trends and help develop a marketing plan while the project is still in the design phase. In others, they are full members of the team, taking a year or more off from selling to actively set goals and specifications for the car.

There is one last group that participates in these design groups: the suppliers. While American designers were working alone and then taking bids on parts, Japanese suppliers were not only sitting in on design meeting, they were integral

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*Karlsson and Carlsson, p. 7.*

*Womack, Jones and Roos, pp. 128-130.*

*Iheda, p. 6.*

*Womack, Jones and Roos, pp. 181-182.*
parts of the team. To understand how this could occur, one needs to place Japanese assembler-supplier relations in their proper context.

First, Japanese assemblers are far less vertically-integrated than their European and U.S. counterparts. The major U.S. and European firms show a fairly consistent range of their share of their vehicle's value added:

<table>
<thead>
<tr>
<th>Company</th>
<th>Value-Added %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daimler-Benz</td>
<td>43.4%</td>
</tr>
<tr>
<td>GM</td>
<td>43.2%</td>
</tr>
<tr>
<td>Peugeot-Citroën</td>
<td>37.3%</td>
</tr>
<tr>
<td>BMW</td>
<td>36.9%</td>
</tr>
<tr>
<td>Chrysler</td>
<td>35.5%</td>
</tr>
<tr>
<td>Ford</td>
<td>33.4%</td>
</tr>
</tbody>
</table>

The nine Japanese firms are also in a close-spaced range, but at a far lower level. Fuji Heavy Industries (Subaru), at 24.1%, is the most vertically integrated. Honda, the leanest, produces only 16.1% of the value of each car.²²

With such a difference in vertical integration, more design work should be channeled to suppliers. However, the level is extremely high, with more than 50% of research and design costs being borne by suppliers to the major assemblers.²³ While this explains why it is beneficial to have supplier engineers sit on design teams, it does not answer the question of how the system works. To fully understand that, it is necessary to look at the ongoing relationships between assemblers and suppliers.

²²Iheda, pp. 4-5.
²³Cusumano and Takeishi, p.1.
Japanese assembler-supplier relations

The Japanese system of supplier relations grew out of the rapid growth in the Japanese auto industry following World War II. There was a pent-up demand for vehicles among the populace, but when manufacturers tried to meet demand, the shortages of the post-war depression and their own damaged facilities prevented them from being able to meet it. Following economic necessity, they began to outsource work to companies that were able to produce certain parts. The first parts were the labor-intensive components, but over time, more specialized parts were outsourced.\(^24\) As more of these parts were trusted to suppliers, the companies acquired expertise. The Japanese manufacturers soon found it easier to use that expertise than to develop their own. Since these companies also had supply problems, they soon began to subcontract. By the mid-1950's the tiered system of Japanese suppliers was well-developed.

How does this system work? Most assemblers have a relatively small group of suppliers with whom they work closely. These first-tier suppliers help design systems and are closely linked to the main company, and are often the sole suppliers for their systems. In return, the company often is the sole customer of that supplier for automotive parts. The first-tier companies usually have complete control over their systems. For example, if they develop brakes, they will design the entire brake system, and then subcontract for individual components. In turn, these second-tier suppliers will contract out to third-tier companies, often for raw materials or simple components.\(^25\)

Within these relationships, much of the assemblers' techniques are duplicated. The supplier engineer who sits on the assembler's design team will also be a

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\(^24\) Iheda, p. 26.
\(^25\) Ibid., pp. 5-7.
member of his own company's team, which in turn will work with the second-tier suppliers. One example is of a first-tier supplier which had 10 second-tier suppliers. While arranging standards with the assembler, it worked with these companies to set component standards and set a schedule that would mesh with that set by the assembler.26

This illustrates an advantage of the Japanese system: design of each part by its manufacturer. Instead of the assembler designing all components in-house, suppliers help design the parts that they will build. Furthermore, machine tooling begins once preliminary designs have been certified, with only minor changes made after the process has begun. In the entire process, time is considered to be the most crucial element. Thus, for example, by introducing this method into its first American plant, Honda's machine tooling was finished one year after designing, as opposed to the standard two years seen in the U.S.27 In traditional sequential design, these synergies would not have been utilized.

The number of parts that are outsourced for simultaneous design is considerable. In Japan, only 30% of parts are actually designed by the assembler, compared to 81% in the U.S. A further sign of this decentralization is the fact that 62% of these components are "black-box" parts, since the assemblers outsource systems, not components. As long as the system fits the specifications for performance, quality and cost, the supplier is free to design the components that will allow it to function most efficiently. Since this suppliers are brought in two years before production, as opposed to the 6-12 months standard in the U.S., they have the time to do this properly and work with the assembler on perfecting the system.28

26 Ibid., pp. 18-20.
27 Womack, Jones and Roos, pp. 116-117.
28 Cusumano and Takeishi, pp. 6-7.
Another aspect of the relationship is the way that component prices are set. Rather than taking bids from three companies, engineering information is shared so that systems can be matched to negotiated target prices. The design teams often work on process engineering at the supplier, so that parts cost can be reduced. Any savings are then shared between the two companies.\(^{29}\)

Since there is no competitive bidding in this system, there are fewer suppliers for each company. This is supported by the joint design, which more often than not allocates each part to only one supplier. Thus, while U.S. assemblers have 1,000 to 2,500 suppliers per model, most Japanese firms work with only 300.\(^{30}\) Furthermore, since many of these firms are tiered, the number of companies with which the assembler's design team works is much smaller.

Japanese assemblers show a commitment to suppliers that is unheard of in the United States. This extends beyond sharing information and engineers to actual transfers of capital. The average Japanese company has a 20% stake in many of its first-tier suppliers, so that over 50% of its components come from firms in which it has equity.\(^{31}\) While some call this "hidden" vertical integration, there is evidence against this. While the degree of ownership varies widely between different assemblers, the degree of cooperation does not.

This commitment extends beyond national borders. When Japanese assemblers opened the first plants in the United States, they invited many of their suppliers to make the transition. Currently, there are 230 Japanese-owned compo-

\(^{29}\) Womack, Jones and Roos, pp. 148-149.  
\(^{30}\) Ibid., p. 140.  
\(^{31}\) Cusumano and Takeishi, p. 5.
ment manufacturers producing in the United States, operating out of 300 plants. While the Japanese manufacturers have begun to develop U.S. supply networks, many still rely on their Japanese suppliers for key components.

The importance of engineering

For Japanese companies, research and development take a far greater role than in the United States. They spend more on R&D as a percentage of sales and also foster a commitment to R&D in the culture of the organization. As with other aspects, this starts with supplier relations. Suppliers to the major assemblers must be willing to work on R&D over the long-term. Not only must they share engineering expertise, they must also be willing to trade employees with the assembler so each can learn the other's processes. This culture is shown by Nissan's number one requirement for suppliers: CAD/CAM design capability.

This philosophy extends throughout the internal organizations of the assemblers, too. At Toyota, for example, all records of salesmen are entered into a centralized database. Their observations, as well as hard data, are then continually scanned by design engineers looking for ways to change the product. This real-time search for change is prevalent throughout many Japanese assemblers.

Japanese companies are also not constrained by built-in company models or images. More so than American and European companies, they are willing to copy the latest trend, even if the new vehicle bears little resemblance to previous models from the company. While this varies from company to company in ex-

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Womack, Jones and Roos, p. 67.
tent, it is a natural outcome of the open attitude that Japanese companies have to design. Cross-sectional teams would lose their effectiveness if standards were imposed from above.\textsuperscript{35}

One final sign of Japanese assemblers’ commitment to R&D is the promotion process. To reach top management, one must have been a shusa. In addition, many top managers are those with experience working at suppliers.\textsuperscript{36} Without this experience, it is impossible to become a senior executive. Managers know where the path to the top lies.

\textit{Japanese superiority in product development time}

The superiority of the Japanese system has been borne out in several measures of success. The first is simple: average number of engineering hours required to produce a new vehicle model. Japanese companies average 1.7 million hours, while firms in both the United States and Europe average around 3 million hours.\textsuperscript{37} Two direct benefits from this time difference are lower development costs, and shorter lead times for internal development.

Some have argued that this number is misleading, since much of the design work is outsourced. Thus, Kim B. Clark undertook a second study, where he adjusted the figures to account for different levels of vertical integration and different methods of accounting. The results were still significant:


\textsuperscript{36} Womack, Jones and Roos, p. 199.

\textsuperscript{37} Ibid., p. 111.
Table III.2
Adjusted Product Development Figures for Europe and Japan

<table>
<thead>
<tr>
<th></th>
<th>Europe</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Person-Hours Adjusted for Differences</td>
<td>3.6 million</td>
<td>1.2 million</td>
</tr>
<tr>
<td>Development Time Adjusted for Differences</td>
<td>62.8 months</td>
<td>42.6 months</td>
</tr>
<tr>
<td></td>
<td>59.6 months</td>
<td>46.6 months</td>
</tr>
</tbody>
</table>

Even with adjustments, Japanese companies required only half as many person-hours as European firms, and were able to put models into production in a year's less time.

