Automobiles and the Future

Competition, Cooperation, and Change

Robert E. Cole, Editor

UNIVERSITY OF MICHIGAN
CENTER FOR JAPANESE STUDIES

THE UNIVERSITY OF MICHIGAN
CENTER FOR JAPANESE STUDIES

MICHIGAN PAPERS IN JAPANESE STUDIES
NO. 10

MICHIGAN PAPERS IN JAPANESE STUDIES

No. 1. *Political Leadership in Contemporary Japan*, edited by Terry Edward MacDougall.

No. 2. *Parties, Candidates and Voters in Japan: Six Quantitative Studies*, edited by John Creighton Campbell.

No. 3. *The Japanese Automobile Industry: Model and Challenge for the Future?*, edited by Robert E. Cole.

No. 4. *Survey of Japanese Collections in the United States, 1979-1980*, by Naomi Fukuda.

No. 5. *Culture and Religion in Japanese-American Relations: Essays on Uchimura Kanzō, 1861-1930*, edited by Ray A. Moore.

No. 6. *Sukeroku's Double Identity: The Dramatic Structure of Edo Kabuki*, by Barbara E. Thornbury.

No. 7. *Industry at the Crossroads*, edited by Robert E. Cole.

No. 8. *Treelike: The Poetry of Kinoshita Yūji*, translated by Robert Epp.

No. 9. *The New Religions of Japan: A Bibliography of Western-Language Materials*, by H. Byron Earhart.

No. 10. *Automobiles and the Future: Competition, Cooperation, and Change*, edited by Robert E. Cole.

AUTOMOBILES AND THE FUTURE: COMPETITION, COOPERATION, AND CHANGE

edited by
Robert E. Cole

Ann Arbor

Center for Japanese Studies
The University of Michigan

1983

Open access edition funded by the National Endowment for the Humanities/ Andrew W. Mellon Foundation Humanities Open Book Program.

ISBN 0-939512-14-9

Center for Japanese Studies
The University of Michigan

Library of Congress Cataloging in Publication Data

Automobiles and the future.

(Michigan papers in Japanese studies; no. 10).
Third annual United States-Japan Automotive Conference.
1. Automobile industry and trade—United States—Congresses. 2. Automobile industry and trade—Japan—Congresses. 3. Competition, International—Congresses. 4. Automobile industry and trade—International cooperation—Congresses. I. Cole, Robert E. II. United States-Japan Automotive Conference (3rd: 1983: University of Michigan). III. Series.

HD9710.U52A826 1983 338.4'76292'0973 83-14345
ISBN 0-939512-14-9

Printed in the United States of America

ISBN 978-0-939512-14-0 (paper)
ISBN 978-0-472-88011-9 (ebook)
ISBN 978-0-472-90208-8 (open access)

CONTENTS

PREFACE

At the time we held our 1983 U.S.-Japan auto conference in March, the hoped-for economic recovery as manifested in auto sales had revealed itself quite modestly. Three months later, the indicators are more robust and certainly long overdue for those whose livelihood depends on the health of the industry—some of whom, like myself, are university professors.

With Japanese import restrictions in place until March 1984 and drastically reduced break-even points for domestic manufacturers, rising consumer demand holds great promise for the industry. The rapidly rising stock prices of the automakers captures well the sense of heightened optimism, as do the various forecasts for improved profits.

While the news is certainly welcome, it nevertheless should be greeted with caution. As Mr. Perkins noted at the conference, "we have a tendency to forget things very quickly. If we have a boom market this year, there is a good chance that a lot of the things we learned will be forgotten."

What are the kinds of things that should not be forgotten?

1. While the publicized profit estimates of the Big Three are a welcome change, they still pale in comparison to the $10 billion a year investment in new plant and equipment being required of automakers and parts suppliers just to insure that they stay reasonably competitive. Although top management knows this, they have done a poor job of communicating it to their employees. This reflects the broader problem they have had with information sharing.

2. To achieve sustained productivity improvement requires significant work-rule modification on the part of the unions, and this would necessitate significant management commitments to job security. Institutionalization of pay-for-knowledge systems can be the *quid pro quo* for breaking down the division of skills and developing a multiskilled labor force.

3. To achieve sustained quality improvement requires that the pressure for production that comes with economic recovery not overwhelm the renewed commitment to quality. Past experience in this regard is not encouraging.

4. The profit and employment improvements that do take place will still be occurring behind the protection of voluntary Japanese import quotas. The persistence of differences in manufacturing costs, as discussed at the conference, means that we have yet to solve the puzzle of competing successfully with the Japanese, certainly at the lower end of the market. The pressure to solve that puzzle can dissipate in the face of the euphoria of a boom year.

5. Government policymakers are likely to breathe a sigh of relief at the improved performance of domestic automakers. While they have good reason to do so, they are likely to forget just how close to the edge we came. And the temptation hereafter will be to dismiss industry and union claims for an improved environment in which to do business. Will they be as eager to pursue an extension of voluntary trade restraints on the part of the Japanese in 1984 as they were at the height of the economic downturn?

6. The automakers have been bravely talking about restructuring their relationships with their suppliers. The effort has gone forward on a variety of fronts, such as quality improvement, just-in-time delivery, and longer-term relationships with fewer suppliers. Yet it is clear from talking with representatives of supplier firms that there is still a great deal of mistrust on the part of suppliers toward these efforts. While there is little doubt that top management of the auto firms sees the need for change, their ability to force these changes through the middle management hierarchy is yet to be fully tested. And economic recovery seems likely to take the heat off pursuing some of these efforts.

7. A strong start has been made in developing new practices allowing for worker participation in shop-floor decision making. Yet progress is uneven and often fragile. Management's efforts to improve productivity, which often pit one plant against another, can easily lead to a derailment of these efforts. Cooperative relations between management and labor historically proceed

most effectively in a crisis atmosphere but come apart during prosperity.

8. Principles of joint sacrifice on the part of management and labor, however weakly developed during the crisis, will come under pressure from the various interest groups that believe they have unduly sacrificed and, therefore, are justified in demanding a bigger piece of the pie now that times are better.

9. The auto industry is a mature industry with slow growth in total domestic demand but volatile year-to-year changes. Given this situation plus the persistent pressure from imports, it can be anticipated that another downturn will occur in the not-too-distant future. In the light of the enormous social costs extracted by the current downturn, will we have learned something from this experience that will allow us to proceed more intelligently the next time? How, for example, do we plan to deal with the continued automation and streamlining of the industry and its impacts on employment?

10. With the U.S. dollar continuing as the major international currency and with the U.S. as an attractive haven for nervous foreign investors, the dollar may tend to carry an exchange rate that is unfavorable for equilibrium in our foreign trade.

To put the matter differently and more bluntly, with growing prosperity we run the risk that management will fall back into old habits, making impossible the achievement of sustained quality and productivity improvement. Similarly, the commitment to develop cooperative relations with workers and suppliers will weaken. The union will be under membership pressure to retrieve concessions rather than to take the longer-term view. This longer-term view recognizes that "up-front increases" and adherence to existing work rules increasingly come at the sacrifice of future job security. Government policymakers will turn their attention away from the industry. This may not mean a great deal given how weakly focused their attention has been during the last three years and how mixed and contradictory government auto policies have been for over a decade.

Is this a realistic scenario that has just been described? Certainly it is. There is clear historic precedent for many of these observations, and simple common sense suggests that no matter how strongly industry executives and union leaders protest to the contrary, the fact that the sense of crisis has been removed will have an important psychological impact on everyone in the industry.

It is this mental relaxation that is the clear danger. We have yet to solve the basic issue of U.S. competitiveness in the auto market. We have yet to meet fully the Japanese quality challenge. We have yet to harness in a serious fashion the creative talents of our labor force and suppliers. If we fall back in our efforts, then in view of the variety of current Japanese advantages, it is only a matter of time before comparative advantage dictates that we vacate a good part of the industry.

We can only hope that our leaders fully understand that we are dealing with the survival of an industry central to the strength of our manufacturing sector, the livelihoods of millions of individuals, the viability of whole communities, and our national security. While many might wish that the Japanese threat would just go away, the fact is that it has played a major role in stimulating the competitiveness of the American auto industry, and its continued presence may provide the force necessary to sustain our increasing competitiveness. They are not going to go away. The challenge is long-term, and before long it will include Korea, Taiwan, Brazil, Mexico, and other newly industrialized nations.

Robert E. Cole
Professor of Sociology
Project Director, Joint U.S.-Japan Automotive Study
The University of Michigan

INTRODUCTION

Alfred S. Sussman

Welcome to the third annual United States-Japan Automotive Conference. I bring you greetings from the regents of the university, President Shapiro, and Vice President Frye, who is ill and sends his regrets for not being here to greet you as he had planned. In addition, I speak for our faculty, which respects the fields represented here and the breadth of interest among the speakers and other participants. The University of Michigan prides itself on the interdisciplinary nature of many of its activities and the broad sweep of its basic and applied programs. This conference is very much of the kind we hope to continue to engender.

It may interest you to know that in this very building late last week the Department of English sponsored an international conference on Orwell's *1984*. And today, right above us in another auditorium, is a conference on Karl Marx. I will not draw any moral judgment on the juxtaposition of these conferences and yours, except to observe that the dark vision of Orwell relates better to the subject of Karl Marx than the automobile industry. After all, increased accommodation between the sometime conflicting interests of labor and industry has been one of the happier developments since the time when Marx wrote. And there is room for further optimism when people from democratic societies, competitors yet respected colleagues, can sit down together to discuss the future of such a vital economic force as the auto industry. Having attended the previous conferences in this series, I have no hesitation in predicting that this one will contribute much to our understanding of the pressing and important problems facing this industry.

Alfred S. Sussman is Dean, Horace H. Rackham School of Graduate Studies, The University of Michigan.

OPENING STATEMENT

Paul W. McCracken

For many reasons the automobile industry in North America, and probably in the world generally, has moved into a decision zone. There is the emergent evidence that the U.S. economy has rounded the curve at the low point of the business cycle, with December 1982 being a good candidate for the low month of the recedence phase. There is growing evidence also that economic prospects for the Federal Republic of Germany now point to some expansion in 1983 rather than a further decline as expected earlier. The prognosis is for a further expansion in Japan, although Professor Oshima may have some comments on that projection.

As pointed out at this conference a year ago, for the United States the auto component of our GNP during the first year or so of a cyclical expansion has normally increased approximately three times the rate of improvement for the economy generally. If the economy in real terms increases about 4 percent during the year ahead, and 4 percent is now a conventional projection, this would suggest about a 12 percent gain for what the national income statisticians call "Auto GNP." This would, if realized, translate into around nine and one-half million car sales by a year from now. (The average of forecasts for the increase during 1983, of those reporting to Bob Eggert's Blue Chip Economic Indicators, is now closer to 5 percent.)

There is, of course, an important question to answer. Will the 4 or 5 percent growth for the whole economy be realized? There are skeptics. This has been a recession of unusual severity in terms of its duration and the magnitude of decline. Since the historical average for the first year of expansion has been somewhat over 6 percent, however, ten million car sales by year-end 1983 would not be out of context with our experience. The question we are now asking ourselves, and somewhat anxiously, is whether we will realize this normal response. A good case can be made that the response of the market for new cars should now

Paul W. McCracken is Edmund Ezra Day Distinguished University Professor of Business Administration, The University of Michigan, and Chairman, Council of Academic Advisors, American Enterprise Institute for Public Policy Research.

be particularly strong. Low sales during recent years mean that cars in the hands of users are abnormally old, and the number is low relative to population and income. A period of rising employment and income, such as now seems to be ahead, would seem to be the time when consumers would make good on these arrearages.

Some solid reasons for uncertainty and concern, however, do remain, and developments in the world oil market are contributing to this uncertainty. For the three months ending with January, gasoline prices, according to data from the consumer price index, declined at the rate of 16 percent per year. Does this mean that consumers will now be wanting larger cars at a time when the industry has committed its resources to the production of smaller cars that the market earlier seemed to signal and that, in any case, have been indirectly mandated by legislation? Should this legislation be modified? Should other federal action be taken to tilt demand toward cars that the companies are now geared to produce? If so, what should such actions be? While a possible decline in oil prices not so long ago might then have seemed to be the stuff of pleasant dreams—and fundamentally and in the long run it will be good for the world economy—any major change in the price of oil produces difficult and even protracted adjustment problems.

Even if the demand for new cars rebounds in response to improving business conditions, how will this demand distribute itself between domestically produced and foreign-produced automobiles? The current quotas limiting the number of Japanese cars to be imported, which *de facto* if not *de jure* have been imposed by this country, may be the *force majeure* in 1983 that will tend to direct the increase in demand toward domestically produced cars. As has often been pointed out, however, these import restraints are, in effect, a tax on the general population to subsidize workers in the auto industry, whose average income levels are already higher than those of the general population. This will be tolerated for a period, but the vitality of the domestic industry for the longer run ineluctably will depend on its ability to compete head-on with international competition in areas such as cost, product design, and quality. This year seems to be destined to be a period when some of these urgent and important questions will begin to be answered.

Our speakers for this session come to these questions from that wide variety of backgrounds and experiences that will make for a profitable discussion.

