M.I.T. - JAPAN SCIENCE AND TECHNOLOGY PROGRAM

THE JAPANIFICATION OF THE AMERICAN AUTO INDUSTRY

by James P. Womack
Research Director
International Motor Vehicle Program
Center for Technology, Policy and Industrial Development
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"Japanification". Like all neologisms, it has an awkward ring. However, the alternative, "Japanization", is no better, and a label of some sort is needed for a very profound process going on, as we speak, in the industrial heartland of the U.S. So, let's call it "Japanification".

This said, let me hasten to add that this talk is not limited in application to the motor vehicle industry. Nor is it only relevant to Japan and the U.S. Cars and Japanese-American industrial relations are really but examples bearing on my broader concern. This is the periodic collision of industrial cultures -- confrontations between very different modes of thought about organizing production -- which are one of the most dynamic aspects of world industrial history.

The present collision between Japanese and American ways of thinking about the organization of complex manufacturing is certainly striking but this phenomenon is nothing new, even in the auto industry. What's more, there seems to be a pattern in the way these confrontations are resolved to reach a new equilibrium. Therefore, there is much to learn by taking the auto industry as our example today. By examining the automotive "collisions" of the past as well as the one now in progress, we may shine a light on means of making the current chaos into a positive-sum encounter.

A Century of Transformations

As it happens, the motor vehicle industry is just entering its second century as a practical, commercial activity. When it emerged in France and Germany in the mid-1880s, motor vehicle manufacture had the characteristics of the classic "start up" industry. A host of tiny companies designed and assembled autos but most depended on pre-existing machine shops to fabricate the component parts. The work force was highly skilled in both the assembler and supplier firms, the product was changed and improved practically from week to week, and vehicles were largely custom built to the specifications of the tiny elite able to afford the early "horseless carriages".

This pattern continued for about twenty years to just past the turn of the century. In 1906 German and French producers accounted for 60 percent of world motor vehicle production and were the industry's technology, prestige, and export leaders. Then as now, an American wanting the most sophisticated automobile bought it from a German
manufacturer. However, total world production in 1906 was only about 80,000 units, or about a third of the capacity of one modern-day auto assembly plant.

The American Transformation

At this point Henry Ford introduced several ideas which dramatically altered the popular image of the "motor vehicle" and its production system. The Europeans had envisioned the auto as a product for an elite little concerned with price but highly interested in superior performance. Ford envisioned the auto as a practical tool for a mass market of farmers oblivious to elegance and sophistication but vitally concerned with price, reliability, and simplicity of repair. The Europeans saw auto production as a new focus for traditional crafts, to be shared by a host of small firms, each with an array of highly skilled workers using relatively simple and flexible machines. Ford saw it as a new form of industrial activity which used specialized machinery, automated wherever possible, and a mass of unskilled workers performing repetitive tasks.

After 1908 (when the Model T was introduced) and especially after 1913 (when the Highland Park plant was opened) Ford's simple standardized product produced at low cost by unskilled workers squared off against a wide variety of differentiated products produced at high cost by highly skilled workers. And Ford won.

In 1921, at the peak of his success, Ford produced 938,000 Model T's, accounting for 54% of total worldwide motor vehicle production. By 1923 Ford had increased Model T output to 1.9 million identical units (43% of world production), which remains today the highwater mark for annual production of one model.

We may term Ford's innovations, including the continuous flow assembly line, unskilled but well paid workers, and a product "designed for manufacture", the first "transformation" in the character of the motor industry. These innovations were soon complimented by a host of organizational advances introduced by Alfred Sloan at General Motors, who pioneered methods of managing the giant enterprises which Ford's production breakthroughs seemed to make inevitable.

Sloan realized that a single product would not suit every "purse and purpose" (in his phrase) but that it was possible to cosmetically differentiate products without sacrificing the scale economies in mechanical parts which he believed were the key to cost competition in the industry. Similarly, Sloan experimented with ways to efficiently
manage the enormous bureaucracy created by production of cars in the millions and the downward integration of the assembler firms into component parts. At its peak, GM produced more than 8 million vehicles annually, covering practically the entire marketplace from cheapest to most luxurious, and added nearly three quarters of the total value in the product in its own factories.