Another sign of Japan's superiority in design is the number of new models introduced in the past eight years. While American auto makers have gone from 36 models to 53, Japanese companies have expanded from 47 models to 84. At the same time, Japanese commitment to revamping old models has kept the average age of its products at 1.75 years (time since production began on latest model). Detroit has let the average age of its fleet rise from 2.7 years to 4.7. Europe has done even worse, letting its average age rise from 4.75 years to 7.1, while the number of models declined from 49 to 43.³⁹

In summary, the major differences between American and Japanese practice show a fundamental difference in design philosophy:

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³⁸ Clark and Fujimoto, pp. 7-9.
³⁹ Womack, Jones and Roos, pp. 119-121.
Table III.3  
Major Differences in Automobile Design Practice

<table>
<thead>
<tr>
<th>Organization</th>
<th>U.S.</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Leadership</td>
<td>Functional Hierarchy</td>
<td>Project Teams</td>
</tr>
<tr>
<td>Functional Participants</td>
<td>Diffuse Engineering</td>
<td>Dedicated Team Leader</td>
</tr>
<tr>
<td>Average Team Size</td>
<td>900 Engineering</td>
<td>All Parts of Company</td>
</tr>
<tr>
<td>Reliance on Suppliers</td>
<td>Moderate</td>
<td>485</td>
</tr>
<tr>
<td>Number of Suppliers/Model</td>
<td>1,000-2,500</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt;300</td>
</tr>
</tbody>
</table>

A model of an optimal organization to improve product development

Japan has shown both superior performance and a commitment to development that is weaker in the United States and almost absent from Europe. To ascribe this blankly to the package of activities by Japanese firms, however, will not help American and European firms learn. There are many ways to define the optimal organization for supplier relations, but experts often use this list approach. A company is assumed to be at the leading edge if it applies all of them.

One example is Richard Lamming’s:

- Pricing based on production cost of the component, not lowest bid
- Black-box components used in vehicle
- Long-term relationship between assembler and suppliers
- Assembler supports R&D at the supplier
- Two-way flow of information between assembler and supplier

The problem with such lists is that they do not attack the core issue: what are the key concepts that define such an organization? To simply say that an assembler should use black-box parts, or should support R&D at the supplier does not explain why these are important and thus, there is little guidance on how they
can be achieved. Only when one compares these practices to those of the U.S., and then using the theory behind the U.S. actions, can one begin to describe the theoretical underpinnings of the system.

From the comparison between Japanese and American practices, there seem to be three key elements that help explain the difference results of the two systems. First and foremost, an internal organization conducive to the free flow of information must exist. In all of the Japanese firms studied, much effort is given not only to expose designers to a variety of potential data sources, but situations are set up where different parties can share ideas. While information is proprietary to the company, it is not restricted to one group within the company's engineering community. Second, it must be made easy for suppliers to tap into this system, and vice-versa. By limiting the number of suppliers and bringing them into the information flow, they can become an effective part of the organization and allow the company to reap the benefits of simultaneous design. Finally, a strong commitment must be shown, both to the suppliers and the product development process. If suppliers or designers believe that their role is not crucial, there will be less incentive to perform.

Building an strong internal organization

Japanese companies have done much to build organization that promote the sharing of information. Consensus-management, engineering transfers, supplier-grading, and other methods all contribute to the flow of data, both internally and externally. The mistake is to think that these are the cause of the success, for these are procedural steps used to further a corporate culture. To fully understand why Japanese companies are successful, one should look at the more basic
management techniques, ones that promote a culture of information-exchange outside of the prescribed procedures.

One way Japanese companies do this is through the downward-shift of responsibility. Whether on the manufacturing line or in the design lab, the lower-level worker has far more responsibility to make decisions and regulate his activities than in the U.S. paradigm. While all actions must come up for approval, initial ideas and solutions are expected to flow from the bottom. This causes lower-level managers to seek out data at many levels. The procedures mentioned above help smooth the path, but other procedures could also accomplish this.

Another method of encouraging information gathering is the objective-setting process. Rather than assign roles at the start of the project, the team works together to reach a consensus on objectives and specifications for the vehicle. In this process, participants are expected to share information, and such sharing is rewarded through the promotion process. Thus, by exposing designers to all facets of the program, they are more willing to entertain different ideas. In addition, once these goals are set, it is much easier to move the process quickly, as everyone understands their role in the greater scheme of the project, and is therefore less likely to become territorial about their particular design.

The organization of the Japanese design team also promotes communication. While the engineer’s first loyalty is to his project, he also reports to a functional group, and is expected to appraise the group of progress on the design project. Thus, cross-team contacts take place, on both formal and informal levels. In this way, system designs can be shared between different teams, further quickening the design process.

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40 Karlsson and Carlsson, pp. 8-9.
Without this type of organization, it is difficult to gain from bringing in suppliers. Territorial design organizations will be less likely to share information, since they tend to view such sharing as a distributive exchange. Companies that give designers orders from above may be unable to adapt to a system of shared information, since top management may use information as a source of power. Finally, companies that reward individuals instead of teams will have difficulty encouraging managers to outsource supply, since they may feel that it will hurt their career progression. Only an organization that is designed to share information internally will have the self-confidence and the experience to use suppliers.

*Use supplier relations*

The first step in extending this type of organization to suppliers is to control the number of barriers to contact. One way to do this is to streamline the interface between the assembler and the supplier. For the Big 3, this will be a big step. GM currently has 6,000 people in purchasing, while Toyota functions with only 337.41 Reducing the number of people reduces the chance that bureaucracy will exist, and also improves the chance for personal relationships to work.

This effort also requires a small number of supplier contacts. Working with 2,500 different companies on design would tax even General Motors. To lower this number, companies can take four tacks. First, they can reduce the number of components in the car, reducing the need for suppliers. Second, they can integrate vertically, and reduce the number of outsourced components. Third, they can use tiers and deal only with major suppliers. Finally, they can single-source all parts.

Many of Japanese companies use the last two methods to control the number

41 Womack, Jones and Roos, pp. 155-156.
of suppliers (since component design is done by suppliers, reductions in parts used do not lead to the end of a relationship). They work with a limited number of top-level suppliers, which makes absorption into the system much easier. It is less difficult to bring in outside engineers when a dozen companies are represented, instead of hundreds. Then, each of these suppliers need work with only a selected number of second-tier contractors. At the same, time each component is made by an average of 1.3 suppliers.\textsuperscript{a} For most parts, there is only one source. While this can create a "hostage" situation, it also increases responsibility and makes it easier to work with that supplier on continual improvement.

Once chosen, these suppliers are full members of the information network. Computer link-ups are used, and the aforementioned employee trades are made. Even day-to-day contact is maintained at a level similar to that within the company. The shusa can easily call a meeting at the suppliers' plants, and daily contact between assembler and supplier design engineers is expected.\textsuperscript{a}

To encourage the sort of matrix communication found within the assembler, each assembler sponsors professional supplier organizations. Regular meetings communicate new design concepts, and performance results are compared.\textsuperscript{a}

While these organizations may violate antitrust regulations in the U.S., professional associations already perform much of the same role. The key is that informational exchange is encouraged to a far greater extent in Japan. The type of organization is not important, only the way that it is used.

Finally, the organization must show commitment to the supplier relationship. In Japan, this is done through several methods. Long-term relationships

\textsuperscript{a}Cusumano and Takeishi, pp. 18-19.  
\textsuperscript{a}Womack, Jones and Roos, pp. 146-148.  
\textsuperscript{a}Ibid., p. 153.
and information sharing is part of this, but the clearest example of this commitment is financial, through equity stakes in their suppliers and shared savings. Thus, by spreading the wealth, assemblers gain the trust of their contractors.\textsuperscript{45}

This sharing of savings is crucial, because the assemblers exercise some control by demanding semi-annual price reductions from their suppliers.\textsuperscript{46} If assemblers did not return some of these savings in the form of process improvements, the relationship with suppliers could easily turn distributive. Thus, the hedging of a potential trouble point with other actions demonstrates commitment.

\textit{Show commitment to product development}

The final ingredient in this model is a firm commitment to product development. The Japanese have demonstrated this through the ways listed above: promotions for designers, high R&D budgets, etc. The fact that R&D continued at high levels during several recessions showed that these practices were rigid and product development must continue at all costs. It is clear to all parties that new product development is crucial to the firm.

The management of Japanese assemblers show this commitment through many other informal mechanisms. In Honda’s annual reports, for example, the president is always shown next to a race car, showing the company’s commitment to engine design. Furthermore, much of his letter to shareholders discusses future design work, not past accomplishments. Using techniques such as this, a culture that accepts change has been built in these companies, so that all employees show a high commitment to product development.

\textsuperscript{45} \textit{Ibid.}, p. 150.
\textsuperscript{46} Cusumano and Takeishi, pp. 7-8.
An Example of the theory in practice: Partial commitment in Europe

To explain the necessity of having all three elements of this model in place, one can use the example of European automobile assemblers. They have outsourced many systems for years, and they, too, place a considerable emphasis on design. However, they do not have organizations that promote the free flow of information, so using many of these practices is not enough to accelerate the product development process.

At first glance, European manufacturers seem to work at a level closer to the Japanese than the Americans. Many of the assemblers are small, and often work with large suppliers with extensive R&D labs. There is also some evidence that suppliers have begun to tier themselves, much as has occurred in Japan.\textsuperscript{47} Within these relationships, there has been much outsourcing of systems. Bosch, for example, has designed complete electrical systems for several of the German automobile assemblers.