COMPETITION AND AUTO TRADE: A TECHNOLOGICAL PERSPECTIVE

Keichi Oshima

Introduction

It is a great pleasure and privilege to have this opportunity to present my views on "competition and auto trade" between the U.S. and Japan. The theme not only is one of the most topical economic issues between the two countries—relating to trade balance, employment, and the relationship of industries—but also covers the much more fundamental and complex theme of world automotive industries during the uncertain evolution of international economy and trade. Since it is, however, out of my area of expertise to present an overall view on the topic, my presentation will be confined to my familiar area, technology, which, I believe, is still one of the determinant factors of the issue.

First, it has to be noted that the issues of competition and trade within the automotive industry have two different aspects: one is related to the problems derived from general macroeconomic difficulties, such as recession, inflation, and a decline in general demand; the other comprises problems inherent in the auto industry, such as the maturity of technology, the saturation of new demands in the industrialized countries, and the specific position of the auto industry as a pillar industry in relation to other industrial sectors and the national economy. I believe that the problems posed by these two aspects, though strongly interlinked, should be distinguished and discussed separately. Otherwise, the fundamental and long-term perspective of the auto industry could be lost in the current turbulence of macroeconomic affairs.

Second, a correct understanding of the technological evolution of the auto industry is a crucial determinant in judging future perspectives. In general, the auto industry has already arrived at a highly mature stage of technology with regard to product innovation. The Dephi Study of the University of Michigan

Keichi Oshima is Professor Emeritus, the University of Tokyo, Vice Chairman, Technova Incorporated, and President, Industrial Research Institute, Japan.

indicates that experts expect no major technological breakthrough in the near future. The introduction of microelectronics and the development of new materials might lead to a new era of active technological innovations, but at the moment there seems to be no convincing evidence that that is happening. One can probably refer to the steel or ship-building industry as a precedent case of a technologically mature industry. The auto industry, however, has a different dynamism that affects technology since it manufactures and markets consumer goods.

Technological maturity combined with the apparent saturation of new demands in the market gives rise to strong competition among companies in the quality and economy of their products. Therefore, the perspective of auto trade is closely related to technological competitiveness in productively supplying products of attractive performance and high quality to the consumers rather than to outstanding technological innovations that can create a new, expanding market. In this regard, it is useful to touch briefly on the past development of the auto industry in Japan.

Development of the Japanese Auto Industry

In the early 1950s there was a general discussion whether Japan would reopen its passenger-car production, which was interrupted after World War II. The leading argument of the economists was exemplified in the famous statement by the president of the Bank of Japan, Hisato Ichimada: "Japan should not resume passenger-car production since it would be more economically practical to rely on foreign supply as an international division of labor, especially in the overwhelming dominance of the Big Threes." On the other hand, there were two major groups that disagreed with that view: one was, naturally, the Ministry of Finance, which was concerned with foreign currency reserves, then at a serious deficit; the other was a group of industrialists and engineers concerned with the reconstruction of Japanese industry.

Since automobile production, through the widely expanded umbrella of its supporting industries, has a dominant impact on the engineering technology of all manufacturing industries, passenger-car production was considered an absolute necessity for reconstructing a Japanese industry that would be internationally competitive in advanced technology. In fact, many of the highly qualified engineers of the aeronautic industry, which was banned by the occupation army after World War II, moved into the automotive industry. Therefore, the development of the Japanese auto industry was strongly oriented to the local market and conditions, on the one hand, and aimed at the achievement of high technological standards in the entire production process, on the other. It must be pointed out that, as a part of the reconstruction policy, the government was rather successful in supporting

the technological improvement of suppliers, but auto manufacturers maintained strong independence in their decision making with regard to production, as is indicated by the fact that the government's Peoples' Car Plan in 1955 was not accepted by the industry.

The Japanese automobile industry made every effort to become competitive in products and production technology with auto industries abroad. On the other hand, its products were mainly small-sized passenger cars aimed at the Japanese domestic market. It is interesting to note that the level of technology, measured according to the number of patents registered by the transportation sector, increased from the beginning of the 1960s and rose substantially in the following decade (figure 1). In the 1970s there seemed to be some saturation although a possible increase in the 1980s might be expected. The increase in the production of passenger cars followed after a delay of about five years, the time necessary to implement new technology into the production process (figure 2; for a comparison of patents and production, see figure 3). A marked increase in 1965 shows the start of motorization in Japan; export followed after another delay of about five years. The increase of exports in 1975 and 1979, coinciding with the two oil shocks and their abrupt increase in crude-oil prices, was due to the advantage of the Japanese automobile in fuel economy, favored by its competitiveness in a situation of high fuel prices.

In fact, the Japanese auto industry has never tried to compete with the U.S. industry in its major market of large cars. The strategy of exporting Japanese cars to the U.S. focused on sales in the complementary market of small-sized cars as second cars. Until the oil crisis in 1973, there was little real competition between the Japanese and U.S. auto industries in the sense of fighting for market shares. The present conflict, or so-called trade friction, was predominantly caused by the decline in sales of the U.S. auto industry, which failed to make the proper shift to the production of fuel-efficient, small-sized cars. Therefore, the perspective of Japanese auto trade in the U.S. will be greatly dependent on how successful the U.S. auto industry, in competition with the Japanese and other auto industries, will be in meeting the change in the U.S. market toward small-sized cars.

Future of World Auto Trade

It seems to be generally accepted that the automobile markets in advanced industrialized countries are close to saturation; the future market will be in replacement vehicles. With regard to developing countries, it is obvious that there exists a large potential auto market with the increase in per capita income. However, a rapid expansion of the market in developing countries in the near future is unlikely.

Under these circumstances, it is natural to foresee that world auto trade will be more oriented to competition within a market demand for quality rather than quantity. Also, in order to economically supply high-quality products, the division of labor among the best qualified producers of components and products will be promoted. This implies that auto industries will become more internationalized, and thus, the competition will not be between national industries, such as the U.S. industry versus the Japanese industry, but between individual or group enterprises. Penetration into the market of developing countries will be more or less in preparation for the possible recovery of the growth of demand in the future. Trends in the world market of the auto industry indicate that auto trade will become much more complex than the shipment of automobiles across national boundaries; it will involve more trade of components, exchange of technology, and cooperation in marketing.

Conclusion

In view of the foreseeable saturation of the world market in the near future and the present technological maturity of the auto industry, the perspective of competition and the outcome of auto trade between the U.S. and Japan will be very much dependent on the technological capacity of the U.S. industry to produce competitive cars to meet the demands of consumers. Judging from the past performance and statistics of R&D expenditure and research manpower, there is no doubt that the technological level of and the capacity for technological innovation in the U.S. auto industry are the best in the world. The apparent difficulty in the competition at the moment is attributable to the lag in moving into the production of competitive, small-sized, fuel-efficient cars to meet with the shift in consumer demand due to fuel price increases. It is obvious that, with the change in the world oil situation, if the U.S. consumer demand for large cars returns, the U.S. auto industry will maintain its competitiveness in this traditional market. However, in the world market, and presumably also in the U.S., it is to be expected that the strong demand for small-sized compact cars will continue in the future. Therefore, the real competition in the auto industry will be in the compact-car market.

It seems to me that auto trade in this area of compact cars will equalize when the effort of the U.S. auto industry to develop competitive cars materializes. In this case, as mentioned before, the competition will be much more between enterprises than national industries. Cooperation across national boundaries will be enhanced by these enterprises to strengthen their competitiveness in the changing structure of the market.

It is to be emphasized that revitalization of the world auto industry at this stage of its maturity can only be possible through continuous efforts for

technological development and free competition in the market, which lead to the timely and proper responses of auto manufacturers to various consumer demands. Any artificial restriction of competition will result in the decline of technological efforts for innovation. If the protection of national industries spreads throughout the technologically advanced countries, it will not only weaken the technological competitiveness of the auto industry in each country but also discourage the technological efforts of others. The consequence of such practice will be a decline in the entire world auto industry, following the path of the steel and ship-building industries, and will lead to a disastrous situation.

Figure 1

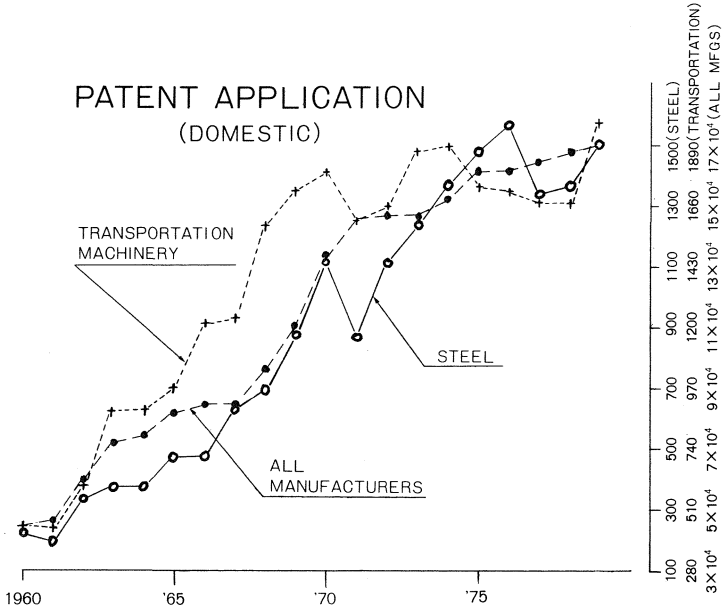


Figure 2

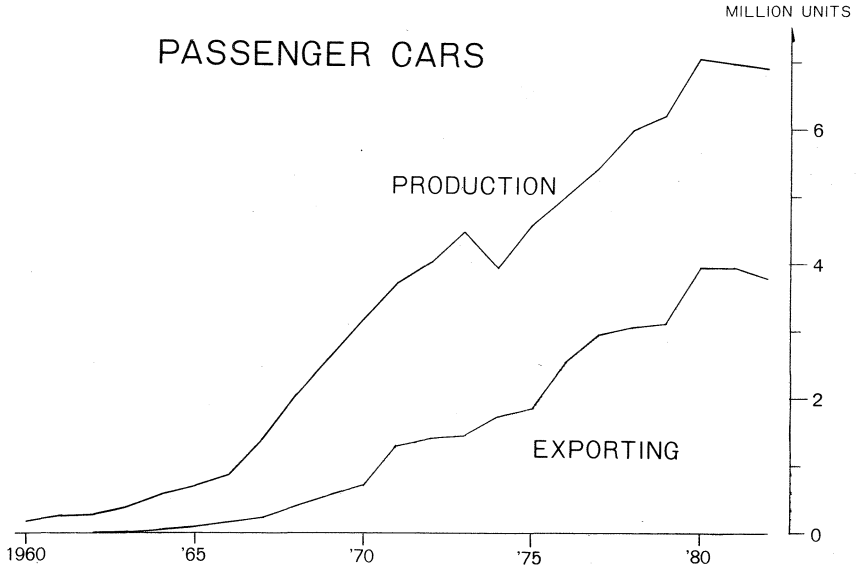
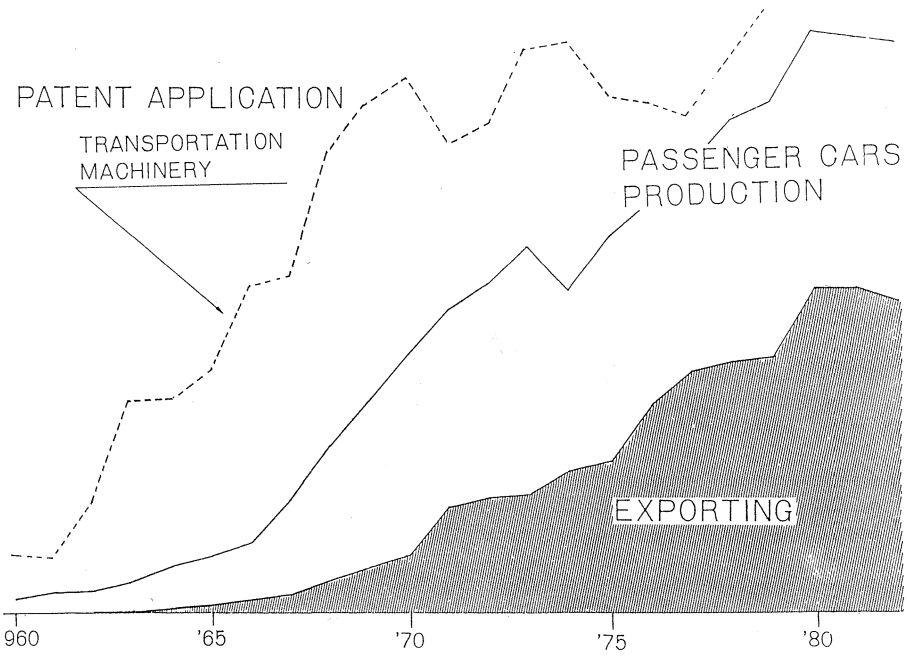


Figure 3



INTERNATIONALIZATION OF THE JAPANESE AUTO INDUSTRY: REAL PROGRESS OR A SNAIL'S PACE

Robert A. Perkins

Twenty-five years ago, around the time I began my automotive career, the entire Japanese motor-vehicle industry was producing fewer vehicles in a year than the U.S. industry produced in ten days. In 1957 Japanese producers exported a total of only *410 passenger cars.* In the next ten years, from 1957 to 1967, total production of motor vehicles in Japan grew seventeenfold, topping three million units for the first time. But even then, exports were still less than 12 percent of production, just over 350,000 units.