In combination, Ford and Sloan very nearly conquered the world. In the 1920s Americans were producing 85 percent of the world's motor vehicles and the U.S. and Canada accounted for about 70 percent of the world's motor vehicle exports. However, absolute conquest through exports of finished units ultimately proved impossible.

The European Transformation

In Europe, in particular, there was a determination to maintain a presence in motor vehicle manufacturing. European producers -- Andre Citroen and Lord Nuffield among them -- made pilgrimages to Detroit very similar in spirit to American journeys to Japan fifty years later. They observed an obsessive work ethic in America and a faith in automatic, dedicated machinery manned by unskilled labor. This was denounced as incompatible with the European tradition of skilled craftsmanship -- and copied as rapidly as possible once the European pilgrims returned home. To provide time for learning, European governments obligingly raised prohibitive trade barriers which the Americans could only hurdle by directly investing in European manufacturing.

Despite rapid learning by European firms and major American investments in Britain and Germany, the European motor industry mounted no challenge to American-based production in the 1920s and 1930s. The trade barriers which kept American-made products out also stifled trade within Europe and denied producers the mass markets available in America. It was only after the unification of the European marketplace toward the end of the 1950s that the conditions were right for an attack on American dominance of the world motor industry.

The attack was not what might have been predicted. Rather than simply copying the American strategy, competing on the basis of the lower wages then prevailing in Europe, the European auto firms chose to compete on the basis of product diversity. This led to a second transformation in thought about the nature of the motor vehicle industry.

Retrospectively, the basis of the European strategy was easy to see. A variety of producers, each based in one country, developed a variety of products to sell in national markets with very different tastes. Tiny cars predominated
in Italy, much larger sedans were the norm in Sweden, sports cars were an English specialty, and so on. The Americans viewed this proliferation of products as a sign of industrial immaturity. Detroit assumed that European producers would eventually settle on a "standard size" for the automobile, just as the Americans had in the 1920s. They would then compete in world markets on the basis of low costs made possible by lower wages and massive production volumes. Instead, when the Europeans realized that their product diversity was a strength rather than a weakness, they mounted an attack on American producers in their home market. They sought market niches Detroit had ignored, first at the bottom with the Beetle and then in luxury and sporty segments.

This was not to say that Europeans ignored the advantages of mass production. Production volumes for individual products were still vast compared with pre-War practice, but the need to provide consumers in maturing auto markets with truly differentiated products was acknowledged as well.

The consequences of the European strategy for U.S. auto production have been quite striking, indeed devastating, although the popular debate on Detroit's plight assigns practically all of the blame to Japan:

EUROPEAN VERSUS JAPANESE IMPORTS TO THE U.S. MARKET, 1986

<table>
<thead>
<tr>
<th></th>
<th>European Producers</th>
<th>Japanese Producers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units Imported</td>
<td>650,699</td>
<td>2,618,708</td>
</tr>
<tr>
<td>Customs Value (000s $)</td>
<td>10,969,366</td>
<td>21,057,708</td>
</tr>
</tbody>
</table>

Source: United States International Trade Commission

In 1986, European producers sold only 25 percent as many units in the U.S. as the Japanese but garnered 52 percent of Japanese revenues! What's more, the Japanese sales were still largely at the small car end of the market, where the Americans have always lost money, while the Europeans grabbed practically the entire luxury car market, where Detroit used to earn vast sums. Can it be that Europe rather than Japan has done the most damage to the American industry?

What was distinctive about the European industry was the product. What was not distinctive was the production system, which in the post-War era began to look remarkably
like Detroit's. Unskilled labor, largely from Southern Europe and North Africa, used dedicated machinery and the Taylorist approach to the minute division of labor, to build large volumes of cars. This meant, however, that European producers had a very difficult time competing head on with Detroit when producers in both countries offered a comparable product. Nor could they successfully set up operations in the U.S. when strengthening currencies removed their European labor cost advantage. Witness Volkswagen's unsuccessful experience in Pennsylvania and Renault's fiasco with American Motors.

Their decision to copy Detroit's production system also created an opening for Japan. This in turn led to a third and very dramatic transformation in fundamental thinking about the organization of mass manufacturing.