Thus, there is potential for rapid product development. However, a glance at the numbers in the previous section tells a different story. Despite using many of the "best" practices, European manufacturers take as long as American assemblers to design a car, and use twice as much labor as the Japanese to engineer new models. The failure is not in practice, but in the assemblers' decision not to adopt parts of the three necessary structures.

First, the organization of European companies is strongly functional, much as is found in U.S. companies. There are no project managers in the Japanese mode, so there is no one person who coordinates the process. Furthermore, within these units, functional managers wield a great deal of power. Coordination is weak, and is done mainly through testing. Since this is a stress-

\textsuperscript{47} Womack, Jones and Roos, pp. 164-167.
ful exercise, it does not promote the free exchange of information that would be expected from companies that outsource R&D. Despite the efforts of many of these companies to build informal dialogue between engineers, a true supportive organization does not yet exist.

There are also problems with supplier relationships. While they are long-term, there are conscious efforts to distance engineering departments from each other. The strong functional leaders can be territorial, so information exchanges are only on a formal level. In addition, financial arrangements are made to limit the dependence of one company on another. Thus, while many practices should promote informational exchanges, the fact that suppliers are not part of the organization makes this difficult to achieve.

Finally, there is a lack of commitment to new product development in these companies. This sounds surprising, since these companies are known for their devotion to engineering perfection. However, these companies have a different time frame, looking for quantum leaps every decade instead of incremental change. Many European companies have a specific image, so that all vehicles are expected to conform to certain set standards. Within these companies, there is a belief that customers do not want something new, but look to the company to continue to produce the same models, fine-tuning them every year. Their inability to produce new models quickly is a matter of choice, but their organizational structure now can be used only for this long-term approach.

Thus, while the European companies support many of the best practices, they have shown little inclination to change their organizations to promote infor-

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4 Clark and Fujimoto, pp. 9-10.
40 Iheda, pp. 12-18.
50 Clark and Fujimoto, pp. 4-7.
tion flows, better supplier contacts, and quicker product development. Currently, they see little strategic reason to change. However, if the market trends that have increased competition in the U.S. spread to Europe, they may find it difficult to succeed. Even if they commit to accelerating the process, their organizations will hurt their efforts. Until they promote internal information sharing and bring in their suppliers, they will not be able to create many changes needed if increased Japanese market share leads to a change in consumer tastes.

Much of the European attitude resembles that of American companies before the crises of the mid and late 1970's. Then, it was the American assemblers who faced a changing market, and they were the ones that needed to alter their priorities. The next chapter looks at that process in detail. The results can serve as a guide for the European companies.
IV. THREE MODELS FOR CHANGE IN THE UNITED STATES

Those who deplore the state of the American automobile industry often claim that the Big 3 find it impossible to change. However, the 1980's saw attempts by all three of Detroit's assemblers to alter their practices and adopt some of the new theories of design and supplier relations that were described in the previous chapter. In addition, Japanese transplants and joint ventures have demonstrated other means of bringing simultaneous design and supplier partnerships to America. There have been almost as many different approaches to this problem as there are automobile assemblers.

It is worth looking at three examples of change, so that one can see the advantages and disadvantages of each approach. General Motors built a new subsidiary, instilled in it an organization conducive to change, and introduced new practices wholesale. However, the rest of the company still lacks such an organization and is making only small strides. Ford has adopted many of these practices on a widespread basis, but has yet to transform the culture of much of its organization. Honda has built a new organization, but it has yet to show commitment by designing an all-new platform in the U.S., a fact that makes some outsiders doubt both its sincerity to decentralize design to the U.S. and its ability to do so.

General Motors: Establish a new subsidiary

Of the Big 3, General Motors has made the most headlines in its efforts to adapt Japanese practices to the American auto industry. This is due to the creation of Saturn Corporation, GM's first new automobile subsidiary in over 60 years. Saturn is the division that was chartered to save the GM by introducing new methods and new cars that would compete well with the Japanese.
However, GM has not relied on Saturn alone to help it adapt these new methods. Through its joint venture with Toyota, NUMMI, and restructurings of both its subsidiary structure and its design practices, it has adopted many of the techniques from the new supplier relationship paradigm. However, their usefulness have been stilted by the emphasis placed on Saturn and the diversion of capital resources to that project.

**Saturn Corporation**

Saturn was incorporated in 1985, but its roots go back to the 1981-1982 recession. The Saturn project was started during GM's worst year financially, when it lost almost $1 billion dollars and saw market share erode to the Japanese. In response, Roger Smith, then GM's chairman, set in motion a plan to develop a new car that would compete directly with Japanese imports. The car was to be a subcompact, and would offer the same quality as Japanese cars at a similar or lower price. It was to be aimed directly at those buyers who did not even consider GM in their car-purchasing decision process.

Early on, it was realized that to build such a car, it would be necessary to adopt Japanese manufacturing practices. These would include lean production methods, automation, and rethinking of corporate culture and organization. The last part was the most radical change for GM. It would necessitate bringing in the United Automobile Workers and GM's outside suppliers to work with the new corporation in almost every respect. GM's often poor relations with these groups would have to be improved.

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With this in mind, GM believed that the key to Saturn’s success would be raising employee involvement to levels that rival those of the Japanese. This became the central motivation of many of Saturn’s subsequent actions. The decision to build a new plant far from Detroit was partly due to the effort to get a clean start in employee relations. Similarly, the work force was controlled so that current employees who were the most adaptable joined the company. Most importantly, it was believed that a fresh start would enable employees to take ownership and consider themselves part of the company.\footnote{Doron P. Levin, “Saturn Plant Makes Friends,” \textit{New York Times}, January 23, 1990, p. D7.}

These efforts helped introduce a culture of information sharing. By breaking down barriers and reducing bureaucracy in Saturn, GM has begun to create the atmosphere needed to encourage open exchanges among all parties involved.

With this background, designers at Saturn have followed many of the practices of Japanese companies. Unlike many of their American counterparts, they traveled around the country and observed how cars are used. They brought in line workers and had them work on prototypes so that their input would matter. Overall, Saturn has worked hard to use these practices to further increase communication. First, though, they built an conducive organization.

With such a strong emphasis placed on employee relations, supplier relations were relegated to a secondary role. However, Saturn introduced many of the practices that the Japanese use. Suppliers were brought in at an early stage, so that they could participate in the design of the car. From this, many suggestions were made, enough so that Saturn’s engineers credited suppliers with most of the new car’s innovations.\footnote{Lindsey Chappell, “Saturn Guns the Engine for October Intro.,” \textit{Automotive News}, #5354, August 20, 1990, p. 1.} Moreover, the organization of free exchange that
has been fostered among employees has been extended to suppliers. More communication exists between Saturn and its suppliers than is true with the rest of GM’s operations.

There are several aspects of Saturn’s relationships with its suppliers, however, that have inhibited its ability to introduce simultaneous development and the level of communication that would allow suppliers to be full members of the design team. The first of these is the high level of vertical integration at Saturn’s plant. In order to better control quality, GM decided that Saturn would produce its own engines and transmissions, and even stamp its own chassis parts. Saturn also assembles many components into subassemblies at Spring Hill.\footnote{54 Chappell, 1/1/90, pp. 9-10.} This level of vertical integration has prevented it from treating its suppliers as full partners, since many of them are supplying components instead of systems. In fact, supplier production is so limited, in regards to system delivery, that the Wall Street Journal has compared Saturn’s plant to Ford’s Rouge complex.\footnote{55 White and Guiles, p. A1.}

The other problem with Saturn has been continual change in priorities over the life of the project. The 1982 concept car was a fuel-efficient subcompact. The one now on sale is a compact that is also available as a sedan and a sport coupe. Furthermore, production runs have been cut in half and marketing orders have changed constantly\footnote{56 Ibid., pp. A1, A4.}. Since GM failed to follow Japanese practice and set firm objectives at the start, it has made it difficult for its suppliers to fully participate in the design practice. With a lack of commitment to its designers’ autonomy, Saturn has been unable to pass along responsibility to its suppliers.

Overall, though, Saturn is an example of a successful way to introduce
changes in supplier relations. By first building an organization that will accept these new methods, Saturn is preparing itself for improved product design. The first models may have taken eight years to develop, but in that time Saturn has built an integrated organization that is willing to work with external agents. The next step is to shift design of systems to the suppliers. If Saturn can do this successfully, it will be well on the way to introducing the new paradigm to America.

**GM's other actions**

GM's efforts have begun to introduce some of the practices of Japanese design in its other divisions, but with limited success. One successful program has been its efforts to shrink the total number of components in its models. Since the mid-1980's, it has radically reduced the number of components in many of its subsystems, while it has also increased the number of parts that are common to more than one vehicle line. Curiously enough, GM's functional structure has helped here. Since many of its subsystem designers work on more than one project, they have been able to incorporate their experience into the systems for several cars. However, the lack of integration among the divisions has prevented them from fully sharing this information among the different car divisions.

One way to encourage this has been a reduction in the number of free-standing component divisions within General Motors. From 13 divisions in 1988, this has been reduced to nine today. The latest merger was that of the Engine division and the Hydra-Matic transmission division. GM is trying to foster a freer exchange of information between the divisions by breaking down the organization-

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57 Trees, 2/4/91, p. 95.
al walls between them.