At that time the Japanese industry was working behind extremely solid and highly protectionist walls, which prevented any meaningful auto importations into Japan. This was understandable since the government of Japan had targeted the auto industry as a necessary industrial growth segment because of both domestic reasons and the need to generate foreign-exchange earnings. Naturally, they could not afford competition from low-cost (at that time) U.S. and European manufacturers. They also had regulations or administrative guidance procedures that prevented investment in the Japanese industry by foreign manufacturers. The latter prohibition was not lifted until 1970, and then only for minority investment. My personal opinion is that it would be impossible, even today, to buy control of a Japanese auto manufacturer.

We should not be surprised by these two defensive measures—one trade oriented, one investment oriented. The Ministry of International Trade and Industry had to establish a national policy to aid and strengthen a Japanese-owned car industry behind protective walls until such time as it could remain competitive "inside and outside of Japan."

Tariff-type import barriers were progressively reduced in Japan through the 1970s, and no duty now exists. But substantial nontariff barriers still exist, as

Robert A. Perkins is Vice President, Far East, and Director, International Liaison, for the Chrysler Corporation.

do other marketing hindrances, such as a prohibition on dual franchising unless an arrangement with the dealer's Japanese factory is made. The big companies, with the exception of Nissan and their limited 60,000 volume assembly program with VW, are not about to allow major international auto producers' products into their dealerships even if they are uncompetitively priced.

About fifteen years ago the Japanese motor industry started to enter the international sales market, beginning in the East Asian markets. But in the large U.S. and European markets, and in Latin America, the Middle East, South Africa, Australia, and New Zealand, the trickle of products from Japan seemed to pose no threat to the U.S. and European manufacturers. The tiny, oddly styled, noisy Japanese vehicles of *that* vintage, although inexpensive, did not suit the marketplace. But the Japanese knew that the world automotive market, and, in particular, the largest market of them all, the U.S. and Canada, was a promising market for future sales. Being a very capable people and utilizing all their talents and hard work, they designed, at a targeted low cost, a range of the most competitive automotive products the world has yet seen. How the picture has changed in just the last fifteen years! In 1982 nearly a third of the world's motor vehicles were produced in Japan, over eleven million units. Since 1967 production has tripled, while exports increased nearly twentyfold to six million units—well over half of the total Japanese production last year.

Japanese cars, trucks, and buses were exported last year to 177 countries. In many markets, including our own, Japanese vehicles have such a significant and growing presence that special legislation, bilateral agreements, or administrative barriers have been put in place to restrict the growth of Japanese vehicle penetration. It is an amazing record of growth and market penetration by anyone's standards, and one that deserves our respect. And yet, in spite of their international standing and the fact that their products are approaching worldwide domination, we should ask the question: Has the Japanese auto industry become truly international?

Last year at this conference, Mr. Tamura of Toyota spoke on this same subject. Tamura-san and I are old acquaintances from the mid 1970s when Australia was forcing the Japanese industry to manufacture and assemble in that country or be limited to a 20 percent import share and pay high tariffs. He and officials at Nissan and our associate, Mitsubishi, got the message and directed their firms to invest in Australia through 85 percent content programs. Today they sit contentedly behind tariff barriers of 57.4 percent and 20 percent BU import-limitation regulations. I found Tamura's remarks extremely interesting because they were candid and truly portrayed the way in which a large portion of the Japanese auto industry views its role on the international scene. To Mr. Tamura and his associates, internationalization means adapting to the needs of international markets with as little change on the home front as possible. It is a Toyota City-based approach concentrating on three principles.

First, companies must centralize product planning in Japan to meet the needs of all markets in the most rational way possible. They employ a global-design concept that can incorporate into each vehicle the ability to meet the various requirements of each country to which it may be exported. Second, companies must use Nagoya-based suppliers whose quality and reliability are known and trusted. According to Mr. Tamura, Toyota has about thirty overseas suppliers and would like to have more. Unfortunately, most international suppliers insist on an old-fashioned market approach, a take-it-or-leave-it attitude that the Japanese suppliers do not have. For this reason, Mr. Tamura only spoke of the "possibility" of further sourcing, and only when overseas suppliers can match the quality of Japanese suppliers. (Last August, at a conference on the internationalization of the auto industry sponsored by the University of Michigan, Tom Hague of Borg Warner made some interesting observations concerning what it is like to be a supplier in Japan to Toyota. I recommend that you obtain a copy of Mr. Hague's remarks; he is a U.S. businessman with many years of international experience and an understanding of the Japanese.) Third, production facilities—in Japan—should be flexible enough to be responsive to changes in worldwide demand while minimizing disruptions in the production process. If a plant produces only one model and the demand for this model drops, the plant's output must be reduced or stopped altogether. By assembling more than one model in the same plant, the mix of vehicles can be adjusted for demand changes without necessarily reducing total output. This has proven to be another successful concept.

This is all perfectly logical from a manufacturing point of view, but there are predicaments facing the C.E.O. of any large vehicle-manufacturing company in Japan when he analyzes his strategic plans for the U.S. and Canada.

1. He is holding a $2,000 advantage in *landed* costs over his U.S. competitors. If he invests in the U.S., his cost advantage is reduced.

2. He carries the burden of having a full-employment policy at home—in effect, a no-layoff policy that cannot tolerate severe market slumps.

3. He operates under a wage scale that, unlike ours, is not by classification but by seniority. This means that his labor costs go up as the work force ages, and he can only recover these costs through increased productivity and higher volume. Higher volume is the key because it allows him to bring down the average age of the work force by hiring annually the cream of the high-school graduates. This reduces not only the

average wage but also fringe-benefit costs in the areas of pensions and health care.

4. The Japanese C.E.O. sees his largest export market—the U.S.—divided in its response to the trade deficit with Japan. Voluntary quotas may end in a year or two; local content is far from becoming law; and our government continues to advocate strenuously the benefits of "free trade."

When all of the above is taken into account, one can understand why Toyota talks about internationalizing only in terms of sales and product planning. And, in terms of their success, it is impossible to fault their interpretation of "internationalization." Toyota has led the way for Japan to become the world's largest auto producer. But it describes its idea of internationalization as concentrating in Japan while adapting marvelously to the requirements of international markets. No one doubts that the Japanese are first-class salesmen, product planners, and production engineers, but it takes more than that to become an international company by "Western traditions," and perhaps that is where our two systems differ.

First, Japan cannot become the leading automobile manufacturer in the world and continue to act as though they are only a small country trying to survive with no natural resources. In fact, their highly productive and homogeneous society is a fantastic resource. Second, size carries with it certain responsibilities; the ancient precept of *noblesse oblige* is as true now as it ever was. Companies have an obligation to provide jobs, pay taxes, and support the economy of each market in which they sell. Third, participating in the economy of the local markets is good business in the long run. More cars are sold if the economy prospers, and a healthy investment policy is a great boost to the economy. Moreover, Japanese investment will create a positive intercultural base of public and political understanding and negate the island fortress mentality that currently prevails in Japan and is growing here in the U.S.

In contrast, our own domestic auto industry and the European industry over the years have taken a different and, I think, more responsible international approach. In the 1920s and again after World War II, as GM, Ford, and Chrysler grew in size, they invested in fully integrated manufacturing facilities in Europe and in major markets such as Australia, Brazil, and Mexico. (By fully integrated, I do not mean we were equal opportunity employers—which, of course, we all were—but rather that investments covered more than just a KD assembly operation.) In countries from Germany to Argentina the Big Three invested in foundries, machining plants, stamping plants, and engineering-design and other facilities needed to establish an automobile industry. I think it is safe to say that in the

postwar era the proinvestment attitude of the U.S. auto industry helped immeasurably to get Europe's industry off the ground. How different this would have been if GM and Ford, for example, had decided to internationalize in the Japanese style and had designed European cars in Detroit, had sourced from U.S. suppliers, and had produced here all the units needed to match international demand.

This responsible attitude of putting investment and jobs where the market is was not limited to the U.S. manufacturers. The larger European manufacturers—VW and Renault are good examples—also expanded through sizeable investments in their large overseas markets. Unfortunately for the U.S. and European manufacturers who are all competing with relatively the same advantages or handicaps—depending on how one views the world auto situation—the game was upset by new players. The Japanese had a different game plan for this international industry, and the results have been a profound dislocation of and serious problems to this country's and Europe's auto industries and their supplier bases.

Fortunately, there are signs of change. Last December the president of Nissan, Mr. Ishihara, delivered a speech in Tokyo in which he outlined his company's ongoing plans for internationalization. It was clear from his address that he understood that internationalization means investment outside Japan. We are encouraged by Nissan's and Honda's plans for the U.S. with their new manufacturing facilities in Tennessee and Ohio. At the same time, we have to realize that these are only KD assembly operations, which provide local employment at the stamping and assembly end of the manufacturing process but do very little for the supplier base and add nothing in terms of engineering, research and development, or basic manufacturing (casting, forging, machining, powertrain-component production). We must also remember that North America is the largest automotive market in the world—certainly worth the most significant investment that any large marketer of cars and trucks can make—and that we rate at the top of the list for political stability in any country-risk analysis. Nevertheless, the Nissan and Honda investments are the first steps in the right direction.

What about Toyota? As is well known, Toyota and GM have recently announced plans to assemble a version of a Toyota vehicle in this country. Frankly, this is a perfect example of how *not* to internationalize. First, it is fundamentally a bad arrangement because it joins together two of the world's largest car producers and, given their size, raises serious antitrust questions. Second, neither company needs the other. They each have the capital, technology, and manpower to produce this car alone. As is indicated in the newspaper accounts, GM's real investment in this venture is $20 million plus an idle facility that they probably had no intention of using. Toyota put up $150 million—about a quarter of Nissan's investment in the U.S.—and receives added volume. And most importantly, Toyota believes this will keep the "protectionist wolf" from their door. Third, it

will not increase employment but, as I see it, will result in a reduction of present levels. This new subcompact will have a very high level of substitution sales in the Chevrolet channel and will sooner or later—probably sooner—replace the Chevette, which is produced in Delaware and has a 95 percent plus level of local content. Replacing 95 percent American cars with 50 percent American cars does not create new American jobs.

We fully understand the pressure on GM to reduce its average cost of production at the low end of the range by going to greater and greater off-shore sourcing. It would have been much more acceptable, however, had it been done with their existing Japanese partner, Isuzu. In fact, from a general reading of the press it is apparent that under the right circumstances both Chrysler and Ford would be interested in manufacturing ventures in the U.S. with their Japanese associates, Mitsubishi and Toyo-Kogyo, respectively.

But from Toyota's viewpoint all this is perfectly in keeping with the attitude the Japanese have assumed worldwide with very few exceptions, namely, do the absolute minimum to satisfy local demands—or, put another way, "Do what will satisfy and pacify Washington." In Australia they *had* to invest or their access to the market would have been severely limited. In Taiwan, where Toyota was permitted no passenger-car imports unless they invested—to be accurate, the Taiwanese government did permit an average of thirty-two Toyota imports per year from 1979 through 1981—they have just announced a $540 million joint venture for the manufacture of a large portion of the key components, as well as the assembly of 200,000 cars a year. And yet Toyota, who in 1982 sold 664,000 cars and trucks in the U.S., their largest overseas market, provides the U.S. with only an assembly and stamping project. In other words, Taipei says no imports, and Toyota enters into a $540 million joint-venture manufacturing and assembly investment. Washington takes a "softer approach," and Toyota not only protects its existing U.S. sales of 660,000 units but also gains the added attraction of an incremental 200,000 GM/Toyota cars, all through an alliance with the world's largest manufacturer and an investment of just $150 million. Comparatively, it does not make sense and is another reason the Japanese are increasingly being perceived as too successful for their own long-term good. There is a point beyond which they will fail because of this very success, but the question is, What will the U.S. do about this situation?

It cannot be denied that there is growing protectionist sentiment in this country and Canada that has been brought about by the huge trade imbalance between our countries and Japan. In 1982 the trade imbalance between Japan and the U.S. was $13 billion in automotive trade alone. By 1987 it could reach $28 billion if the importation of built-up Japanese cars is not controlled. I need not comment on the extremely serious implications of this imbalance for unemployment; the problem is all too familiar. But it seems clear that this country cannot

allow this situation to continue much longer, and token investments are far from being the solution.

The Japanese make no apologies for the fact that they protect their agricultural sector, for example, from the results of free trade as a matter of national policy. In my opinion, Japanese agriculture is practically a mirror image of the situation that the auto industry—or, for that matter, the semiconductor industry—faces in the U.S. The average size of a Japanese farm is 2.9 acres; in the U.S. the average size is 431 acres. This discrepancy makes the production cost of Japanese agricultural goods very high in comparison to costs in this country. Domestic rice, for example, which is Japan's major crop, costs three and one-half times more than imported rice. The same is true for oranges, beef, and scores of other items.

Why then are not imported agricultural goods driving the uncompetitive, high-cost Japanese farmer out of business? Because the Japanese government will not let that happen, and the fact that rural areas are overrepresented in the ruling Liberal Democratic Party of the Diet assures that this situation will continue. This is all very understandable and logical when viewed from a Japanese political perspective, but I think that we have the right and the obligation to do likewise and protect our manufacturing sectors as a matter of national policy until lasting solutions are developed.