The Japanese Transformation

As the Japanese auto makers looked out at the world in the 1950s they saw nothing but problems. For starters, demand in Japan was very differentiated -- very large cars (which might be called "MITImobiles") for senior bureaucrats and company executives, very small cars for city dwellers and farmers, and an extraordinary range of auto-sized commercial vehicles for use in crowded cities and on small farms. While the government was carefully protecting the domestic market from both foreign products and foreign investment, it also expected the manufacturers to serve all segments of the market.

Equally troubling from the standpoint of manufacturers with visions of competition on the world stage was the fact there were too many of them. Every major industrial group was determined to compete in the motor vehicle sector in a tiny domestic market. In addition, because the groups had considerable financial resources to hang on in sectors that they deemed vital to their future, there was little prospect of American-style shake out of the industry into a stable oligopoly. This in turn meant that neither total production volume by company nor production volumes for individual models were likely to approach what the Americans considered the minimum feasible in order to operate a modern industry using dedicated tooling and unskilled workers.

In typical Japanese fashion, the auto makers proceeded to make a virtue of these vices. Since it was apparent that massive scale and dedicated tools were out of the question, they made the most of their flexible tools to produce a wide variety of products. Since flexible tools demanded more skilled workers in any case, the Japanese makers gave these workers a much more diverse set of tasks to do, including maintenance of the machinery, quality checking, and active
input into a search for continuous but incremental improvement in every aspect of the production system.

This meant that from early in the post-War era Toyota and the other Japanese producers were making a remarkably wide range of products and working very hard on a new type of production system. This took more than twenty years to perfect but in the end the Japanese production system was delivering products in a wider diversity of specifications than Detroit had ever considered and with an unexampled level of accuracy and consistency. As production volumes in Japan grew with export success, more and more American-style equipment was added to Japanese plants until the tools came to be very similar to Detroit's. Yet remarkable differences persisted, and even widened, in the amount of human effort, inventories, and manufacturing space needed to produce a given number of products.

Similar advances were being made in the product development process so that new models could be developed more rapidly (3-4 years versus 5 or 6) with fewer manufacturing problems at lower cost. Americans still don't grasp this, unless they have recently been in Japan. There one sees an enormous range of products -- Starlets, Coronas, Carinas, Crowns, and Soarers, plus innumerable pickups and vans, just to go through Toyota's line -- which have not yet been sent here.

In a moment we will look concretely at the differences in the Japanese and American systems of manufacturing organization, but first let us survey the consequences of the Japanese Transformation. The most striking manifestation is the American trade balance in motor vehicles and parts. (Figure 1.) While only about 60 percent of this is due to Japanese imports, the U.S. motor vehicle trade balance with Japan has rapidly worsened in the last year even as the yen has steeply appreciated. Given Japanese plans to introduce a wide range of products within the next year in the large car and luxury segments of the market as well, one could argue that the leading Japanese firms are truly poised to conquer the world from their Japanese production base.

This will not be possible, however. The total value, at wholesale, of motor vehicles plus crash and replacement parts consumed each year by Americans in 1986 was about $230 billion. This was wholesale value excluding distribution costs and therefore is the amount truly up for grabs in international competition. As we have seen, $55 billion of this $230 billion was garnered by foreign production in 1986. To move the whole industry off shore would more than double the already staggering U.S. trade deficit, yet even modest additional movement seems likely to trigger further rounds of dollar depreciation or more comprehensive trade
Figure 1

U.S. TRADE BALANCE IN MOTOR VEHICLES AND PARTS
1964 - 1986
(BILLIONS OF DOLLARS)

Source: U.S. INTERNATIONAL TRADE COMMISSION
protection, or both. Thus the Japanese motor industry is now in an analogous position to Detroit in the 1920s: Japanese producers can settle for their current share of the world market and direct their energies into other fields or they can produce vehicles inside the markets of sale.

Direct Japanification of the American Auto Industry

Honda, a dynamic company plagued by a weak market position in Japan due to its late entry into auto manufacture (1967), was the first to move into the U.S. Its Marysville, Ohio assembly plant was announced in 1979 before trade barriers were raised. All of the other Japanese assemblers have now followed so that by 1990 the line-up of Japanese production facilities will be as follows:

JAPANESE-MANAGED U.S. ASSEMBLY CAPACITY IN 1990

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Product</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota</td>
<td>Georgetown, KY</td>
<td>Camry</td>
<td>200,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Celica</td>
<td>500,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pickup</td>
<td></td>
</tr>
<tr>
<td>NUMMI</td>
<td>Fremont, CA</td>
<td>Nova</td>
<td>250,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FX16</td>
<td>500,000</td>
</tr>
<tr>
<td>Honda</td>
<td>Marysville, OH</td>
<td>Accord</td>
<td>360,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Civic</td>
<td>500,000</td>
</tr>
<tr>
<td>Nissan</td>
<td>Smyrna, TN</td>
<td>Sentra</td>
<td>240,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pickup</td>
<td>240,000</td>
</tr>
<tr>
<td>Mazda</td>
<td>Flat Rock, MI</td>
<td>Mustang</td>
<td>240,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>626</td>
<td>300,000</td>
</tr>
<tr>
<td>Diamond Star</td>
<td>Bloomington, 2 cars</td>
<td></td>
<td>240,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Illinois</td>
<td>240,000</td>
</tr>
<tr>
<td>Subaru/Isuzu</td>
<td>Lafayette, 2-4 cars</td>
<td></td>
<td>120,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indiana</td>
<td>240,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&amp; trucks</td>
<td></td>
</tr>
</tbody>
</table>

1,650,000 2,520,000

In addition, Japanese-managed or affiliated plants under construction in Canada will be able to send their output to the U.S. without encountering the U.S. quota on finished units from Japan:
JAPANESE ASSEMBLY CAPACITY IN CANADA IN 1990

<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Product</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota</td>
<td>Cambridge, Ontario</td>
<td>Corolla</td>
<td>50,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Honda</td>
<td>Alliston, Ontario</td>
<td>Accord</td>
<td>80,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Suzuki/GM</td>
<td>Ingersoll, Ontario</td>
<td>1 car &amp; 200,000</td>
<td>200,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Daihatsu/Bombardier</td>
<td>Valcourt, Quebec</td>
<td>1 car</td>
<td>100,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Thus by 1990 the Japanese producers will have between 2.1 and 3.1 million units of North American-assembled cars and light trucks to add to the 3.4 million units they are now importing under current quotas and tariffs. Assuming very optimistically that the market for cars and trucks will be as strong in 1990 as it was in 1986, it is apparent that these plants, if successful, will wreck a terrible destruction on the existing, "brownfield" plants of the American Big Three. Given a typical plant size of about 250,000 units per year, these Japanese "greenfields" can easily supplant as many as 9 existing facilities, each employing around 4,000 workers. In the extreme case, they may supplant as many as 13 existing assembly plants.

What's more, the same process of Japanese direct investment in greenfield plants is now underway in the much larger parts sector which accounts for 75 percent of the value in each car as it leaves the assembly plant. Thus, in the space of only a few years we may witness a wholesale reconstruction of the North American motor vehicle industry and transfer of ownership to Japan.

The Preliminary Results

This is hypothetical, of course. If the Japanese plants fail to transfer the vaunted Japanese manufacturing superiority to North America, a glut of uncompetitive Japanese-owned capacity may result instead.
As it happens, we are just now far enough along with operational experience at Japanese "transplants" to grasp the likely impact of Japanese direct investment. John Krafcik, a researcher in MIT's International Motor Vehicle Program (IMVP), has recently conducted a very careful comparison of the NUMMI joint-venture plant in California in relation to Toyota's Takaoka plant in Japan and several General Motors plants in the U.S. (His work, incidentally, is not that of the amateur observer. He came to the IMVP from several years of work as an engineer at NUMMI, during which time he spent a considerable period working in Toyota's Takaoka plant.) His findings can be summarized as follows:

<table>
<thead>
<tr>
<th></th>
<th>Toyota Takaoka</th>
<th>NUMMI</th>
<th>GM Lansing</th>
<th>GM Framingham</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours per car for standard activities*</td>
<td>15.6</td>
<td>19.1</td>
<td>33.6</td>
<td>34.1</td>
</tr>
<tr>
<td>Defects (per 100 cars as reported by users)**</td>
<td>63</td>
<td>69</td>
<td>137</td>
<td>116</td>
</tr>
<tr>
<td>Factory space (per car per year in sq. ft.)**</td>
<td>4.9</td>
<td>7.0</td>
<td>9.0</td>
<td>8.1</td>
</tr>
</tbody>
</table>

* These are all labor hours -- direct and indirect, assemblers, technicians, and managers -- used to perform the following activities: welding of all parts, painting, engine dress, hard trim, soft trim, check out/calibration, and rework/rectification. A correction for the size, complexity, and option content of the product has been made so that the cars assembled in the different plants are as comparable as possible.