Another sign of commitment to developing this culture is the elevation of engineers to high posts within GM. The best example is Robert Stempel, who became Chairman & CEO in 1990. Stempel is a former component designer who has run several design divisions, and plans to have more engineers running parts of GM.\textsuperscript{59} If they are amenable to ideas of change, this could prove useful in raising the priority of design at GM.

These efforts have already been combined on one project. The 1991 Chevrolet Caprice brought in suppliers far earlier than any other GM design project. The first designers were brought in when the designers were working on clay models, and many of the parts in the prototypes were built by suppliers who then received contracts for the production model. Furthermore, a dedicated team was used for the first time. Thus, once the prototype was built, it took only two years to begin production, as opposed to the 2.5 that is the GM standard.\textsuperscript{60}

\textit{GM's problems}

While all of these actions have spread some change throughout the organization, there is evidence that GM has not completely succeeded. The experiences of the current recession have shown a mixed result. First, GM has announced a plan to cut $2 billion in the amount it pays each year to suppliers (currently about $30 billion). One way it plans to do this is by providing engineering expertise to many of its larger suppliers, thus helping them to improve their processes so that they can reduce their own production costs. However, the flipside is that

\textsuperscript{59} Treece, 2/4/91, p. 95.

GM also plans to use fewer suppliers. It believes that it has a better chance of cutting costs if it produces more components in-house.\(^1\) While this may be true, it shows that the organization has still not committed to supporting its contractors and still sees them on a cost basis.

Another sign of GM’s trepidation over giving up control is its current efforts to purchase all of the raw materials for its suppliers, especially for commodities such as steel. The incentive is to reduce overall cost, since GM can use its size to negotiate better deals. However, there is a fear among suppliers that GM will pocket all of the savings itself, instead of sharing them. Each supplier has its own cost structure, so some may lose if they have their own inexpensive sources of raw materials. Since GM has not asked for cost information from its suppliers, it will be hard to distribute the money equitably.\(^2\)

GM also has not shown a strong commitment to development. Earlier this year, it announced a $500 million per year cut in its capital budget. While it will not cut overall R&D, it said, it might cancel “minor programs.” GM has not defined what will be considered minor.\(^3\) Information-sharing is not encouraged when relationships are maintained only in good economic times.

This knowledge-sharing would be encouraged if the lessons from Saturn were spread throughout the company. However, there are many reasons why these lessons will not be learned. First, there are so many lessons from the Saturn experience that it is hard to determine the most important. Even Toyota, one of the industry leaders in quality production, does not produce new products

\(^3\) Levin, 2/5/91, p. D5.
in new plants, so it can more easily monitor the process. Not only did Saturn do this, it also introduced a new culture. The lessons of supplier relationships will be underplayed while GM works with the UAW on implementing many of its HRM practices in its other plants.

An embarrassment of riches is not the only problem, for there is also a question of attitude. The poor view of Saturn held by many GM employees will taint many of these lessons. Many feel that Saturn was a rebuke to the rest of GM, since it took much of the capital available for product development. There was a sense that GM had given up on many of its existing divisions, heightened when the Ford Taurus appeared without an adequate GM response. In addition, many of the changes at Saturn have also occurred, in a more limited way, at many of the other subsidiaries.

The ultimate problem with the Saturn experiment, however, is that GM has never been able to enforce change from above. The strong sense of the "not invented here" syndrome has prevented many of the process improvements of NUMMI from being introduced elsewhere at GM. With the additional antipathy directed towards Saturn, there will be even less of a chance of these lessons being spread.

Finally, many GM managers do not view Saturn as a learning system. From concept in 1982 to the first production model in mid-1990, Saturn took eight years to complete. It is true that some of this time was spent in organizational development, but the fact remains that in the period time of required to introduce the Saturn, Honda went through three generations of the Civic. Many GM

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managers consider that to be a sign of failure.

The last word on Saturn belongs to Luther Coggin, a Saturn dealer. He demonstrated much of GM's judgment of the project when he remarked, "Two or three years ago, we would have been well ahead of the competition. By the time we hit the market, we won't have a giant edge." With this view, it seems that GM still has much to learn about developing a new organization. As long as GM shows a lack of patience, it demonstrates its reluctance to try change.

Ford: Change company practice

Ford has taken a different approach. Rather than isolate change and attack it full force, Ford has attempted to alter its entire organization, both through its joint development of the Escort/323 with Mazda and through restructuring its design practices. Its successes have been striking, but its one weakness has been its inability to completely change its culture to better facilitate the two-way flow of information. However, Ford shows how a large organization can slowly adapt new practices. It also demonstrates that if a company is willing to show some patience and not judge its efforts too quickly, it can begin to make a serious effort at changing the organization.

Ford had an "advantage" over GM in instituting its new practices: the disastrous financial results from 1980-1982. While GM lost more money in those years, Ford's combined losses of over $1 billion left the company in dire financial straits. Unlike GM, Ford had a very difficult time, surviving only because of the strength of its European operations. It was at this point that many of the new design methods first began to be accepted by Ford's engineers.

New design methods

The first of these methods had actually been introduced in the mid-1970's, but with little reason to encourage cooperation, had been a complete failure. Called “Centers of Responsibility” since the 1980’s, it involved the combination of efforts of Ford engineers in different locations. The first effort was the Escort, introduced in 1979. This car demonstrated the complete lack of organizational commitment to the shared design process that existed at that time. After Ford of Europe and North American Auto Operations (NAAO) had jointly designed the car, both sides began to make changes independently of the other. With each side claiming that the other failed to understood the needs of its market, two different models developed. Communication was stagnant, and in the end, the cars had completely different components.70 This was not a promising atmosphere in which a company could speed up the design process or work with its suppliers.

Ford’s next effort produced markedly different results. After purchasing 25% of Mazda Motors in 1979, Ford decided that the next generation of Escorts would be a combined effort between NAAO and Mazda’s engineers in Japan. The goal would be not only to design a world-class car, but also to import Japanese design techniques into the Ford organization. Thus, a plan was worked out where Ford would design the exterior and Mazda would develop the interior parts and the drivetrain. Mazda would have the lead design role, primarily so that the project would stick to schedule.71

Once started, Ford learned more than how to produce on schedule. It also learned that each process step is interlinked with all subsequent steps. The first

70 Womack, Jones and Roos, pp. 211-213.
lesson was in prior planning. In 1982, the team set down specific goals and objectives for the car. Specifications for performance were laid out before any major design work began, and were then put down on paper.72 While Ford engineers agreed to this, they did not see the full effects until 1985. At that time, a choice needed to be made between working on a new engine or renovating the existing Mazda 323 engine. Ford engineers flew to Japan to work out the arrangements. When they argued for a reworking of the schedule so that they could experiment with new engines, Mazda refused. The schedule had been developed in open discussions, but once consensus had been reached, it was absolute. If it required using an older technology that met the specifications, so be it.

After the discussions, Mazda demonstrated the importance of the schedule by having its engineers work overtime. For Ford, the one week delay was standard operating procedure. For Mazda, it was a sign of trouble and the need to show commitment by working harder.73

As part of these efforts, Mazda introduced to Ford the aspects of Japanese assembler-supplier relations. The Escort/323 project brought in suppliers almost from the beginning of the design work. When the first prototypes were to be built, Ford saw them as showpieces, but Mazda insisted on treating them as testing grounds for parts. Furthermore, it insisted that Ford's U.S. suppliers produce the same parts for the prototypes that they would for the production model. Under these circumstance, Ford had no choice but to involve these suppliers at an early stage. Some were able to produce parts on their own. Others set up joint ventures with Mazda's suppliers so that they could learn to produce components at the designated precision. In the end, 150,000 parts were flown from the U.S. to

73 Treece, 3/26/90, pp. 94-95.
Japan to be used in the prototypes. Almost all of the companies involved in that effort built the same parts for the production model.\textsuperscript{74}

This is not to say that all of the efforts went smoothly. Many times, Ford learned about Mazda's design changes after Mazda's suppliers. It was worse for some American suppliers, who learned about these changes second-hand. There were three reasons for this. First, Mazda's organization did not yet include the Americans. They were used to dealing with suppliers who had their offices next to Mazda's and with American companies not there, they did not make the effort to contact them. Second, on Ford's side, there was a reluctance to send engineers to Japan, and by keeping them mostly in Michigan, made it difficult to communicate. Finally, many of Ford's suppliers were resistant to change. They did not want to share production information with outside companies, making it difficult for Mazda to work with them. Thus, Mazda turned to its own suppliers, who were more open to the free exchange of ideas.\textsuperscript{75}

Thus, the first instance of this development process was moderately successful. Unlike GM, Ford saw this as a learning process. Ford has now been exposed to the Japanese paradigm of supplier relations, and will use future projects to improve development time and quality. This has been made easier by other efforts within the Ford organization.

The first of the efforts was a stated program to outsource more of its value-added to suppliers. This was done by extending contracts and winning concessions from the UAW over plant staffing. The results are shown in improved Ford productivity. In 1979, it produced 3.2 million vehicles with 244,000 workers.

\textsuperscript{74} \textit{Ibid.}, p. 95.