I will not dwell on inequities in dollar-yen rates, tax systems, the targeting of industries, the Japanese capability of managing trade by sectors, or other structural differences. Perhaps over time some of these dislocating factors created by national policies, or the lack thereof, on both sides of the Pacific will be corrected and will permit freer and fairer trade. But in the meantime, the Japanese C.E.O. in our previous example must consider substantial and meaningful investment in North America. Otherwise, his company will face the prospect of indefinite rolling quotas or local-content legislation. What any manufacturer fears, particularly a Japanese manufacturer, is level or declining growth. Ambassador Brock's comments at his press conference in Tokyo on 12 February 1982 are very apropos:

> Japan cannot continue to reap the rewards of free trade without having to share its risks, because to continue this strategy is to ensure that access to the U.S. market will no longer be free. The longer term answer is investment.

In conclusion, there is no doubt that the Japanese auto industry has done a remarkable job in internationalizing by their definition. I hope that we can

convince them that there is another and wiser perspective to internationalization in the automotive industry—one which has been followed for years by European and North American manufacturers.

PROSPECTS AND CONSEQUENCES OF AMERICAN-JAPANESE COMPANY COOPERATION

John F. Smith, Jr.

Introduction

There are probably some Americans today who are not aware of the tremendous success that Japan has had in the industrial world, but they would be hard to find. The Japanese have shown themselves to be tough competitors in stereos, televisions, electronics, precision optics, cameras, motorcycles, and steel. And, certainly, we all know about their strength in the automobile industry.

Since 1970 the Japanese automakers, as a group, have caught and surpassed everyone in production—first the Germans, and then, starting in 1980, the Americans. Five Japanese producers—Toyota, Nissan, Honda, Toyo Kogyo, and Mitsubishi—now rank among the world's largest. In the U.S. passenger-car business, imports in 1973 amounted to 13.5 percent of sales, of which the Japanese share was 6.3 percent or less than half. In 1982 imports reached 26.6 percent, of which the Japanese accounted for 21.3 percent or 80 percent of total imports. But the success of Japanese automobile manufacturers has not been limited to the U.S. The Japanese have made successful inroads in Europe, Australia, Asia, Africa, and the Middle East. Virtually all parts of the globe have felt the effects of the export drive launched by the Japanese automotive industry.

The Japanese success in exports is rooted in large-scale production of high-quality cars at the lower end of the industry. In that portion the Japanese have a substantial domestic base on which they can build their export business. And in a period when major oil shocks have significantly shifted worldwide consumer preference toward this lower segment of the industry, their modern industrial plants, lower labor costs, disciplined manufacturing systems, and higher productivity have given them major cost advantages. The Japanese do not enjoy these cost advantages over American manufacturers alone. European companies face the same

John F. Smith, Jr. is Director, Worldwide Product Planning, General Motors Corporation.

disadvantages, despite their long experience with smaller cars, a reputation for high quality, and their ability to survive in an intensely competitive market. They, too, have been outflanked by the Japanese in areas such as inventory control, productivity, manufacturing systems, work-force motivation, and cost.

Economic Problems

With the severe worldwide economic stagnation of recent years, Japan's export drive has led to a decreased use of domestic industrial capacity. Here in the U.S., the utilization of industrial capacity was 84 percent in 1978, but in 1982 it sank to below 70 percent. A look at some of this country's most basic manufacturing businesses—the "smokestack" industries—which have played a vital role in U.S. economic growth during the last century, reveals an even more devastating story. In the auto sector, for example, the drop was even more severe—from 89 percent in 1978 to about 53 percent in 1982.

The decline in the utilization of domestic industrial capacity has, in turn, led to severe unemployment problems. Unemployment in the United States currently stands at 10.4 percent, down from a high of 10.8 percent last December. But that 10.4 percent unemployment rate only tells part of the story. The loss of jobs has ravaged America's industrial heartland. The great industrial states—Michigan, Ohio, Illinois, and Indiana—have unemployment rates over 12.5 percent, with the rate in Michigan at 16.5 percent. In major industrial cities like Flint, a quarter of the work force has been laid off. The human, political, and economic problems faced by these states are enormous, and ballooning unemployment compensation and welfare costs have emptied state treasuries.

Again, the picture in basic manufacturing is worse than the general statistics. Our primary- and fabricated-metals industries have unemployment in the 19 to 29 percent range, figures closely matched by the motor-vehicle industry at 23 percent, or one out of every four or five people unemployed. Such concentration of unemployment in key industrial sectors and geographical areas puts tremendous strain on our economy. Meeting basic human needs becomes increasingly difficult, and the damage to the public infrastructure and financial integrity of the hardest-hit areas will heal only slowly.

Many European countries are facing similar problems. In the European economic community unemployment now stands at 9.3 percent, and in the United Kingdom unemployment has reached 12.9 percent.

Import Restrictions

In this period of widespread and deep economic difficulty, it is understandable that many nations have imposed severe restrictions on many imports,

including Japanese car imports. In Britain the current agreement between the automotive groups of the two countries limits Japanese car imports to 11 percent of domestic sales; Italy allows only about 2200 Japanese car imports each year; and France has administratively limited Japan to no more than 3 percent of their domestic sales.

In this country there has been intense pressure for legislation that would prod Japanese manufacturers into building domestic plants and employing American workers, and there are good reasons for the Japanese to locate manufacturing here. Our practice at GM has been to locate manufacturing facilities, provide jobs, pay taxes, and contribute to the economy where we have volume sales. It is good business and the only sound basis for fairness and balance among the major trading nations of the world. The Japanese now seem to be coming around to that point of view: Honda has started production; two major Japanese auto producers will soon be making cars or trucks in this country; and a number of Japanese automotive-component manufacturers are considering U.S. operations.

But even with the increasing Japanese manufacturing presence in this country, there has been growing sentiment for some kind of protectionist legislation to limit the number of Japanese imports. A local-content bill passed in the House during the last congressional session but failed to gain Senate approval. A similar bill has again been introduced in Congress and will doubtless be debated at great length this year. In the face of this growing protectionist sentiment, the Japanese undertook a voluntary restraint program in 1981 and have limited their exports to the U.S. for the first two years to 1.68 million cars per year, the average level of 1978-80. They have now agreed to continue this level of restraints for a third year but are resisting efforts to extend the program further. With the uncertainty of voluntary restraints by the Japanese after March 1984, there will be pressure for the U.S. to erect trade barriers. But such barriers—quotas, tariffs, local-content requirements—would certainly trigger additional protective responses in other countries and could limit our nation's ability to export many kinds of goods and products at the very time when it is essential that the U.S. increase its sales to other countries.

Rather than a return to prosperity promised by the advocates of local-content legislation, protectionism in any form offers only a retreat to the economic isolationism of the 1930s, which could result in adverse impacts on U.S. producers and consumers and would raise serious questions about the ability of the U.S. to compete internationally, not to mention its commitment to the world trading system. Protectionism is not the answer. Legislation is inflexible and often results in more problems than solutions. Instead of trying to hide behind laws and regulations, U.S. auto companies must catch up with their foreign competition, and catch up as quickly as possible. The automotive industry must learn to design and manufacture small cars economically and be a leader in management

technology. Labor and management must continue their united efforts to bring labor costs down to competitive levels, and quantum improvements in productivity and quality must be made. That is the only true road to recovery for our industry. It is a difficult road, but it is the only one open to us.

Cooperative Business Arrangements

Everyone in the American and European auto industry is striving to overcome the competitive advantage held by the Japanese. Certainly, part of the competitive strategy must emphasize new design and manufacturing technology. There is no doubt that robots, lasers, flexible automation, and computer-assisted design (CAD) and computer-assisted manufacturing (CAM) can help us to improve quality and productivity while reducing costs. But new management strategies, such as the expanded use of cooperative business arrangements between U.S. and Japanese companies, are also required. These arrangements, including joint research and development, licensing and marketing agreements, common production of components, joint ventures, supply agreements, and equity ownership, can utilize the excellence of both Japanese manufacturing and management techniques and American technology.

Equity-ownership agreements have already been established between American Motors and Renault, Ford and Toyo Kogyo, and Chrysler and Mitsubishi. All are attracting a great deal of attention. For example, Ford Motor Company owns a 25 percent equity interest in Toyo Kogyo and relies on that low-cost Japanese source for many of the cars it sells in Japan and in the rest of the Asia-Pacific area. Again, the attraction of low-cost, high-quality production of small cars had led Ford to turn to a Japanese producer for a product suitable for that geographical area. Reportedly, Ford is also considering that source for future distribution in the U.S.

Outside the auto industry, cooperative ventures are also becoming increasingly common. One of the more interesting cooperative ventures that has been announced recently is a U.S.-European-Japanese venture to develop jet engines for a new 150-passenger airplane. Even in the computer industry, where U.S. companies are generally considered to have a substantial technological lead, the attraction of Japanese quality-control methods, manufacturing technology, and low costs is proving irresistable. Data General has formed a 50-50 joint venture with Nippon Minicomputer—Nippon Data General Corporation; Amdahl has sold an equity interest to Fijitsu; and even IBM, the world's leading computer manufacturer, has agreed to hold discussions with Matsushita Electric on forming a joint venture to design, develop, and manufacturer low-cost, high-volume information-processing products such as terminals, office automation systems, and small business computers.

Another example of a joint venture is the formation last year of GM Fanuc Robotics Corporation, a new separate company devoted to building industrial robots and owned 50-50 by GM and Fanuc, Ltd., a well-known Japanese robot manufacturer. Both companies brought strengths to this joint venture: GM has robotics software capabilities and knowledge of the U.S. marketplace; Fanuc has a varied product line and advanced technology in engineering and manufacturing mechanical and electrical hardware. This new company will manufacture and sell the GM-developed, numerically controlled robot painter, GM's most advanced robot, along with Fanuc's line of industrial robots. Plans call for a manufacturing facility to be established here in the United States as soon as possible. Bendix has also entered into a cooperative venture with Yaskawa Electric to develop and market industrial robots.

Equity ownership and joint ventures are the most familiar examples here in the U.S., but cooperative business arrangements of many types are not new to the automobile industry. The Europeans were probably the pioneers in this field, and they continue to practice such arrangements extensively. For example, British Leyland now assembles and sells the Honda Acclaim under license in Britain, and the success of this venture has led the two companies to work together on the design, engineering, and development of a new luxury car. Volkswagen supplies engines and transmissions to Chrysler, makes some body panels for BMW, has held talks with Nissan on producing the German company's Santana model in Japan for Japan and Southeast Asia, and has recently agreed to build transmissions jointly with Renault. In the future, Volkswagens are to be assembled at SEAT plants in Spain under an agreement between the two companies.

That is hardly an exhaustive list, but it does make the point that business arrangements take many forms. They can range across the entire automotive-manufacturing process from design to manufacture, assembly, procurement, and distribution.

As has been indicated, the Japanese participate in many of these business arrangements both in Japan and abroad, and they, too, have a great deal of experience in this field. In fact, as far back as the early 1950s, Japanese manufacturers began entering such agreements with the ultimate goal of gaining access to technology that would help them close the gap with Western producers and with the immediate goal of expanding sales within their own country. Nissan entered agreements with Austin, Hino with Renault, and Isuzu with Hillman. A number of Japanese parts manufacturers also worked out arrangements with European and American counterparts. All these arrangements were established in an effort to acquire technology for the design and production of automobiles, components, and key parts.

Americans, too, have had experience with various forms of these business arrangements. All the American automobile companies have supplier-customer

relationships with other automotive companies. But in general, our experience has been limited until the last decade or so. Now there exists much more interest in a wider variety of such arrangements.

Innovative business arrangements grow naturally out of the increasing internationalization of the auto industry, and GM is no stranger to international operations. Today, GM has wholly owned manufacturing and assembly operations in more than thirty countries, is involved in about twenty joint ventures worldwide, and is actively pursuing similar projects in other countries. A basic purpose of these arrangements is to help keep foreign opportunities open to General Motors products. Our agreements with Japanese manufacturers have also enabled us to remain competitive by providing customers with a wide choice of products at the lowest possible prices. And these agreements will *preserve* jobs in North America, not jeopardize them.

Analysis of Production Costs

The Japanese currently have the capacity to build small cars and ship them here at costs far below our own. On a U.S.-Japan industry aggregate basis, it is difficult to pinpoint the exact amount of this difference because of a variety of factors, including the difference in vertical integration between the U.S. and Japan. In spite of these difficulties, a number of published studies generally indicate a cost advantage in favor of Japan that ranges upward from $1500.

General Motors has completed a number of internal studies of the cost differential, and they indicate that a $1500 advantage per car, resulting primarily from the fewer hours the Japanese require to build cars and their lower wage rates, may be a low estimate. In addition to labor, differentials extend to other cost areas such as direct materials, machinery, tools and equipment, the maintenance of inventories, and lower interest costs and commercial expense. GM's internal analysis indicated that in 1982 the minimum cost to produce and sell a new small car in the U.S. marketplace was more than $2000 higher than that of its Japanese competitors. Our figures are based on an exchange rate of 210 yen per dollar. A rate of 175 yen per dollar would significantly lower the cost disadvantage, but unfortunately, much of last year the rate was in the range of 250 yen per dollar, even exceeding 275 at one point.