** These are defects in four categories -- paint, trim, electrical connections, and rattles -- as reported by owners in the first three months of operation. These types of defects are normally due to problems encountered in the assembly plant. They are taken
from J.D. Powers & Co.'s "Initial Quality Survey". The NUMMI number is not available from the Powers survey. It has been estimated based on examination of internal company quality audit data for the products in question.

*** The calculation of space utilization excludes office space, unused space, and space used for other than the "standard activities" under examination. It does not include all parts storage space for standard activities.

These results are particularly remarkable given the fact that NUMMI uses an old (circa 1962) General Motors assembly plant, is organized by the United Auto Workers Union, and has hired 80% of its workforce from the pool of workers laid off when GM closed the plant in 1982. In addition, the level of automation in the plant is very modest by current day standards, falling roughly half way between the very low level at GM's Framingham plant and the very high level at the recently retooled Lansing plant.

Thus the inescapable conclusion emerges that the difference in performance between NUMMI and current day GM facilities is not robots or some inherent superiority of the workforce but rather superior social organization. How is this accomplished?

The key techniques are now widely understood but it would take more time than we have here to enumerate them in full. Let me simply note the key differences between the Toyota/NUMMI and GM production systems on the plant floor.

In the GM system the workforce is still bound by a very narrow "Taylorist" conception of factory work. Each worker on the line has a simple repetitive task. Designing the work tasks, assigning them, checking quality, maintaining the machinery, and searching for means to improve the production process are in each case the responsibility of a separate set of specialists. In addition, line workers at traditional GM plants are backed up by foremen who perform no actual production tasks but instead deal with problems and maintain order. Finally, a pool of relief workers hover in the background to fill in for absentees and to perform "tag" relief.

By contrast, the Toyota and NUMMI systems assign a broad array of tasks, not to individuals but to work teams of about 7 members. These teams rotate jobs within the group to put some variety in what is still a repetitive task. More important, they also deal with minor maintenance and housekeeping, perform quality checking, and search systematically for ways to improve the production system.
The team leader, who is a union member unlike the foreman in GM plants, organizes the group's activities and -- very important -- fills in on the line for absent workers. Not surprisingly, this creates considerable social pressure on workers. The absenteer rate at NUMMI is very low, indeed a quarter of that at many GM plants. In combination with mass relief (for coffee breaks and lunch), this means that no pool of reserve workers is necessary.

It is important to understand that the Toyota system is still "Taylorist" at its core. Each work task is worked out -- indeed choreographed -- with excruciating care through classic time and motion studies. Toyota calls this "work standardization" and firmly believes that no improvements in productivity or quality are possible in its absence.

The great difference between GM and Toyota is that in the former system the Taylorism is "top down", being strictly the province of the industrial engineers. In the Toyota system the standardization of the work tasks is a job for the work team itself, with the assistance of staff engineers as needed. This "self-administered" Taylorism seems to be capable of enlisting the best efforts of the work force. By comparison, the American, top-down approach seems invariably to produce the classic syndrome of line workers "holding back" knowledge from management. This in turn leads inevitably to the addition of workers to deal with "inexplicable" problems, and in the long term to high costs, low quality, and an alienated workforce.

To be fair, it must be noted that NUMMI under Toyota management is not quite so productive as Toyota's own plants in Japan -- a difference which we attribute largely to a faster work pace. However, NUMMI does produce remarkable efficiency gains and quality improvements compared even with highly automated GM plants elsewhere in the U.S.

Our continuing work in the IMVP clearly indicates that other Japanese greenfields in the U.S. and Canada will broadly duplicate NUMMI's achievements. It follows therefore that with time, as more an more greenfields open, the American-managed "brownfield" plants will come under unbearable competitive pressure, even in the absence of additional competition from finished unit imports.

Potential Responses by American Producers

If adjustment to the Japanese transformation in organizational best practice is inevitable, what are the options for the American companies with their very large sunk costs. The most attractive in terms of conserving capital and traditional alliances with governments and the UAW is to revitalize brownfield plants at both the assembly
plant and component plant level. In the most optimistic circumstance, dramatic gains in labor productivity and quality would lead to volume increases through recapture of the market share lost to imports over the past decade. Thus the need to close plants and dismiss tens of thousands of workers would be avoided.