In 1988, it made 3.8 million vehicles, but with only 185,000 workers and fewer assembly plants. By committing to its suppliers in the 1980's, Ford set the stage for its efforts to work with these subcontractors on quality and design.76

These efforts were part of Ford's Q1 program. Introduced in 1981 in its own plants, it was soon extended to contractors. As Ford improved its own quality standards, it also raised them for its suppliers. To apply them, it used a carrot and stick approach. High quality contractors received more orders, and some were allowed to work on the design of their own components. However, Ford has admitted to "beating up" on others. Those whom it deemed unwilling to change were dropped.77 Thus, Ford adopted some of the new methods, but its organization may still be too quick to change suppliers.

For those who did work with Ford, however, the benefits quickly grew. The best of the suppliers were ultimately put on the Escort/323 project. After the first rocky experiences, Ford and the suppliers made more efforts to work together. Ford checked process control systems and worked with the contractors to design machine tools and SPC controls. It also explained to them the role of each component in the car, rather than simply spell out specifications. Eventually, Ford's assistance extended to non-manufacturing roles. It was Ford, for example, that coordinated the shipment of prototype parts through Japanese customs, and then helped set up ties between Mazda and the American companies.78 This showed a new commitment to its suppliers, since they benefited as much as Ford.

Moreover, these actions were not a simple parroting of Japanese practices, but an effort to apply the theory in a way particular to U.S. needs.

76 Chappell, 1/1/90, p. 10.
78 "Escort Leans into the 90s," pp. 20i-21i.
These actions are now extending past the Escort/323 design team, a sign that the organization is learning. One example is the new Thunderbird. Since Bendix's quality on brake systems had improved 69% in the 1980's, it was given the design contract for the brakes on the next generation. Bendix also has the authority to subcontract for components.

These changes are also shown in attitudes of higher management. Daniel Maron, steel and engineering procurement manager of Ford, recently stated:

We don't tell the supplier how to formulate the steel. Instead, by understanding the requirements for the vehicle, the supplier can help us design it so we can take advantage of new developments in the steel industry.79

Ford may not yet have gone to a tier system, and is still learning about distributing design responsibility, but it has gone farther than any other U.S. manufacturer in introducing new design techniques to America.

An unchanged organization

Unfortunately for Ford, introducing new methods without introducing a new organizational structure has led to mixed results. The first sign is the bureaucracy of Ford's purchasing department. When Ford introduced new computer systems to take care of its accounts payable, it decided to use the opportunity to reduce staffing so that information could flow more freely. At first, it intended to reduce the purchasing systems staff from 500 to 400. However, when Ford looked at Mazda's staff, it was shocked to see that it consisted of only 5 people.80

Much of this discrepancy is due to the nature of purchasing. In the Ford orga-

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nization, much of that staff checked on costs, and was involved in double-checking purchase orders to see that parts had passed inspection and had been delivered on-time. At Mazda these people did not exist. Mazda’s information systems were connected to the suppliers, so that all invoicing and quality checking was transmitted automatically. Furthermore, Engineers controlled the relationship, so purchasing and accounts payable had to have people on-staff who did nothing but manage suppliers.

The middle management in Ford’s purchasing department has yet to adopt many of the new attitudes. Rather than work with suppliers, they still maintain a somewhat adversarial role. While there are now some shared systems with larger suppliers, many of the smaller ones are still cut off. Furthermore, there are still many one-year contracts and switches of suppliers every year. While there is less of this at Ford than at Chrysler and GM, this problem still exists. Until this purchasing system is changed, engineers will be unable to fully develop close design relationships with suppliers.

There are also signs that top management has not fully bought into the new paradigm. Like GM, Ford has asked its suppliers to reduce costs during the recession, in this case by 5% per year. This is not different from Japanese companies, which work with suppliers to meet designated cost reduction goals every six months. However, Ford is not showing the same commitment that the Japanese do. Ford has insisted on up-front price cuts, even for suppliers with multi-year contracts. Furthermore, Ford has not announced any programs that would aid smaller suppliers in their process engineering. Instead, Ford held six to eight

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81 “Ford Has a Better Idea,” p. 117.
82 Ibid., p. 116.
hour sessions with suppliers, discussing process control methods and alternative materials. While helpful, this is not the broad-based support that would show commitment to suppliers.4

This lack of commitment is also evident in Ford's product design schedules. In two cases, Ford has decided to delay product development to save money during the recession. One is the new Taurus/Sable project, which is now due to enter showrooms in 1996. Thus, the current Taurus will have been based on the same platform for 12 years by the time the next model is introduced. The other delayed project is the Tempo/Topaz/Sierra, due in 1994-95 (nine years on the same platform). This car is being jointly developed by NAAO and Ford of Europe, the first such attempt since the Escort. By showing that it has not yet adopted the same respect of schedules that Mazda has, it may undermine efforts to introduce other aspects of Mazda's organization, as well as downplay the importance of joint design ventures.

Ford's commitment to change

There are signs that Ford is ready to take the next step and restructure its organization to increase the flow of information. The first is its introductions of WERS (Worldwide Engineering Release System), a computer network that currently links 20,000 of Ford's engineers. Drawings, documents and programs can be sent over this system, which allows designers in different functions, projects, and locations to interact with each other. One stated goal of the system is to reduce time to market, and since it is possible to put joint venture partners and suppliers on the network, this could do more than any other activity to foster the

information flow that is crucial to ensuring the success of the organization.\(^5\)

Ford has also shown its commitment through the money invested in several projects. Ford paid out $1.9 billion to develop the Escort with Mazda, and has said that it considers this money a down payment on learning.\(^6\) There is a strong sense at Ford that this money should not be wasted.

The use of this money also shows a commitment to people. $22 million was spent on training Ford’s workers in Wayne, Michigan so that they could produce the Escort using Mazda’s methods, including informational exchanges. Now that Ford has invested this money, there is reason to try to use it on an ongoing basis. It is expected that similar money will be invested in other plants, as well as in training for design teams.\(^7\)

These efforts may pay off in two new design projects. One is a joint minivan project with Nissan. Started in 1988, the goal is to begin production of the new vehicle in the U.S. in 1992. Ford plans to invest $1 billion in this project.\(^8\) The other is the new Mustang, due in 1995. For the first time, Ford is using a dedicated design team without input from a joint venture partner. There are six core engineers and a group of Assistants. They are producing their own prototypes, with parts from suppliers. While not at the level of the Japanese, Ford has made a big leap ahead of its Big 3 competitors. Furthermore, it is already reaping many benefits. While time to market will not be greatly improved in the Mustang pro-

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ject, Ford plans to save 45% of its normal development costs.  

Two last examples show both organizational change and commitment. The first is the combination of the Alpha Group (manufacturing improvement) with the regular Product and Manufacturing Engineering staff. Ford now believes that to foster continuous improvement, barriers between the two groups need to be broken down. The second sign is that William Clay Ford, Jr. is now Executive Director of Business Strategy for the the group. By putting one of the highest ranking Fords in the design group, the company is showing not only that design is important, but working in that group is on the path to top management.  

By giving design a higher priority and fostering change, Ford may overcome its weak organizational development. As it stands now, Ford is familiar with many of the techniques of the new paradigm, and is slowly transferring this knowledge from its partners to its own engineers. However, until the entire organization accepts that information flow and sharing of power is crucial in the new practice, Ford will be unable to fully work with its suppliers and share the benefits from simultaneous design. 

Honda of America: Build a organization conducive to informational exchange 

The last example is not one of the Big 3, but Honda, which is now the fourth largest manufacturer of automobiles in North America. Honda faced a different challenge from the American companies, since its needed to build a new organization, not change an old one. However, it still faced many of the challenges

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* They are number three in cars, but fourth when minivans and 4X4-type vehicles are included.
that the Big 3 must overcome. It had to find suppliers willing to work under the new paradigm, and it also had to develop international and local design teams that could operate as efficiently as those in Japan. The way it accomplished this was through patience and incremental change.

First, one must not underestimate the importance of the U.S. market to Honda. For over a decade, U.S. sales have represented more than 50% of Honda’s vehicle revenues, and with the company’s current decline in Japan, are increasing over time.  

At the same time, Honda’s value to the United States has increased greatly since it opened its first motorcycle factory in 1979. Its Marysville, Ohio plant produced almost 364,000 vehicles in 1989, the highest single-plant output in North America. At the same time, the American portion of its value-added has continued to grow. In 1987, Honda purchased $1.6 billion worth of components from American suppliers for its automobile production alone. Thus, there is already much commitment of Honda to America, and that is important for winning the confidence of U.S. suppliers.

The role of patience

While increasing its presence in America, Honda has shown much patience, an aspect often missing in the Big 3. While Honda’s stated goal is to localize, it is taking the process one step at a time. This can be seen in the slow construction of its U.S. organization:

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Table IV.1
Honda's Involvement in the U.S. over Time

- 1959: Limited motorcycle exports from Japan
- 1962: First successful motorcycle sales campaign
- 1970: Automobiles exported to U.S., three years after Japanese production began
- 1972: First U.S. suppliers signed
- 1975: CVCC engine paves way for increase in automobile sales
- 1977: U.S. motorcycle plant announced
- 1979: Marysville, Ohio motorcycle plant opened
  Automobile plant announced at same location
- 1982: U.S. auto production begins
- 1984: U.S. engine plant announced
  U.S. R&D arm formed
- 1986: U.S. engine production begins
- 1990: First U.S.-designed car, the Accord Station Wagon, is introduced
  Second U.S. auto plant opens*6

One can see from this table that the localization process is slow, but is designed to bring along each step after the previous one has had much of the problems worked out. For example, U.S. suppliers were not signed until a proven U.S. market for Honda's motorcycles had developed. Similarly, American manufacturing facilities were not developed until Honda had proven that it could work with American suppliers. Honda concentrated on building an organization that worked. It would not introduce a new aspect of the organization until it was certain that the organization could accept change. It is a slow process, but one that fits the Japanese ethos of continuous incremental change.