Solutions

Given those numbers, we are faced with difficult choices. GM could abandon the small-car business and build only larger cars, but that would mean deserting many customers who have relied on GM for small cars. We could wait until we develop additional new small cars of our own—American cars, built in an

American way, by American workers, with American standards, to appeal to American tastes and preferences. In today's competitive marketplace, however, such a car would have to be more than just a new car. It would have to be built in a way that makes use of new product technology and manufacturing efficiency to help narrow the current cost disadvantage. Unfortunately, it takes years to design, engineer, tool, test, and implement new manufacturing systems and work practices. Thus, GM decided that the only sensible interim solution was mutually beneficial business arrangements with the Japanese, arrangements that preserve jobs here in the U.S. while improving the foundation for future expansion. These joint ventures will help maintain our distribution organization, will mean better value for our customers now and lead to sharply improved value in the future, and, as in the case of our newest affiliation, will provide GM with access to new car-building techniques that will accelerate our ability to make small cars competitively.

As a result of the decision, GM has established two equity affiliations with Japanese automobile and truck manufacturers and has just agreed to a limited manufacturing joint venture with Toyota. This new arrangement will produce, as early as possible in the 1985 model year, a new small car at GM's currently closed Fremont assembly plant in California. The company will employ about 3000 people, including those working in a new stamping plant to be built adjacent to the existing assembly facility. An additional 9000 American jobs will be established to supply parts. (In addition, many Japanese auto-parts manufacturers are considering building facilities in the U.S. in the wake of the decisions by Nissan, Honda, and Toyota to build cars and trucks here. This would create even additional American jobs.) About 200,000 cars a year, which GM will purchase and market through the Chevrolet dealer network, will be produced at the Fremont plant. The car, a small, front-wheel-drive model that was specifically designed for Chevrolet and not copied from an already available model, will contain about 50 percent local content, including seats, interior trim, sheet metal, and many other components.

This specific joint venture, terminating not later than twelve years after the start of production, will provide GM's U.S. dealers with one small-car line, provide U.S. workers with jobs, and help us to develop the new assembly and manufacturing techniques needed to build such a car competitively in this country. Although we will cooperate in the manufacture of this product line, we intend to remain intensely competitive with Toyota everywhere else.

In addition to the advantages listed above, it should be emphasized that this type of joint venture is not unique; GM has taken similar steps before. It imported Opel models from Germany for a number of years until economic conditions made it more competitive to produce the Chevette in the United States. Even more recently, GM imported small trucks from our Japanese affiliate, Isuzu, for eleven

years. When demand for such vehicles increased, GM designed the new S-10 and S-15 trucks, which are now the most popular small trucks sold in the United States. We are also developing a new small-car line with Isuzu: Isuzu will produce this car in Japan, and GM will purchase it for sale in the U.S.

General Motors owns 34 percent of Isuzu but has no management responsibility (although GM employees have served in consulting capacities in engineering, manufacturing, finance, and other areas). GM also holds 5 percent of Suzuki, which is developing a new minicar that GM may purchase for resale in the U.S.

Conclusion

In response to the problems that plague the U.S. auto industry, GM has chosen to develop business arrangements with Japanese companies. Obviously, other companies are making other arrangements, suited to their needs and plans. But I suspect that the growing cooperative activity by the world's automotive manufacturers in the last few years will continue for some time. Innovative forms of cooperation will allow companies to improve the production, distribution, technology, and design capability required to survive in the global industry of the 1980s.

Business arrangements, I believe, will prove much more effective in bringing foreign automotive companies to manufacture in the U.S. than any legislation ever could. The forces of the marketplace, flexible and ever-changing, have a way of inducing desirable results much faster and more effectively than any law chiseled in stone. There are still many barriers to cooperation between U.S. and Japanese manufacturers. Differences in language and social customs can lead to misunderstandings, and legal barriers—tariffs, quotas, and local-content laws—initiated for the best of reasons, can throw a wrench into the machinery of cooperation that is just beginning to function smoothly. But these difficulties are worth overcoming because everyone stands to benefit from cooperation, especially the consumer, who will see the benefits of improved manufacturing technology, higher-quality products, and lower costs that result from greater efficiency and improved labor relations.

OPPORTUNITIES AND BARRIERS TO UNION AND WORKER COOPERATION WITH MANAGEMENT

Irving Bluestone

In the past dozen years or so, the concept of work organization commonly described by the umbrella term "Quality of Work Life improvement" has been making inroads in both the private and public sectors of the economy. At its essence, it is a departure from the authoritative precepts of scientific management and is directed toward affording meaningful opportunities for employees at all levels to participate in the decision-making process in the workplace. It represents a labor-management activity undertaken concurrently with traditional collective bargaining, but it is focused on the enhancement of human dignity and those issues of organizational effectiveness that are of common interest and mutual concern to the organization, to the employees, to the union, and, ultimately, to the consumer. Since it was in the auto industry that the first major thrust to introduce the QWL concept as a joint labor-management endeavor occurred, it is fitting to trace broadly its development in that industry and to fashion some projections regarding its future.

The development of a joint union-management QWL effort in the automobile industry began at Harman International Industries (a manufacturer of side-view mirrors) in 1972 in one of its plants in the rural community of Bolivar about seventy miles southeast of Memphis. The history of that particular experiment is well documented because it was here at the University of Michigan that documentation from the initial stages to the final report was kept. In 1973, while the parties at Harman were still feeling their way, so to speak, with this new concept, the notion of Quality of Work Life improvement was discussed by labor and management in the auto industry's national negotiations. In that same year an agreement was reached at Chrysler, Ford, and General Motors to establish a national committee to explore the opportunities that might exist for involving

Irving Bluestone, retired Vice President of the International Union of the United Automobile Workers, is University Professor of Labor Studies at Wayne State University.

employees more directly in making decisions on the shop floor. Nothing happened at Chrysler or Ford at that time, but at General Motors the Joint National Committee to Improve the Quality of Work Life was established. (Frankly, it was on the insistence of the UAW rather than General Motors that these efforts were undertaken.)

Despite the slow start the program began to move quite rapidly after a couple of years. At first, an initiative was taken by only a few General Motors facilities, where in each case the local union and management joined together to develop, design, plan, and implement a QWL process—and no two were alike. Even then, however, a full commitment was lacking, especially at top decision-making levels within the union and, particularly, within management. In 1975 it was agreed that an executive seminar would be undertaken. The top executives of General Motors and the members of the International Executive Board of the international union were invited to discuss the meaning, intent, and purpose of Quality of Work Life improvement processes, as well as to obtain information through the introduction of QWL reports from one or two local unions and local managements. This seminar was a good start for establishing a sufficient commitment at top levels so that it could diffuse throughout the rest of the corporation. And similarly, at the union level those who were skeptical, in some respects at least, began to look with favor upon the QWL process as an extension of a union goal, namely, democratizing of the workplace. By 1979 over forty facilities in General Motors had undertaken to introduce a QWL process.

At Ford there was a delayed beginning, as I noted, but in 1979 the parties renegotiated this concept and titled it the Employee Involvement Program. By 1980 the concept at Ford took off like a shot, and it has developed vigorously ever since. Today about sixty-five units at Ford have a QWL process in effect; at GM there are about eighty-five. The United Electrical Workers Union, which also represents workers in several of the General Motors facilities and which follows normally the pattern established by the UAW in its negotiations with General Motors, undertook the same type of development in several of the plants where they represented the workers. Other firms in the automotive industry soon displayed an interest in this concept and, together with their respective unions, began to put together a design for implementation. There are now a number of companies, such as Rockwell International, Eton Federal Mogul, and Atlas Crankshaft, that have jointly developed such programs with the unions. It is also spreading into other industries, such as the communications (AT&T) and steel industries.

Some programs have been failures, as the implementation of any new concept may fail; others are still in the development stages; and still others have achieved quite notable success. The question now is, Is the Quality of Work Life as a concept of work organization merely a passing fad stimulated by the crisis of

an economic depression in the auto industry—as well as in others, such as steel—or is it truly becoming an institutionalized process of joint activity that will become a permanent fixture just as Taylor's scientific management became a permanent fixture some eight decades ago? Will the orthodoxy of the adversarial relationship in collective bargaining preclude such institutionalization and lead to full-scale, ongoing controversy that will negate any joint activity in the workplace? These are fair questions, and they are subject, at best, to a judgmental response.

In an article that appeared in the *Daily Labor Report* of 17 September 1982, Saul Levitan and Clifford Johnson argued—and they are not alone in this argument—that employee participation programs are bound to founder because "they offer a soothing image of harmony and prosperity but fail to resolve the inherent conflict between labor and management." In effect, they argue that the organization is rooted in the notion that what is good for employees is bad for management and what is good for management must, out of necessity, be bad for employees. They go on to state that "it is this battle which ensures a future of tough choices and confrontation for decades to come."

Regarding this projection, one might ask whether it is merely an academic exercise indulged in by those not directly involved in the newly developing workplace processes or whether it is a realistic appraisal of the future of union-management relations. To be sure, the traditional controversial issues of collective bargaining will continue, and they will be the subject of tough negotiation. But the counterargument to the conclusion espoused by Levitan and Johnson is that there is no reason why the parties cannot engage in argumentative collective bargaining and concurrently and jointly support a continuing process of Quality of Work Life improvement. In fact, my own point of view as a labor leader is that Quality of Work Life improvement represents an extension of the primary purpose of unionism: to introduce a fuller measure of democratic values into the workplace. Joint actions designed to achieve this objective are beneficial to the employee, to the union, to management, and, ultimately, to the consumer. They are a reflection of societal changes affecting work structure and work organization.

Higher levels of education now exist among those who are entering the work force. Moreover, it is a different kind of education in which students are taught to think for themselves, challenge authority, and not to accept, in the same fashion as was true years ago, the autocratic behavior of those who are the bosses. Studies by Yankelovich have demonstrated that there is a "new morality" that is affecting the current generation and will continue to affect future generations. In the final analysis, the precept of this new morality is, "I do not accept authority at face value; I want to be shown that it is right." And of course, intensified global competition, not only in the auto industry but also, as was pointed out by Mr. Smith, in other industries in which America has had a technological advantage in the past, is the reality of the future.

These recent developments are challenging the Tayloristic concept of scientific management that has dominated workplace organization and structure for the past eight decades. The trend now is toward a higher form of employer-employee relationship, one that is more conducive to a partcipative system of employee involvement. In that regard a current MIT study of the world automobile industry indicates in its preliminary report that in the years ahead the number of automotive manufacturers will reduce to between seven and nine worldwide. Talk about global competition! This does not and will not mean the obliteration of the adversarial relationship between union and management. Controversial issues will remain the subject of tough bargaining. What share of the corporate profits will be given to the workers? What share will they receive in terms of fringe benefits? What kinds of working conditions will have to be negotiated to improve upon the achievements of the past? Grievances will continue to be filed, and they will have to be processed. In fact, over the years emerging trends in collective bargaining have made it increasingly evident that traditional bargaining relationships can and do continue concurrently with the introduction of Quality of Work Life processes that involve workers in decision making. QWL focuses on those aspects of the collective-bargaining relationship in which the parties have a mutual interest, a common concern, and in which all the parties—employees, management, the union, and the consumers—have much to gain. This continues even as the orthodoxy of inherent conflict, to use Levitan and Johnson's terminology, continues for hard "bargaining" issues.

For many years management and unions have jointly negotiated, jointly administered, and jointly implemented apprenticeship training programs. Since the early 1970s there has been a joint alcoholism rehabilitation program in many major corporations. Similarly, management and unions have initiated joint health and safety programs, joint orientation programs, joint counseling programs for prospective retirees, and, more recently, joint attendance programs as well as joint product- or service-quality programs. In other words, there has been the emergence of joint effort in matters that are of common concern and interest to both parties. These programs may arise out of a tough collective-bargaining posture, but after having been negotiated, they require a joint cooperative effort for full and appropriate implementation.

From a management point of view, the Quality of Work Life improvement process represents a better way to improve the quality of the product and its servicing, a better way to enhance overall efficiency, a better way to reduce scrap and reduce repair, and a better way to lower overall costs. These conclusions are the result of comparing the appropriate data from firms with and without a QWL process. What then will happen when improved economic times reoccur? Will the QWL process wither away? Will the Levitan-Johnson concept of inherent conflict destroy the QWL process? I believe not, but in part it depends on the depth and the seriousness of management's commitment to this new process

in response to the new challenges that face it, and also the depth of the union's commitment to this process in the face of challenges that confront it.

The QWL process has already proven its value to employees, unions, management, and consumers. Although the parties may not see eye to eye on many matters, they will not bite off their nose to spite their face. Doug Fraser, the president of the UAW, recently spoke in Lansing on this subject:

> It never occurred to us to ask the question, Is there a different way for a worker to perform his job? Must these jobs be tedious and monotonous and repetitive? We thought that was purely a managerial prerogative, that management dictated at the workplace how you would perform the job, and that, afterall, they knew how to do it better than we did. They thought that, and we assumed that, unfortunately, there were only two ways of doing things: the wrong way and the company way. And obviously, both sides are finding out that there is another way, and that is the joint way.