It is now clear that this will be very hard to do. In our recent study of GM plants, for example, we find that dramatic "Japanification" of existing plants will almost surely lead to drastic reductions in employment in the short run because the company's product weaknesses and other cost/quality problems prevent the recapture of market share. A "fewer jobs or no jobs" proposition is obviously hard for the union leadership to sell to the rank and file so long as the company is profitable. This raises the possibility that a wave of plant closings and further loss of market share is the only feasible path for many managements in the auto sector.

There is a brighter side, however. Ford in particular has been making very rapid and dramatic strides to reduce labor content per unit in its U.S. brownfields. This has been accomplished by holding employment at the low levels of 1982 while increasing production steadily over the past four years. In this situation, new work practices yielding productivity gains can be sold to the rank and file as the path to job security.

However, even at Ford improvements in manufacturing performance seem limited to labor content. Quality and inventories have improved modestly but are still far from the Japanese level at Honda Marysville and NUMMI. The problem is that very few American managers really understand how to make the full Toyota-style system work. The NUMMI venture is the most systematic effort to date to transfer knowhow from Japanese to American companies and even in this case the transfer is very modest. Only about 1.5 "NUMMIized" managers per GM assembly plant will be able to obtain hands on experience at NUMMI during the life of the joint venture. Yet to greatly increase the number of GM "loaners" at NUMMI would jeopardize the continued success of that facility.

Unfortunately, other methods of knowhow transfer seem to transfer the words but not the tune. For example, I recently talked with a GM plant manager just back from a one day session at NUMMI designed to pass on the key lessons. His reaction was that NUMMI was a "show" plant, with special support services and a very simple product (which is not true, by the way). While conceding that NUMMI performs smoothly for the moment, this GM veteran attributed the result largely to the glow of favorable publicity and outsider attention which has improved worker attitudes in the short run. In his view, it is simply blaming the victim
to suggest that he could run his plant as efficiently as NUMMI given an uncooperative union, low quality suppliers, and an impossibly complex corporate bureaucracy. And so it goes.

An Alternative to Japanification?

If Japanifying brownfields is a truly daunting task perhaps there is an alternative approach for the American-owned companies. One idea, often advanced in the early 1980s, is the "high tech" leap which would seek to eliminate a large fraction of the manual labor and repetitive design and engineering tasks in car manufacture through the introduction of a new generation of automation. The opposite approach is to move much of the existing North American manufacturing base to low wage areas such as Mexico and Korea.

It is now clear that neither approach can really restore a competitive balance for the Americans. As we have argued earlier, an attempt to move a large amount of manufacturing to Korea, Taiwan, Brazil, and Mexico will very quickly encounter the same trade problems now facing the Japanese. Production will grow in those regions to be sure, but its export potential will largely depend on its displacing Japanese imports to the U.S. so that the overall U.S. trade balance is not affected. This approach may benefit American-owned companies but it does not address the problem of American-based manufacturing.

The "high-tech leap" is unlikely to help much either. In our very careful surveys of plants we are finding that the current generation of automation is useful for reducing drudgery and perhaps for enhancing quality but that it has practically no advantage in terms of productivity. This is not to say that some retooled "high-tech" plants are not more efficient than the previous "low-tech" operations, but rather than the productivity improvement, when carefully analyzed, traces to new forms of social organization rather than to the new tools. More ominously, plants unable to re-tool their social processes seem to gain nothing in productivity from new tools. (A full report of our findings for a cross-section of about 20 plants in the U.S., Canada, Mexico, Japan, and Europe will be available in May 1987.) Thus it seems clear that social retooling (i.e., "Japanification") must precede a new generation of automation if a leap is to be made in productivity.

This said, it is important to note that there very likely is an automation leap in the near future. Unfortunately for the American companies it will probably be pioneered by several of the Japanese auto makers. Fortunately for American auto making, this new generation of
automation, if successful in Japan, is likely to be introduced in the U.S. and Canada very rapidly.