This patience also extended to learning how Americans and American corporations work. Unlike the U.S. auto companies, which have tried to import certain Japanese techniques wholesale, Honda introduced steps one at a time and adapted as necessary. For example, Honda gave more credence to individual

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*6 Shook, pp. 218-228.
achievement in the 1960’s than did many of its Japanese competitors. Part of this was due to the internal culture of Honda, but part was also due to its uncertainty about American work practices. It introduced team practices slowly, and sought input from its workers. Thus, it allowed the first group of employees to decide at Marysville which Japanese practices to bring on-board. In this way, it was able to balance the need for change with the need of its workers to adapt.

This patient view also extends to the way that Honda treats its suppliers. One anecdote relates the teaching process: a new U.S. manager wanted to switch suppliers because of quality problems. His Japanese superior refused, saying that it was worth the time to work with the supplier to improve quality. While it would take over a year to reach the standard, it was believed that both sides would ultimately benefit. The supplier would reduce its costs, while Honda would receive preferential treatment. In addition, both sides would learn more about the process and be able to improve it.

The formation of non-Japanese R&D labs was also seen as a slow learning process. Each addition was designed not only to increase capabilities, but to provide useful knowledge to the local operating units and the company as a whole. In the U.S., the first step was to send Japanese engineers to learn about the U.S. market. Next, U.S. labs were established to teach American engineers Honda’s processes. Following that, the labs were used to develop machine tools for the Marysville plant, and have now been used to teach engineers how to build the robotic assembly equipment needed for the Accord Station Wagon. With that experience, the next step is to design a completely new car. While Honda usually

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allocates four years to the process, it is showing further patience by setting the end of the 1990’s as a deadline. Thus, it plans to use the process as a further teaching tool for its American R&D.\textsuperscript{100}

This patience has allowed Honda to build its organization first, making it easier to spread design innovations. A look at how it has implemented the process has many lessons for U.S. producers.

\textit{Bringing Japanese assembler-supplier relations to America}

When Honda first started producing automobiles in America, it had 27 U.S.-based suppliers, including transplanted Japanese supplier plants and joint ventures between its traditional Japanese supplier and American contractors. Today, it has 194 U.S. suppliers, and many of them are independent of Japanese companies.\textsuperscript{101} The process by which this has been accomplished is a mixture of teamwork and hard-nosed business tactics.

The first step in the process occurred when Honda first built its Marysville facility. At that time, it stated that it had these priorities in selecting suppliers:

1. U.S.-based companies
2. U.S./Japanese joint ventures
3. Transplanted Japanese suppliers
4. Imports or joint ventures between Honda and Japanese suppliers\textsuperscript{102}

By setting these priorities, Honda committed itself to building a U.S. supply network. It set up opportunities for U.S. suppliers to ensure that they would know that Honda was serious in carrying out its pledge.

\textsuperscript{101} Levin, 3/14/90, p. D8.
\textsuperscript{102} Shook, pp. 175-176.
First, Honda had a set of suppliers exporting to Japan. Exports had started in 1972, and consisted of noncrucial parts such as auto seat fabrics. Over time, Honda expanded this to working parts, such as headlights and catalytic converters. Thus, many of its American suppliers had built a relationship with Honda by the time it rolled the first car off the Ohio assembly line in 1984.\textsuperscript{103}

Honda also had a history of actively searching for American suppliers. In 1972, Honda sent engineers all over the United States, looking for companies that produced goods to Honda’s standards and would work on a JIT basis.\textsuperscript{104} In 1984, however, the opposite was true, as many potential suppliers sought to do business with Honda. To ensure that it would choose suppliers willing to work with Honda’s organization, Honda introduced an application process. Since Honda had scrounged for suppliers in Japan, this was a practice particular to its American business, not a blanket copy of Japanese practice. It is used not only to set standards, but to develop an organization before shipments begin.

The process starts with a screen of the company’s current business. Honda prefers companies that will be 30-100% dependent on Honda, so that Honda is never the company’s number two priority. Honda feels that it needs to be strict for two reasons. First, once it chooses a supplier, it will not abandon it for economic reasons. Second, since over 80% of the value in the car is outsourced, it needs to be sure that the company will devote to Honda the attention that Honda itself would pay to the part.\textsuperscript{105}

The application process itself is rigorous. The managers of the vendor are brought to Honda of America for interviews, while Honda sends its engineers to

\textsuperscript{103} Ibid., p. 164.
\textsuperscript{104} Ibid., pp. 117-118.
\textsuperscript{105} Sheridan, pp. 18-19.
the supplier's plant to observe its processes. Questions are asked about plant finances, capacity and quality records. The capability of the vendor to conduct R&D is a key part of the process. Only after these questions have been adequately answered are monetary terms discussed. The process can take over a year, and in some cases, this is after several years of waiting to be considered.\footnote{Shook, p. 173.}

While the process is arduous, the results have been rewarding. By 1988, 60\% of Honda's automobile components were made in the U.S.\footnote{Ibid., p. 51.} While the goal of 75\% domestic content is still high, it is reachable by 1992.\footnote{Womack, Jones and Roos, p. 217.} In this case, Honda has a huge incentive. Any car with 75\% domestic value-added is considered an American-made car for tax and CAFE purposes. By reaching this goal, Honda will have more flexibility and potentially higher profits.

Once a company becomes a supplier, it is continually graded by Honda. This is done in two ways. First, quality records are kept and forwarded regularly. Every defect is listed by type, and the company is given advice on how to fix these defects. Second, suppliers are divided into segment, i.e., visible vs. nonvisible parts. Good performance is rewarded by being allowed to produce parts in a higher segment.\footnote{Shook, pp. 175-180.}

Honda has also shown loyalty to building information flows by providing a full range of technical expertise. It has 40 engineers in its U.S. purchasing department who visit factories and assist in process control. In addition, there are special teams of design engineers who are temporarily assigned to supplier plants to help in quality and process improvements. At the executive level, 13 Honda managers have been loaned to U.S. suppliers at the Executive Vice President
level. Finally, the Guest Engineer program sends suppliers’ engineers to Japan for one to four months to train with Honda engineers and work in Honda’s plants.110

One example of this cross-training is Inland Steel Co. A manufacturer of corrosion-resistant steel, Honda brought them to its plant to show how its material was used in the car and to illustrate why minor imperfections hurt performance. Then, it sent engineers to Inland’s plant to work out a way of reducing these imperfections. The resulting steel was far superior, and earned extra profits for Inland when it began to sell the same steel to Chrysler. However, Honda still remains its biggest customer.111

This process begins even before a contract is signed. In one case, Honda required certain process improvements before the company could pass the application process. Afterwards, it helped set up a technical agreement between that company and a similar Japanese firm. Only then was a contract signed and deliveries begun.112

Finally, Honda helped its U.S. motorcycle suppliers develop parts for its American automobile production.113 This is a practice with which it is quite familiar. In the early 1960’s, Honda needed to do the same in Japan. Since all of the contemporary Japanese auto suppliers had ties to existing firms, Honda needed to develop an automobile parts supply network out of its existing motorcycle suppliers.114 Honda’s experience in building a dedicated supply network from scratch not only taught it to work well with its contractors; it also showed that it

110 Sheridan, p. 19.
112 Shook, pp. 171-181.
113 “Ford has a Better Idea,” p. 117.
114 Sheridan, p. 18.
was preferable to first build an organization, and practice would follow.

Thus, Honda was able to build a supplier network by going slowly and choosing companies that would work within its system. This aspect is not unique, and has been copied by Saturn, among other. However, Honda’s insistence on suppliers with design capability has allowed it to also advance its domestic R&D.

**American R&D**

As with Honda’s other efforts, it has taken its time in developing its American R&D capabilities. It started with bringing Japanese designers over to America to study how Americans use automobiles. Even at that point, Honda showed an openness not seen in its U.S. counterparts. While the mid-1970’s were a time of stagnation in U.S. design, Honda was taking nothing for granted. One example of this was the way they designed trunks. Rather than assume that they knew how consumers used the car, they drove to Disneyland and watched what tourists put into their trunks and how they did so.\(^{115}\) Another example is their study of the Santa Monica Freeway. To see how American driving would affect the first Accords, Honda engineers traveled to Los Angeles, measured the highway, took asphalt samples, and then returned to Japan, where they built a two-mile reproduction, including expansion joints and road signs.\(^{116}\)

The major problem for Honda was transferring this R&D system to the U.S. This was a big jump, since Honda prides itself as an auto development company, one that invents in-house rather than buys technology. For example, it saw the CVCC engine as a prime mover in its success, not the Civic that was powered by

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\(^{115}\) Shook, p. 65.

\(^{116}\) Ibid., pp. 201-202.
It also wanted to uphold its reputation as the industry leader in design lead time. To accomplish this transition, it used several methods.