In 1982 negotiations were undertaken between Ford and the UAW, and subsequently between General Motors and the UAW and then Chrysler and the UAW. The headlines in the media focused on wage concessions. The media did not, however, give the same emphasis to other areas of those negotations that were the quid pro quos of wage concessions:

1. Plant transfer rights, between plants and within plants
2. Plant closings related to outsourcing
3. The issue of a guaranteed income until age 62 for those with a certain amount of seniority who lose their jobs permanently
4. Experiments in lifetime employment security, to be undertaken at designated plants—designated jointly between the company and the union, at both Ford and GM, respectively
5. Training programs of an extended and comprehensive nature, in which workers will be trained not only to deal with incoming technology and changes in job functions at the workplace but also, for those who will become permanently laid-off, to find jobs elsewhere or in other industries
6. Mutual growth forums to discuss broad issues affecting the industry, the company, the local unit
7. The ratio of supervisors to hourly workers
8. The equality of sacrifice
9. Profit sharing

In regard to profit sharing, in 1958 when the union first raised this issue, the chairman of the board of General Motors Corporation said that it was antithetical to the free-enterprise system. In 1982 profit sharing is a fait accompli in the automobile industry.

Much of this has been going on because of the recognition of the need for change, the need for a new way, a break with tradition. With tongue in cheek a friend of mine a couple of years ago clarified this issue of tradition for me. He said that he had an uncle whose heritage was Swedish and who was indeed a traditionalist. He was the kind of person who felt that only the roots of the past were important. When he looked at the funny cigarettes that were smoked by the younger generation, the bell-bottomed pants, and the long hair, he was convinced as never before that the past was more important than the present. He told his nephew:

> Tradition is so important, you must always hold onto it. Take me, for instance: my father was a Republican—he could have been a Democrat, but—my father was a Republican, and so I'm a Republican. And my father was a cabinet maker, and so, as you know, I'm a cabinet maker. My father was a Methodist, and so I belong to the Methodist church. And my father was a bachelor, and so am I.

Obviously, not all traditions are worthy of rigid preservation, and the tradition of Taylor's scientific management is one. It is neither good science nor good management in today's context. Therefore, those who are more enlightened on management's side and the union's side—and I use the word "enlightened" advisedly—are reviewing the past in terms of the present and the future and are coming to the conclusion that there is, indeed, a need for change.

Change in the workplace, in which the intelligence, the knowledge, and the experience of the work force at all levels can be appropriately and successfully utilized, not only creates greater satisfaction, enhances the dignity of employees, and provides opportunities for self-advancement and self-enhancement, but also improves the overall effectiveness of the organization. These are the future prospects; in my judgment, they will continue to grow and expand to the benefit of the employees, management, the union, and to the ultimate benefit of society as a whole. This requires, then, a supplanting of the scientific management approach to work structure and work organization by an institutionalization of the Quality of Work Life improvement process, a supplanting of the old by the new, and then an advance toward greater success in making organizations more effective and in creating a workplace where employees at all levels may work with dignity.

RESPONSES OF CONFERENCE PANELISTS TO AUDIENCE QUESTIONS

Panelists for the morning question and answer session were Irving Bluestone, Keichi Oshima, Robert A. Perkins, and John F. Smith, Jr. The moderator was Paul W. McCracken.

McCRACKEN: To Jack Smith: You referred on several occasions to the fact that the Toyota-GM venture would enable GM to catch up in terms of management procedures. How did it get behind?

SMITH: Mr. Oshima's chart on Japanese production helps to explain the problem. It was not until the late 1960s that we began to feel the impact of the Japanese imports. Prior to that period, the market was supplied by U.S.-produced cars; it was a U.S. market with U.S. producers, and GM competed with the domestics on an equal footing. In addition, our manufacturing base was similar to the other manufacturers. When the industry became internationalized, however, GM had to compete with the manufacturers from Japan. Since Japanese manufacturers used systems that GM did not use, over a period of time a rather large gap developed between the U.S. and Japan in the cost to produce a car. So, it has only been in the last ten years that this problem has come to light.

McCRACKEN: To Professor Oshima: What has been the reaction in Japan, on the part of both the auto industry and the press, to the GM-Toyota agreement?

OSHIMA: The GM-Toyota agreement has received mixed reviews in Japan. On the one hand, the press and the government welcomes it because they see now that Toyota is investing in the States. On the other hand, there is a strong feeling that the world market, and therefore world production, is declining. Thus, competition is increasing. The agreement is taken as a clear indication, however, that competition is now not between Japan and the United States but between groups of companies and enterprises. So in short, this is a very symbolic development. The strategy of Japanese and U.S. companies has changed with the transition of the world market and technology.

McCRACKEN: To Mr. Perkins: If the Japanese are hurting themselves financially by protecting their agricultural market, why must we arbitrarily hurt ourselves financially by reciprocating with protectionism in the automobile market?

PERKINS: One cannot begin with a clean slate; he has to work with situations as they exist. Japan cannot change the fact that its agriculture is based on a limited area of tillable land. They have a lot of people involved in the agricultural industry, people who have to be employed, who must have useful work, and who, as I mentioned, have a strong political voice. Nor is the U.S. working from a clean slate. We have millions of people employed in the auto industry and its support base, and those people have to be fed, clothed, and actively employed. It is, therefore, a question of how one proceeds. How do you get people to make investments? I do not think that the U.S., particularly, is being invited into Japan to make agricultural investments. But there is no prohibition—and there should not be any prohibition—against substantive and real Japanese investments in the United States. The question is, How do you make somebody take that step when he has a $2000 cost advantage if he ships his products to the United States. It takes a very altruistic businessman to take that step, and I do not think one exists either in this audience or in Tokyo. Therefore, there have to be guidelines—not barriers, but guidelines or some form of action—that will get this process moving forward.

McCRACKEN: To Mr. Bluestone: What can be done to again make U.S. labor in the auto industry competitive with automotive labor in the rest of the world?

BLUESTONE: The industry could reduce wages to the rate that is paid in South Korea, Brazil, and Mexico, but who is willing to do that? In fact, labor cost is a much less important item, in terms of the competitive factor, than one would perceive by the media. First, the exchange value of the dollar is one of the essential elements in determining the landed costs for Japanese automobiles arriving on our shores. Second, there is a vast difference in managerial style and planning, and this has much to do with the effectiveness of Japanese management. For instance, the debt-equity ratio in Japan generally—although this is not necessarily true in the auto industry, certainly not at Toyota—is the reverse of the debt-equity ratio in the United States. As a result, there is far greater pressure upon management in the United States to issue profit and loss statements on a quarterly basis and to pay dividends on a regular basis. The immediacy of the need for profit maximization affects decision making. The U.S. industry does not perform the kind of long-range planning—as was indicated in Hayes and Abernathy's articles in the *Harvard Business Review* some two years ago—that the Japanese industry does. Third, it bewilders me that the Japanese can plan space in such a way that they can produce the same number of automobiles in about two-thirds the space that the U.S. industry demands. They have developed a kanban

operation, which is being contemplated by General Motors for their Buick City in Flint but will take a few years, I imagine, to bring to fruition.

In Japan, the competence in terms of inventory and money management, the interest that the banks have compared to stockholders, the lack of constant and pervasive pressure to maximize profits, and the opportunity for long-range planning have an enormous impact upon the differences in overall unit costs. Labor is only one very small part of that, in my judgment. The concessions that were granted to the automobile industry in the 1982 negotiations were the result of many factors. Obviously, during the period when U.S. firms experienced their heyday of profit making in the automobile industry, employees had the opportunity to share in the swollen profits. The challenge is not to lower the U.S. standard of living to that of Japan, South Korea, Brazil, or Mexico but rather for them to raise their economic standards closer to ours, and that is precisely what Japan has been doing. In that regard, Japanese productivity in the 1960s was about 60 percent of U.S. productivity as a whole; today it stands at over 80 percent. Obviously, their growth rate is higher than ours. In the final analysis, it is not a question of wages; it is a question, in my judgment, of operating more effectively and more efficiently and treating employees as true human resources to be nurtured and developed, not just as adjuncts to the machine to be discarded at will.

McCRACKEN: To all members of the panel: Politics aside, please pinpoint what, in your judgment, are the major weak spots or problems of the Japanese auto industry.

BLUESTONE: Last April a group I was with in Japan heard a report (at the University of Nanzan, Nagoya, Japan) that indicated that job dissatisfaction among employees in Japan is increasing sharply and that the cultural pressures for conformity have led to an immobility that is now being resented by a larger and larger proportion of the work force. One of the executives of a chemical firm, which our group visited, stated that he recognized that this was indeed the case and that Japan was going to have to solve this problem in the next several years. I do not know whether a recent article titled "The Wreck of the Japanese Auto Industry," which I read last week, is sound or not, but it is evident that Japan will have problems just as other industrial countries have had problems in the past, and especially, as Mr. Perkins pointed out, if they attempt to remain isolated in a world that is shrinking rapidly and in which the competitive factors are such that one cannot simply rest upon one's shores and succeed. Thus, my feeling is that the heyday of the Japanese auto industry perhaps has been reached, but that is purely conjecture; I am not an economist.

SMITH: In order to keep growing and to perform the way it has, the Japanese auto industry needs a constantly increasing volume. If they lose that volume, they will

not be able to keep their employment base intact, and they will have problems. If restrictions on Japanese imports become more pronounced in the future, a significant change in their ability to continue to show outstanding gains in productivity could occur. In addition, the Japanese auto industry is a Japanese-based system; they have not internationalized. They do not view themselves as international companies, at least some of them do not, and that is going to present a great deal of difficulty as they are forced to assemble and manufacture in other parts of the world in order to maintain their market shares.

PERKINS: I would just add one other element to what both Professor Bluestone and Jack Smith have said: it is a growth-built industry—everything in Japan, to achieve productivity, is growth oriented. Even the semiconductor industry, which will have an impact on Silicon Valley over the next two years, has geared its productivity to growth. But how do you keep growing if your success becomes so great that people feel you are too large to handle their individual markets? Frankly, the biggest problem that the Japanese industry is going to face is an employment problem. Jack's graph showed a very slight dip (4 percent) in 1981-82. I hate to think what will happen to that Japanese full-employment system if they ever had to face what has happened to the system here in the United States, an operating capacity of 50 or 55 percent.

OSHIMA: The Japanese industry is facing how to be competitive in a period of low growth. It is currently looking for flexible manufacturing systems and internationalization to maintain volume. Personally—though this is a view not accepted by most Japanese—I think the lifetime-employment system will collapse. On the one hand, in order to be competitive, efforts toward innovation must increase, resulting in the employment of younger people. On the other hand, the industry, which has had a lifetime-employment system with a retirement age of about fifty-five, is under pressure from government and labor unions to increase this retirement age to sixty. This burden would be difficult for Japanese companies to accept. In short, the Japanese employment system, which was established after World War II, will be in great difficulty.

McCRACKEN: If I may just pursue that for a moment. Is not this so-called lifetime employment embedded in culture, not legislation?

OSHIMA: Yes.

McCRACKEN: To Mr. Smith: After the termination of the joint venture with Toyota, what will be Toyota's role at that time, and will the car bear joint markings, like AMC-Renault Alliance?

SMITH: In terms of the agreement, we have not discussed the future beyond the end of the twelve-year period. Perhaps General Motors would take the plant back, or perhaps Toyota would want to take the plant over; its future is completely open at this time. With regard to the second part of the question—Will there be joint markings on the car?—the answer is an emphatic "No!" The car that is being produced in the venture is a Chevrolet car, and it will have Chevrolet markings.

McCRACKEN: To Mr. Perkins: Why is Chrysler criticizing the GM-Toyota arrangement instead of doing the same thing?

PERKINS: There is no question that we are interested in joining them. What we object to is the strong anticompetitive position that will exist when the number one and number three carmakers in the world join forces in this project. They represent 50 percent of the U.S. car market and about 35 percent of the subcompact market. Why could it not have been done with GM Isuzu? Instead, Isuzu is now shipping to the U.S. 250,000 vehicles made in their country, and 80,000-90,000 Suzukis will possibly be shipped here as well. We think that the situation is a little backward.

McCRACKEN: Do you agree, Mr. Smith?

SMITH: No, I do not agree!

McCRACKEN: Do you want to make any further comments?

SMITH: I do not want to prolong this disscussion. The one point that I would like to make is that Isuzu is a truck manufacturer that has dabbled in passenger cars on the side. It does not have the capability to come to the United States and produce autos and implement management systems the way Toyota or one of the other five leading Japanese automakers can. Isuzu is not a major passenger-car manufacturer.

McCRACKEN: To Mr. Bluestone: Do you think it is going to be possible for costs in the U.S. auto industry to become competitive internationally, not just labor costs, and are we going to be able to produce cars here on a competitive basis internationally?

BLUESTONE: To both questions I would say yes, provided that there are changes from traditional methods of management, labor relations, and collective-bargaining relations. Most of the emphasis with regard to the competitive factor in the automobile industry has been placed on labor costs, and I addressed that earlier. But there are so many ways in which efficiency and quality can be improved. The emphasis on quality in the Japanese auto industry is quite

remarkable, and a lack of that emphasis is one of the problems that we have had in our industry—not just auto but most industries in this country. Foremen are told to get their production quotas, and we have had some ugly experiences, in the auto industry particularly, because of that policy. There is a realization today, however, that quality production is the best kind of production, and that realization is apparent in the quality of the cars that have been produced recently.