The Bottom Line

From our recent examination of a large sample of manufacturing plants we conclude that the Japanification of the American auto industry is now likely to proceed very rapidly, but that a large portion of this advance in industrial practice will be under the aegis of Japanese companies. This raises a number of dilemmas for all of the parties involved -- Japanese companies, American companies, unions, and governments.

First, if the Japanese quota remains at its present level, all transplants come on stream as planned, a new wave of imports arrives in the bottom of the market from Korea, Brazil, Mexico, Taiwan, Malaysia, Thailand, Yugoslavia, and so on, and the Japanese shift the mix of their imports to the U.S. to the "family size" car segment, then: the American-owned producers will face a desperate crisis. Because these companies are too large for any government to allow to fail, there is likely to be very great pressure for further protection.

Beyond this, if the Japanese assembler and supplier companies push ahead too rapidly and insensitively with direct investments in the U.S. which supplant existing brownfields the demands for government protection may quickly escalate from simple trade barriers to investment controls. As in the recent Fairchild case, investment control measures will initially be wrapped in the flag and restricted to "defense" industries. However, the definition of what is "defensive" is notoriously vague and investment restrictions may spread indiscriminately if the pressure becomes too great. Surely there is nothing more threatening to American elites than the perception that the high ground of the industrial economy will soon be controlled by foreigners.

Finally, even assuming that Japanification through massive direct investment proves palatable to most Americans, another problem lies in wait. This is that treatment of labor as a fixed rather than variable cost is the cornerstone of Japanese management philosophy. Indeed, at the transplants in the U.S., labor is even more of a fixed cost than in Japan because the American compensation arrangements do not involve significant profit sharing or bonuses.

So far, as the low cost and high quality sellers in the North American market, the Japanese have been able to sustain smooth production both in Japan and at the
transplants. All volume losses in the past decade have been
taken out of the production of the American-owned producers
in North America. However, the North American auto market
is uniquely cyclical. (See Figure 2.) This cyclicity, it
should be noted, goes far back in time, well before the
energy crises of the past fifteen years. Indeed, if Figure
2 were taken back to the very beginnings of the North
American industry, it would show the same boom and bust
pattern. This has not been damped notably over time despite
succeeding waves of macroeconomic policies from Keynesianism
to monetarism. As the Japanese transplants and newly
"Japanified" American brownfields garner a larger and larger
share of the North American market the obvious question
becomes: How to deal with cyclicity?

Modest Proposals for Painless (or Least Painful)
Japanification

As I trust I have indicated, Japanification of the
American auto industry is both inevitable, through one means
or another, and highly desirable. However, it cannot be
easy and there will be many opportunities for misguided
governments and companies to slow the process down or,
momently, to halt it. Let me conclude this discussion,
therefore, with a few simple suggestions for making this
transition as painless as possible.

To begin with, American government policy makers need
to understand the present situation in its broader world
context. Neither trade protection nor investment controls
can avoid the necessary industrial restructuring. By
contrast creative manpower policies for those displaced can
speed the process along.

American labor must understand that the choice between
"fewer jobs and no jobs" is indeed the only choice for many
brownfields. Equally important, labor and management must
act on this knowledge before the competitive position of
companies becomes so desperate that "no jobs" is the only
remaining choice.

Japanese producers, at the components as well as
assembler levels, need to understand that alliance with
existing American firms through joint ventures and other
forms of collaboration, rather than a path of direct
conquest, is more likely to gain them a secure and
productive position in North American industry.

Finally, with regard to cyclicality, all the parties in
the North American production process must realize that, in
the absence of macroeconomic stability (which only the
foolhardy will count on), the ability to find export markets
during domestic market slumps will be the key to sustaining
Figure 2

Vehicle Assemblies & New Registrations
Canada, U.S.A and Japan

[Graph showing vehicle assemblies and new registrations for Canada, U.S.A., and Japan from 1955 to 1985.]
fixed-cost labor and social harmony in the production system.

The Japanese, of course, have understood this elemental proposition for a generation, even as North Americans chose to ignore the rest of the world. However, seizing the export opportunities which have always been there will require an even more fundamental rethinking of North American manufacturing, this time at all levels including design, engineering, and component fabrication. This is because successful exporting will require great flexibility in shifting mix and the ability to rapidly modify existing products to suit foreign tastes. Learning to do this rapidly in a vastly complex industry will surely constitute the second phase of the Japanification of the American auto industry. This will be a key task for the 1990s.