First, it attracted good American designers by offering a more open environment than the Big 3. The consensus process attracted many young engineers, and by locating its first R&D facility in California, it cut them off from traditional Detroit thinking. Then, Honda started them on styling issues, not on critical technologies. The goal was to teach Honda methods to the designers, rather than have them build completely new cars.

Honda also sought to bring suppliers in when they were ready. To do this, they became part of the consensus process. While it did not introduce the tiered system seen in Japan, it brought in suppliers to help in their particular area of expertise. Since it had chosen only suppliers with design capabilities, Honda made its job much easier.

Will this work in the long run?

The real test of whether Honda is moving more of its core engineering here would be if the company allows its U.S. operations to do a powertrain.

David E. Cole
Director, U. of Michigan Office for the Study of Automotive Transport

Eventually, we will be able to create full and original vehicle models here, but we have to learn gradually the way Honda wants it done. You have to learn by doing.

John Adams
Design Supervisor, Honda of America

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"Ibid, pp. 188-189.


"Shook, p. 174.

"Levin, 12/14/90, p. D7.

These two quotes illustrate the crossroads at which Honda currently finds itself. It has slowly built up a supply network and has transferred R&D over to the U.S. However, it has not yet convinced Detroit that it is ready to operate as a self-sufficient unit. While some of the reaction is partly due to Detroit’s own rush to judgment, there are some issues that could derail Honda’s efforts.

First, many of the design team leaders have been Japanese, and there is a question of when Americans will be allowed to lead. Commitment means giving Americans a chance to become team leaders.\textsuperscript{122}

Another problem is that Honda still has not fully turned over system design to its U.S. suppliers. Instead, many of its lead system designers are Japanese firms, with U.S. firms acting as second-tier players. While it may take time for firms to reach first-tier status, it is necessary to do this if Honda plans to fully design and build a car in the U.S. by the end of the 1990’s.

Despite these problems, Honda is still the best positioned of the major players. Its organization is still the most open, using real-life design tactic, such as measuring the distance between cars parked at baseball stadiums to see how far the door should open.\textsuperscript{123} Furthermore, Honda has the largest transplant design staff in the U.S., with more than 700 engineers.\textsuperscript{124} Finally, Honda places great commitment on quick product development. Even as sales have fallen in the current recession, Honda has not cut its capital budget. Instead, it has transferred engineers from its racing teams to production vehicle design. The stated goal of the company is to produce cars that match U.S. needs, both on safety and comfort issues. For example, Honda plans to have air bags in all of its cars within three

\textsuperscript{122} Levin, 5/7/90, p. D2.
\textsuperscript{123} Ibid., pp. D1-D2.
\textsuperscript{124} Chappell, 6/11/90, pp. 22-23.
years (the same task will take GM almost six). It plans to use the U.S. designers as the lead team in this project, and sees this as a proving ground for them.\textsuperscript{125} However, is this a sign of trust, or proof that Honda sees its U.S. teams as good only for derivative roles?

Thus, Honda still needs to work on its U.S. design capabilities. Two issues remain: first, its commitment to its U.S. designers, and second, its treatment of American suppliers as second-tier contractors. While Honda is the best-placed competitor, it must resolve these issues before it can truly say that it has implemented the new paradigm in the United States. It has the organization, but it must show that it has as much commitment to its U.S. teams as it does to its Japanese designers and suppliers.

\textsuperscript{125} Levin, 9/25/90, p. A21.
V. THE FUTURE: HOW U.S. COMPANIES CAN CHANGE

There is still much to be done before U.S. auto assemblers can match the results of the Japanese. They must be willing to embark on long-term programs that may transcend several CEO tenures. Restructuring an organization takes time, as more is involved than revised organization charts and reshuffled offices. Attitudes must be changed, new practices developed, and obstacles overcome. Furthermore, the Japanese companies have shown that the best way to learn is by doing. Only after a new car has been designed by organizations working in teams with suppliers will the auto makers be ready to produce new platforms as quickly as the Japanese.

How long will this take? James Womack estimates that 10 years are necessary.\textsuperscript{126} He cites the hiring of young engineers, gaining the trust of suppliers and the overall learning process as the key drivers in this figure. Since the first two steps are necessary before design begins, it seems that it will take four years to integrate suppliers into the organization.

Evidence backs this up. Between 1981 and 1985, suppliers adopted many advanced practices. Within those four years, the percentage using CAD/CAM system rose from less than 10% to over 70%.\textsuperscript{127} Another sign is the increase in quality of several suppliers. In Ford’s case, its steel suppliers went in a five year period from a 6-8% defect rate to 0.5%. New design practices and improved quality require internal organizational change, and if both can be done in four to five years, other structural changes can also be accomplished within that time frame.

\textsuperscript{127} Automotive Industry Action Group, Five Year Survey of the Automotive Industry, Southfield, MI, 1987, pp. 18-19.
Thus, if a car can be designed in six years, than all of the key elements required for organizational change can be achieved in 10.

Rebuilding the organization

What steps are necessary within those ten years so that a blueprint be built for American companies? While all of the Big 3 are at different levels of improvement, they share certain common elements as the greatest priorities. In addition, many of the transplants could also improve some practices in their strategic business strategy.

Purchasing

The primary driver of illogical behavior (in purchasing) is management's measurement-and-reward system.

Kenneth J. Stork
Director of Materials and Purchasing
Motorola\textsuperscript{128}

Purchasing departments in American auto assemblers still stand as stumbling block to the introduction of new relationships with suppliers. After generations of encouraging competition between suppliers and keeping them at arm’s length, they are slowly beginning to change their practices. However, there are still some key elements that have resisted improvement.

First, competition is still king. While quality is now cited as the chief criterion in the selection process, it is now used much as price was: to increase competition between suppliers. Quality factors are weighted with price, and the supplier that has the best combination is chosen.\textsuperscript{129} There is still no cooperation, and

\textsuperscript{128} Sheridan, p. 13.
\textsuperscript{129} Helper, 1988, p. 1.
quality is seen not as an inherent part of the product, but simply a tool for getting a contract. Thus, there is no incentive for long-term continuous improvement.

Second, there are signs that quality is getting more lip service from purchasing departments than dedication. Not only are U.S. suppliers still higher in defect rates than Japanese suppliers (0.35% to 2%, compared to 0-0.1%), U.S. auto makers tolerate this. In addition, the U.S. assemblers also tolerate wider variances.\(^{130}\) Quality standards must be clear, and not used as a competitive point.

Finally, purchasing must learn to think long-term. While average contract lengths between U.S. assemblers and suppliers are now 2.5 years, they still are only half the length of the average Japanese contract.\(^{131}\) Purchasing still prefers shorter contracts, the better to control prices. Changing this will not only allow better communication through longer relations, it will show commitment to suppliers.

*The development process*

The next area for improvement is the development process. While it will take years to change attitudes, new practices need to be introduced now to encourage these changes. One that must be started immediately is increased financial commitment to R&D, since results will take several years to develop. Capital budgets must be drawn up so that money can be allocated and spent on development programs. Currently, as a percentage of revenues, the American companies are behind the Japanese. Chrysler, for example, spends only 3.5% of revenues on R&D, while Honda spends 5%. The key difference, though, is in employment levels. Honda, even with smaller revenues and more outsourced development,

\(^{130}\) Cusumano and Takeishi, p. 9.

\(^{131}\) Helper, 1989, pp. 5-7.
has 8,000 design employees. Chrysler, with almost 70% more employees, has only 5,000 in design.\textsuperscript{132} As hiring this many engineers will take years, hiring plans need to be made sooner, not later.

Another change that must be made is in the “not invented here.” With the increasing use of new technologies in the next decade, this step is crucial. For example, electronics will comprise 40% of a vehicle’s cost in the 1990’s.

There are several means of changing this attitude. First, bring in integration specialists. These are engineers trained to coordinate activities between different specialties. Cross-trained engineers in both electrical and mechanical engineering will work better with outside contractors who will provide expertise.\textsuperscript{133}

Another way of accomplishing this is to change engineering education. Schools in America have traditionally not taught team skills, so American auto makers need to support educational initiatives so that the next generation of engineers think in an integrative manner.\textsuperscript{134} Sponsoring these initiatives now will enable the Big 3 to hire engineers in four to five years who are more willing to work with outsiders.

Finally, product development people must go where the outsiders are. Takeshi Tanuma of Mitsubishi explained this rationale when he opened the Mitsubishi purchasing and R&D offices in Michigan (but not in Detroit): “Most U.S. suppliers have operations here. How can we establish relations with these people if we live in Tokyo?”\textsuperscript{135} The American manufacturers must also spread geographically, putting some R&D where the suppliers are located.

\textsuperscript{132} Shook, p. 186.
\textsuperscript{133} Karlsson and Carlsson, p. 5.
\textsuperscript{134} John B. Heywood, remarks, Leaders for Manufacturing Symposium, MIT, April 24, 1991.
\textsuperscript{135} Chappell, 11/19/90, p. 43.
Business Strategy

The last group of practices that must change are those strategies that support supplier relations. More than improving purchasing and moving R&D personnel, these require changes in management attitudes. Many of the changes required in the U.S. manufacturers have already been discussed, but here, more than in the other areas, the transplants also must change.