The transition from one type of work organization or structure to another is going to have an enormous impact on overall costs. For instance, the worker has traditionally been considered an extension of the machine, an expendable spare part, a "hired hand." Under the new system the worker complements the machine; he is a human resource to be developed. This new system applies not only to blue-collar workers but to all workers throughout the entire hierarchical structure of the corporation. The old system divides a task into little components that are performed repetitively; the new system optimizes task grouping so that there is a broader spectrum of operations in which workers can perform and to which they can devote their mental as well as physical energies. Under the old system everything is externally controlled: management designs, plans, and gives the orders; the employees take orders. This is true not only among blue-collar workers but also among white-collar workers. Even middle managers today are complaining that they no longer have the same latitude of decision making as they had in the past. The old system is marked by authoritarian, organizational control; the new system is more participative. The old system, in my judgment, is competition in a destructive way; the new system provides open communication and more cooperation. Under the old system management makes low-risk decisions. Managers in various industries have told me that the home office insists that any capital investment above a given dollar value has to show a certain percentage return within two years. To meet those requirements, managers fake their proposals. This low-risk system—and, I might add, mergers and acquisitions in this country are largely instigated by a low-risk mentality, not creative innovation—represents short-range, not long-range, planning.

When these changes take place, they will have a positive impact on efficiency, quality, turnover, and a host of other measurable factors, such as absenteeism, grievances, and discipline. Overall unit costs will be reduced, but not by depressing the employees' living standards. It is in these areas, it seems to me, that management and unions have an obligation and a responsibility to work jointly in order to achieve this transition from an old system, which is tired, to a new system, which holds great hope.

McCRACKEN: Let me ask a question of my own. It has always struck me that if one were standing outside this planet and were looking at the world economy, he might have expected this participative system, a concern for greater involvement between the employee and the company, to have emerged in a society with an

underpinning of what you might call the Judeo-Christian ethic. But it did not seem to emerge here. Why not?

BLUESTONE: Do you want a labor point of view?

McCRACKEN: No, I want Professor Bluestone's point of view.

BLUESTONE: Well, I will give you both. Consider for a moment that industry, and management generally, violently and vigorously opposed union organization. (Large sectors of the American industrial complex are still in fierce opposition to union organization as an impingement and encroachment upon their prerogatives.) It was not unusual in the early days of organizing for management to hire goons to maim and kill union organizers. I do not have to repeat what went on in the violent 1930s in the Michigan area when workers tried to unionize the automobile industry. When organization finally did take place, it took place within a climate of conflict, a climate of resistance. Subsequently for years and years, management's approach to collective bargaining was, "Contain the union. Contain them. Do not allow them to encroach upon any of the responsibilities or prerogatives of management, even at the workplace level." As a result, U.S. industry has developed a system of adversarial collective bargaining, which in many respects has been highly constructive. There comes a time, however, when management and the union ought to be able to sit down at the table and bargain through their affairs, not as hard-core adversaries—although there will be tough questions to decide—but rather as problem solvers. Areas of common interest that lie both outside the collective-bargaining arena, such as those that are covered by the normal QWL effort, and within the collective-bargaining arena, even highly controversial issues, ought to be worked through and solved jointly. I think the 1982 negotiations in the auto industry symbolized the kind of joint effort that can be undertaken to meet basic problems. This does not mean that the atmosphere of an adversarial relationship will disappear, but it does mean that what is done by way of joint cooperative effort in one area will have its impact upon the other. I might add that the greatest roadblock to joint problem solving between management and labor is the active attack by many managements against unionization, the determination to maintain a union-free environment. It is difficult, to say the least, for a union to respond to the concept of joint effort if management is bent on destroying the union.

McCRACKEN: A question for Professor Oshima: A recent article in the *Japan Economic Journal* indicated that the Japanese government has shifted its policies away from defense and external affairs and toward economic policy. Is that apt to produce any significant changes, particularly in international, economic, and financial policy, or is the statement incorrect?

OSHIMA: I think it is incorrect. The Japanese government has been focusing on economic policy for a long time, and that is . . .

McCRACKEN: But this article said that the Nakasone government had started out focusing primarily on . . .

OSHIMA: You mean Nakasone and not the present government, I see.

McCRACKEN: Is there a distinction between Nakasone and the government?

OSHIMA: He is from the same party, and there is a strong continuity in the government. We tend, however, to distinguish between the basic policy of the government and the policy emphasized by the prime minister. Maybe I am too frank, but the point is that when Mr. Nakasone became prime minister, he wanted to change the emphasis of past policy by highlighting defense and international matters. The press response is rather complicated because the Japanese press, in many cases, does not pursue defense matters seriously. In any case, it is quite clear that international affairs and defense are important. On the other hand, Japan's past, rather optimistic view of its economy is now changing as it faces the same difficulties as other industrial countries. Several very serious issues of the Japanese economy, such as the government budget deficit, have achieved a rather high priority, and there is strong pressure to reduce government expenditure. The industry has also entered a rather difficult situation due to the uncertain future of new industrial facilities and the market. As I indicated, the auto industry, which was a very prosperous industry in Japan, is facing a decline in production. In a practical sense, therefore, our domestic economy is becoming a very serious issue. Naturally, the prime minister has to look into the practical and very political issues, which gives the impression that Mr. Nakasone has shifted his emphasis to the economy.

McCRACKEN: Thank you. Mr. Perkins: Do you see the U.S. government stepping in to break up the GM-Toyota deal, and do you expect to see federal legislation limiting Japanese auto imports to the U.S.?

PERKINS: I do not forecast what the FTC is going to do about the General Motors-Toyota proposal. We will just have to await the outcome. On the . . .

McCRACKEN: Well, why not just guess?

PERKINS: I would have to flip a coin; it is a very, very close issue, and I do not know which way the FTC will decide. With regard to federal legislation limiting Japanese imports, that largely depends on our economic recovery. We have a tendency to forget things very quickly, and if we have a boom market this year,

coming into the 1984 presidential election, there is a good chance a lot of the things that we have learned will be forgotten. If there are not further restraints, then there will be a considerable influx of built-up vehicles from Japan. Their $2000 cost advantage is terribly attractive, and people, including U.S. manufacturers who import vehicles, will take advantage of it. It is a critical issue that Washington has to face, particularly when it becomes a presidential issue about a year from now.

McCRACKEN: That is an interesting and significant point—that the current agreement expires in a presidential year. To Mr. Smith: Of the 200,000 small cars per year to be built through the GM-Toyota joint venture, how many are projected to be a displacement of the Japanese imports?

SMITH: Well, we hope there are 200,000 displacements. Quite frankly, it is much along those lines that we look at this transaction; we are going to have a car to sell in the United States that will be competitive with Japanese products.

McCRACKEN: Head-on, competitive in price?

SMITH: Head-on, competitive in price, quality, everything.

McCRACKEN: Professor Oshima, you would be disappointed if you left the podium without addressing this question: If you believe in free trade, what is your opinion on the Japanese trade barriers against U.S. products versus U.S. trade policy? Should not free trade be both ways?

OSHIMA: I believe in free trade in Japan and throughout the world. It is important to note, however, that all the remaining restrictions in Japan are mainly in two sectors: distribution, or sales, and agriculture, which is very much related to local constituents. The resistance now to these barriers is more or less political in nature. In addition, although the productivity of Japanese manufacturing industries is very high, the productivity of Japan as a whole is not very high. In other words, the high productivity in the manufacturing area helps support the low productivity of distribution and agriculture. In the interest of consumers and our national economy, we must internationalize and must remove these barriers. Because of strong political pressure, however, it will only happen gradually. Even consumer unions have joined with agricultural groups against the free importation of beef and agricultural products.

McCRACKEN: One more question, to Mr. Perkins: How do you explain and justify Chrysler's import of Mitsubishi products to supplement the lower part of your product line versus your position for some type of import barriers? Certainly, GM's approach is superior to either of these.

PERKINS: Right now, Mitsubishi and Chrysler have a quota that permits the importation of 112,584 units. Toyota brought in around 500,000 vehicles, a five-to-one difference. In terms of how we justify our position, we are not protectionists for the sake of being protectionists. What we want to see, since the U.S. is such a large market and so politically stable, are foreign firms making substantial investment in this country. Frankly, what is being done in Fremont is tokenism on the part of Toyota, and we do not think that is the way to proceed.

McCRACKEN: We have not yet run out of cards, but we have run out of time. Thank you, audience for your questions and panelists for your responses.

AUTO TRADE: PROSPECTS AND PITFALLS

David Macdonald

As everyone is aware, a voluntary restraint on auto exports to the United States, implemented by the Japanese government in the spring of 1981, is now in its second year. The present level is 1,680,000 passenger automobiles, with separate restraints on exports to the commonwealth of Puerto Rico, and on certain station wagons and van-type vehicles, which are classified as commercial vehicles in Japan but passenger vehicles in the United States. On 15 February 1983 Mr. Yamanaka, the minister of International Trade and Industry, stated that the government of Japan would continue, at this same level, voluntary auto-export restraints through March 1984. This continuation assures that virtually every additional car that will be sold in the United States during the next year will be manufactured in North America. The administration has welcomed these restraints, which have reduced the number of Japanese passenger vehicles exported to and sold in the United States during 1981-82, and believes that the Japanese voluntary action is effectively meeting the import issue without permanently damaging American exports, jobs, and the international trading system, as would proposed domestic-content legislation.

These export restraints have dealt with the immediate crisis, but what are the future prospects of the industry, and what is the possibility of new intervention by the U.S. or Japanese governments to deal with the continuing auto-trade problems? After briefly examining how the federal government has been involved in recent developments, these questions will be addressed.

The auto industry's problems have been developing for some time and came to full bloom in 1979 after the second disruption in oil supply following the Iranian revolution. Prior to that time the U.S. industry appeared to be in fairly decent shape, and large numbers of unsold imported cars were sitting in inventory. But U.S. manufacturers were having great difficulty marketing the fuel-efficient cars

David Macdonald, Deputy U.S. Trade Representative before and during the conference, is now an attorney and partner in the law firm of Baker and McKenzie.

that were required to meet the average fuel-economy standards established by law, and when the energy price explosions and shortages occurred in 1979, the whole automotive market shifted. American consumers demanded fuel-efficient vehicles that U.S. manufacturers were not in a position to produce.

Those problems were compounded by the effect of government regulations that constantly shifted the ground rules by which the automotive industry does business in this country. Many business people were reeling from the constant and seemingly contradictory changes in government policy on safety, pollution, and mileage and their inability to accommodate all the demands being imposed on them by their own government. The effort to meet governmentally mandated objectives—many of which had nothing to do with improving the quality or performance of the car in the eyes of the consumer—resulted in a substantial increase in the amount of capital required to do business and a draining of sizeable amounts of money from the capital base. For example, a recent study by Lawrence White, published by the American Enterprise Institute, found that antipollution regulatory standards now in effect will increase the cost of an automobile by $1400. While pollution standards during the 1970s contributed significantly to cleaner air, Mr. White and others doubt whether the tightening of standards in the 1980s and the extension of these standards to trucks will achieve visible benefits that exceed the increased costs. Despite the recent claims that the Environmental Protection Agency is probusiness, on this issue there has been no real relief to the auto industry or consumers. Without some recognition that the economic principle of diminishing marginal returns applies to increasingly stringent requirements for emission control, by 1985 the total cost of this program could increase by 50 percent, from $13 billion to over $20 billion.

It is clear also that there was little foresight and planning by either business or government in meeting the challenge of OPEC after 1973. The government sent conflicting signals to the marketplace by mandating the production of fuel-efficient cars while simultaneously suppressing gasoline prices, and the industry's management did not move quickly enough to replace large cars with fuel-efficient vehicles. Both management and the union were responsible for producing automobiles of less than the highest quality, while agreeing to large compensation packages that outpaced productivity, were inflationary, and resulted in price increases unacceptable to the consumer. The average purchase price of a new car rose 55 percent from 1978 to 1981, while the consumer price index increased 39 percent, and disposable income increased 33 percent. All of these factors, which came to bear on the automotive industry after the 1979 disruption in gasoline supply, caused the industry's profits to disappear and cash to be drained. By the end of 1981, the United States Big Four had a combined negative cash flow from operations of $7.5 billion and were $13 billion in debt.

In response to these problems, the present administration welcomed the export restraints by the government of Japan. These restraints were not intended

to be a major rollback of imports but a measure to restore the confidence of the automotive industry, which had to make tens of billions of dollars of new investment to convert to the production of smaller fuel-efficient vehicles. It is not factually correct to blame the present condition of the U.S. automotive industry, as bad as it is, substantially on imports. Although imports averaged 27.9 percent of the U.S. market through 1982—up from 18.4 percent in 1977, a good sales year--in absolute terms import sales were only 200,000 units more than five years ago. In fact, import sales have been flat since 1979. What has happened is that domestic car sales have decreased because of the recession, high interest rates, and auto price increases that have made it very difficult for people to meet large monthly payments.