One example of this is the building strategy of Japanese companies. Nissan, for example, has been told by several metal suppliers that they would devote more business if an engine plant were built in the U.S. Since it is expensive to ship engines to Tennessee, this move would make economic sense. Since it is not being done, the suppliers feel that Nissan is not showing the same commitment to them that it does to its Japanese suppliers.\textsuperscript{136}

Another example of these practices is the preference of Japanese assemblers (other than Honda) to work with Japanese-American joint ventures. Many American companies believe this shows a lack of trust in U.S. ventures. While it is easier to deal with Japanese suppliers, it will not be effective if manufacturing in the U.S. continues to increase. If U.S. assemblers improve their own supplier relations, this attitude can hurt the transplants in the long run.

Obstacles

While the Big 3 and the transplants are working to revamp their organizations and their purchasing practices, there are several forces working against them. These obstacles present serious problems, since the assemblers have no di-

\textsuperscript{136} Al Wrigley, "Suppliers Focus Attention on Nissan," American Metal Market, Vol. 98, #244, December 17, 1990, p. 4.
rect control over these external players' actions. Thus, not only is internal commitment needed, but so is the ability to cooperate with outside agents.

The most potent force opposing the new paradigm is the United Auto Workers. While the manufacturers have attempted to build their competitive edge, the UAW's primary concern has been the jobs and compensation of its members. While this concern is to be expected, the union's actions have hindered some key efforts.

First, the UAW has made many efforts to have the Big 3 support union shops among component manufacturers. In a compromise reached last year, Ford agreed to give the union a say in which suppliers will lose business during the current recession. Up to 1,000 suppliers will be cut, and the union's preeminent criterion in its decision-making will be the unionization of the supplier's workforce. Non-union shops would be dropped, with no reference to their relationship with Ford.

This attitude is enhanced by a UAW distrust of the suppliers' quality. The attitude of their spokesman is a throwback to the old paradigm:

We need more control over our parts. If you own a car and the starter breaks, you blame Ford and its workers, not the suppliers.137

This disdainful attitude of the UAW could be the biggest stumbling block towards integrating suppliers with the assemblers. Not only is the UAW trying to protect jobs at the assemblers, it actively tries to put a wedge between the them and their suppliers. If the U.S. assemblers are to change the organization, they must somehow control the influence of the UAW over their workers.

This distrust also shows up against any new practice that may lessen this in-

fluence, even when the union is involved. At NUMMI, for example, the union has participated in management, but has also sponsored news articles decrying "management by stress." Similarly, when Don Ephlin retired from the UAW, his successor announced that Saturn, Ephlin's project, would be examined as a possible threat to the salary structure and job security of the workforce.\textsuperscript{138}

As UAW participation in these efforts increases, these protests may decline. When it comes to the transplants, however, the unions have no stake, having lost every election at these plants. It views these plants as threats to its very existence, and has fought them even before Marysville opened in 1984.

One argument against the transplants is their lower wages and benefits. While they do pay bonuses that make up for this, their different salary structure creates pressure on the Big 3. In addition, these plants have higher productivity rates than union shops, which threaten the UAW's standing. Thus, the UAW has spoken out against them.

Japan-bashing is the chief weapon. One way the union does this is to argue that all cars manufactured by the transplants should be considered imports, and thus should be subject to quotas.\textsuperscript{139} In the same line, it argues that only those parts made by U.S. owned suppliers should count for the percentage of costs that is domestic. If these efforts were successful, it could seriously crimp the activities of the transplants, but also hurt U.S. companies' relationships with their suppliers. Many suppliers now export to Japan from their contacts with the transplants. If the transplants were to fail, these relationships would suffer. In addition, the Big 3 all work with Japanese companies. If pressure from the UAW ended this association, much of the learning that they are trying to acquire could

\textsuperscript{138} White and Guiles, p. A4.

\textsuperscript{139} Levin, 3/14/90, p. D8.
be lost.

The worst impact, however, could arise from the general anti-Japan feeling of the UAW. As the Saturn experience shows, any practices that are based on the Japanese experience are considered tainted. If the union continues its policies of Japan-bashing, there could be resistance across the board to change. With this resistance, the U.S. assemblers will be unable to improve their organizations.

These attempts at Japan-bashing extend beyond the union. Despite studies by Robert Reich that show profits to Japan are small compared to overall gains in the U.S. economy from transplants, there have been many actions against the Japanese. The FTC, for example, is examining Japanese supplier patterns in the United States. By working with the same suppliers, the transplants are under investigation for price-fixing and discrimination. In effect, the U.S. government wishes to preserve the old method of competitive bidding. While a successful case could provide more work for American suppliers in the short-run, it almost guarantees that long-term improvement in the U.S. auto industry will not occur. American assemblers would revert to their old methods, while the Japanese would go back to designing and manufacturing solely in Japan.

These attitudes are also encouraged by the U.S. auto assemblers. Chrysler has taken the lead in Japan-bashing in many forms. One way is through commercials that attack the quality claims of Japanese manufacturers. There is also a public relations campaign that belittles many of the activities being carried on in design. For example, Chrysler's chief economist recently referred to the Honda Accord Station Wagon as "derivative, strictly a P.R. exercise."

U.S. assemblers are crippling their own efforts by encouraging these attitudes.

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140 Ibid., p. D8.
141 Ibid., p. D8.
Implementing incremental improvement is hard enough, but when top management disparages the concept, it will be hard to convince the rank and file of its merits. Overall, the Big 3 must try to reduce the level of Japan-bashing, so that these ideas are not also considered tainted.

The last obstacle to implementing the new paradigm are the suppliers themselves. While there has been some change, there is still a great deal of resistance to new practices. Nowhere is this more true than in the realm of finance. A quick check at the increase in information shared by suppliers and assemblers will show that cost information is the main stumbling block:

<table>
<thead>
<tr>
<th>Table V.1</th>
<th>1983</th>
<th>1988</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processing Steps</td>
<td>39%</td>
<td>74%</td>
</tr>
<tr>
<td>SPC Charts</td>
<td>18%</td>
<td>95%</td>
</tr>
<tr>
<td>Product Scheduling Info.</td>
<td>50%</td>
<td>80%</td>
</tr>
<tr>
<td>Cost of Processing Steps</td>
<td>3%</td>
<td>20%</td>
</tr>
</tbody>
</table>

This is a sign that suppliers have not fully accepted this system. As much as they may want to work with assemblers, they will not go the final step. Until they share cost information, true joint design work will not be possible, as costing is an integral part of the process of continuous improvement.

There are also signs that American suppliers have not fully accepted the high standards of quality that will be required in joint efforts. This is shown in the lawsuits filed against Japanese assemblers by American companies. Often, they claim, Japanese companies use poor quality as a false reason to not contract with

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Helper, 1989, pp. 3-4.

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American suppliers. However, this could also be a sign that suppliers are not yet willing to work with Japanese companies to reach high quality standards. Since Honda and Nissan have contracted heavily with companies that agree to do this, other companies may simply be expressing their desire to avoid such contact. In the old paradigm, it is easier to sue than cooperate.

This unwillingness to work together is illustrated in another supplier survey. When polled on the most important means of improving quality in production, SPC and stable schedules were listed first, while direct electronic communication links with assemblers was listed as only ninth. Furthermore, joint design work and shared resources were not even on the list.\(^4\)

Despite these three obstacles, assemblers still have a good chance of implementing change. The union has lost power over time, and is now channeling more efforts into supporting new production practices. Japan-bashing has been reduced by Ford and GM, neither of which is supporting Chrysler’s demands that import quotas include transplants. Finally, as assemblers increase their use of simultaneous design, they will make it more profitable for these suppliers to cooperate. Thus, smart companies will continue to change their attitudes.

A final warning

The chances are very good that U.S. automobile assemblers will be able to incorporate much of the new paradigm into practice. While the 1980’s saw mixed results, all three have plans in the 1990’s to restructure their organizations. Ford is well on the way, while GM seems to have overcome some of its reservations


\(^4\) Automotive Industry Action Group, p. 45.
about Saturn. Even Chrysler, the leader in Japan-bashing, has been quietly learning about design from Mitsubishi. Along with its commitment to the LH program, this shows that Chrysler may soon catch up to the other two.

There are also signs that the obstacles to change are weakening. All three of the Big 3 are now searching for generalist engineers, especially those who have experience outside of design (Chrysler, for example, is now a sponsor of the Leaders for Manufacturing Program at MIT). Furthermore, supplier attitudes have changed during the 1980's, and will most likely continue to do so. Only the UAW stands as a major barrier, but with the increasing importance of transplants and the continued success of plants with new work rules, it seems likely that the UAW's power will decline over time.

Thus, the forecast for the Big 3 is good. They should all increase supplier contacts, with increased quality and reduced product development time. If the 1995 Ford Mustang is produced on schedule, it will mark a great leap forward for U.S. manufacturers. If the other manufacturers could match this commitment, then they could reach Japanese levels by the end of the decade.

However, there is a catch. By the year 2000, Honda will also be designing cars in America, and all of the Japanese companies may have increased their product development speed. Quality is a moving target, and the Japanese firms are masters at continual improvement. As long as the Big 3's goals are static, they will continue to fall behind the Japanese. Only if they truly build organizations devoted to change will they be able to catch up.
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