A particular piece of legislation has again been proposed in Congress to aid our faltering industry and to deal with the problems of more than 250,000 unemployed automobile workers and 750,000 unemployed workers in the automobile supply industries. However, by every independent analysis that I have seen, including that of the Congressional Budget Office, automotive domestic-content requirements will increase net unemployment in this country, not reduce it. First, this kind of legislation will, by its very nature, increase the price of every car sold in this country. Fewer people will be able to make the monthly payments, and that implies that fewer people will eventually be employed making cars. Second, from my perspective on international trade, despite assurances by the proponents of this legislation to the contrary, closing off our market to such a major import as cars—even if only from Japan, a country with an $18 billion trade surplus with the United States—would meet with a very negative international response. There would likely be a series of retaliatory reactions and counterreactions, which would inevitably reduce world trade and result in domestic and international economic stagnation, as have the reactions to similar protectionist legislation such as the Smoot-Hawley tariff some fifty years ago.

A staunch defense of our free trade policy must not be based upon an idealistic view of world trade and how our trading partners behave. Rather, the pursuit of free trade is a necessity for preservation and growth of American jobs. We export 20 percent of all that we manufacture in this country, about a third of all that we produce on farms, and about $100 billion worth of our intangible services; the total amounts to $220 billion. Five million Americans are working in jobs directly related to the export of American goods, excluding those that are working in jobs related to imports as well as indirectly related to exports. In the context of job creation, between 1977 and 1980 four out of evey five new manufacturing jobs were created in export industries.

The real problem today is a recession that is global, deep, and seriously affecting our well being—not just here, but everywhere in the world—and we cannot stop a recession by stopping trade. The only way to deal with a recession is to create more goods, more trade, and more employment. Stopping trade as a

solution to unemployment is one exercise in irrationality to which the world must not again resort.

But what of the future? Have labor and management really been working together to produce higher-quality cars at competitive prices? Can they overcome the cumulative mistakes of past years, the continued striving on the part of the Japanese to increase productivity, and the undervalued yen? Unfortunately, some recent information indicates that the U.S.-Japanese cost difference is widening, not narrowing. Some have responded that the restraints on Japanese auto exports may not have been severe enough, or of long enough duration, to effect the recovery of the U.S. industry. If this is the sole explanation, there will be some in Washington and in Tokyo in March 1984 willing to extend those restraints.

But what if the correct view is that U.S. car manufacturers are not now and will not soon, if ever, be competitive in small cars? What if the forces that drive labor unions will not permit reasonable limits to compensation growth or significant work-rule modification? Then we may be in the trap of our long-term protection of a declining, noncompetitive industry. Our actions on imports could retard rather than promote adjustment in this industry and result in a drag on our entire economy in several ways: the effect of protectionism rising as a solution to the problems of other industries, the negative effect on competitive U.S. exports through emulation of our actions by foreign governments, fewer dollars available to the Japanese to buy U.S. exports, and the diversion of scarce capital from industries that could grow and prosper, such as those in the high-technology sector.

A less than satisfactory commitment to quality and productivity by labor, bonuses to executives who are partially responsible for much of the current problem, and the continued pursuit of self-destructive domestic-content legislation undermine the auto industry's credibility in Washington and across the nation. These issues relating to the negative aspects of continued auto-trade restraints will place a large burden on the U.S. auto industry to demonstrate that it is entitled to the very real sacrifices by workers in export-oriented industries and by consumers.

QUESTION AND ANSWER SESSION WITH DAVID MACDONALD

The moderator for this session was Gilbert Whitaker, Dean, School of Business Administration, The University of Michigan.

WHITAKER: There are a number of provocative questions that the audience has submitted. The first: You have made a strong case for not erecting trade barriers. What is your view concerning the viability of maintaining a free-trade policy in a world that does not have a free-trade policy?

MACDONALD: It is easy to lay out a program proving that free trade creates more wealth for more people. But when other countries are closing their doors, that is a real problem to which every government official must respond. The answer, briefly, is that we have yet to create what I would call a counter-industrial trade policy. That is, we have yet to find a level of reaction and action that closes off or limits our markets to countries that are trying to shift the burden of unemployment to the U.S. through their own restraints. The Houdaille Industries' complaint, which, I think, deals with this issue, may clarify our response, but to preserve a given industry just because it exists is not the answer.

WHITAKER: You have stated that a local-content law would cost jobs. How can it take more labor to import and sell cars than to manufacture and sell cars in the U.S.?

MACDONALD: That question challenges the validity of the theory of comparative advantage as propounded by David Ricardo. Government, at least in this country, is not yet ready to abandon that theory. We still believe that the people who make bananas best should be able to export bananas to the world, and the people who make automobiles best should, by and large, be able to export automobiles to the world. The temptation to meddle with the law of comparative advantage by governments has multiplied a dozenfold since the reduction of tariff levels, from about 30 percent in 1947 to about 5 percent today, and that temptation is most noticable in countries that believe that they can create comparative advantages in particular industries and then target those industries for exports.

Those countries pay for that policy in a macroeconomic sense, whereas our industries will suffer on an individual, microeconomic basis. We must have a microeconomic response to that kind of targeting and still maintain a macroeconomic view that, by and large, free trade will create more wealth simply because it creates more goods per unit of capital than any other system.

WHITAKER: Which countries would retaliate against U.S. local content when nearly all countries have barriers against Japanese auto dumping?

MACDONALD: Japan would not formally announce or admit that it was retaliating, but certain purchases made by the Japanese would probably shift away from the United States in a number of areas. The U.S. has already been notified by the European community that, without any reason, it intends to withdraw unilaterally one of its tariff concessions to the United States. I have no doubt that if they can justify a withdrawal of tariff concessions without any reason, they would certainly withdraw them if they had a reason. Such action would cut down on our exports to the European community, with whom we have a large bilateral trade surplus.

WHITAKER: If the government had not required higher fuel-economy ratings prior to 1979, would not the U.S. industry have been even less prepared for the demand for fuel-efficient cars, particularly in view of price controls on gasoline?

MACDONALD: I think the government has tried to influence the market in so many ways that I am not sure whether U.S. automakers would be more or less competitive with any different combination of government interventionism that might have existed. It has been a disaster from the standpoint of the government, and we are certainly willing, and deserve, to take an enormous amount of the blame.

WHITAKER: This question was probably written in view of your imminent departure from the government. What is your prediction of the FTC position on the GM-Toyota joint venture at Fremont, California?

MACDONALD: Fortunately, that decision is beyond my control and not my responsibility. I have no idea what they will do.

WHITAKER: What share of the U.S. auto market must imports garner before we restrict them?

MACDONALD: Import restrictions on Japanese autos already exist—implemented, I might add, after lengthy discussion with the United States government—and will remain in place at least until 1 April 1984.

WHITAKER: Numerous industrially developed nations have established strict automobile import restrictions aimed at Japanese autos. Is there one example where Japan has retaliated?

MACDONALD: Yes, Japan has eliminated various European auto manufacturers in third-country markets as a result of restraints that the Europeans have placed on Japanese autos. I think this is true in Scandinavia as well as other areas of the world.

WHITAKER: Are there no strategic industries in the U.S.?

MACDONALD: Well, in Congress's wisdom, the textile industry is entitled to complete bilateral protection, but it is the only industry that has been able to galvanize a majority in both houses of Congress on any issue in which they happen to be interested. What is implicit in that question is, Are we going to let our industrial base go down the drain? Of course not, and that is why we presently have restraints on Japanese automobiles. On the other hand, we cannot immunize our industries from competition. Japanese competition has been one of the best things that ever happened to this country. We were getting fat, sassy, and careless until we had to respond to Japanese competition. I think the United States is going to come out of this recession very lean and mean; this is the moulting of America. As interest rates drop and the dollar returns to a more normal rate of exchange with other currencies, a renewal of our industrial resource in many areas, and I hope the auto industry is one of those, will occur.

WHITAKER: I am going to give you an opportunity to forecast: One of the biggest problems for U.S. manufacturers is that they do not know what the U.S. trade policy will be and, therefore, how to plan ahead. In your opinion, what can we expect in the 1980s in trade policy?

MACDONALD: I think that this Congress is a more protectionist Congress than the last, but I doubt that the local-content bill will pass. In any case, the next eighteen months will be one of the toughest periods the U.S. has experienced. The dollar is very expensive in relation to other currencies. Even when that situation ceases, the beneficial effect on trade of a drop in the value of the U.S. dollar will not occur, according to economists, for about eighteen months. If that is the case, we will continue to suffer in Third World markets because of the value of our currency. If we have a growth rate of 4 percent, we will have a $70 billion trade deficit. Our response will be an ad hoc attempt to minimize the effect of that currency problem on the most heavily hit industries. I do not think that it is appropriate to erect some sort of compensatory tariff that would generally make up for decisions made by the Federal Reserve Board and the Department of the Treasury that have put us into a competitive bind. We will try to handle these

things on a day-by-day basis. That projection does not give the industry a lot of assurance, but there never is much assurance in a globally competitive market. The new battle will be in encouraging investments that otherwise might not be made because of another country's industrial policy. We will also try to negate the market-distorting efforts of other countries as sharply and as quickly as we can.

WHITAKER: You touched briefly on this question in your last answer in the context of the Third World: Given the trade imbalance between the U.S. and Japan, why has the yen remained undervalued?

MACDONALD: It is partially because the U.S. dollar is overvalued. The dollar-yen relationship to some degree copies the dollar's relationship to European currencies. That would indicate that the problem is with the dollar, not the yen. Whenever the Japanese government intervenes, they attempt to strengthen the yen, but, at the same time, they finance their debt at artificially low interest rates. For example, they force the banks to take the debt at interest rates that are lower than a market clearing rate would indicate. As a result of these low interest rates, the yen tends to remain low. In addition, the yen has not become an international currency the way the dollar has. These factors indicate that the yen is somewhat artificially undervalued, but I hasten to add that we have a dollar problem just as much as the Japanese have a yen problem.

WHITAKER: Will the Soviet Lada be allowed to be sold in the U.S.? And, is it true that the car may be produced in Canada?

MACDONALD: I do not know of any reason why any Soviet product would not be sold in this country. Of course, the Soviet Union is not entitled to most-favored-nation treatment so they would be up against column-two tariffs and would be facing a rather serious tariff level. If it is produced in Canada, it will be, assuming that it meets the value-added requirements, a Canadian product that would probably be entitled, under the auto agreement, to tariff-free entry.

WHITAKER: One last question: Earlier today there was some discussion of the protection of Japan's agriculture. Is Japan's agriculture benefitting at the expense of our smokestack industries?

MACDONALD: No, I do not think so. The Japanese maintain tariff quotas on about twenty-two categories of agricultural products. These tariffs have hit us pretty hard in some areas, but the situation probably benefits our smokestack industries because it tends to restrain trade between the two countries and thus impede the ability of American consumers to buy Japanese cars. Any time one

country can export a product in exchange for another country's export, it is just a result of economics; it is not a situation where one benefits at the other's expense.

WHITAKER: Before you leave: Is there a question that was not asked that you would like to answer?

MACDONALD: I would simply like to say that I think this administration has tried to respond to the legitimate concerns of U.S. industry as much as any administration and to create a confidence in the government that previously did not exist. In turn, the administration has a confidence in U.S. business that did not previously exist. Whenever the shoe really begins to pinch tightly, this administration will be there. It will not fall on its face because of any religious beliefs on trade theory, and it will try to continue a program of making industry's investments worthwhile while enabling the consumer to take advantage of the best available product from just about any source.

WHITAKER: Thank you very much, Mr. Macdonald.

FUTURE AUTOMOTIVE FACTORIES: SPECULATIVE MODELS

Richard C. Wilson

In this discussion I speculate about the nature of U.S. automotive factories that may dominate the industry by the turn of the century. Three alternate scenarios for the future U.S. auto industry and their consequences for manufacturing processes and strategies will be described, with emphasis on the technological changes in both the automotive product and the manufacturing processes and how these changes may influence the size and effectiveness of the projected factories. The stages of processing typical of the major passenger-car manufacturers, from engine manufacture and body stamping to final assembly, will be examined. I conclude with an assertion about manufacturing management.

United States-owned automotive manufacturers will have invested in the U.S. an amount estimated to exceed $80 billion for new product and process technologies over the period 1979-85. Part of this expenditure is in response to new regulations for product emission control, fuel economy, or vehicle safety. These regulations also directly impact the materials, precision, complexity, and size of manufacturing processes required to fabricate and assemble vehicles in the U.S. Other factors, such as plant OSHA and EPA regulations and the 1981 recession, have also affected the need for new or renovated manufacturing facilities, and competitive pressure (primarily from the Japanese, who have achieved a new benchmark of efficient, low-cost vehicle production) has forced a total reexamination of the quality of U.S. automotive products. Will the U.S.-owned domestic automotive plants become competitive? Are robotics, just-in-time delivery, flexible manufacturing systems, quick die changes, or other new manufacturing technologies the panacea for restoring these facilities to their world dominance? How will these plants operate in the future if they are to achieve this recovery?

In its 1982 report, *The Competitive Status of the U.S. Auto Industry*,[1] the National Research Council proposed three scenarios for the future evolution of

Richard C. Wilson is Professor of Industrial and Operations Engineering, The University of Michigan.

1. National Research Council, *The Competitive Status of the U.S. Auto Industry* (Washington, D.C.: National Academy Press, 1982).

the industry (see table 1). They are the basis for our speculation about the production facilities that might reasonably emerge as a consequence. The purpose in using these three scenarios is to provide a framework for explaining our conjectures about future U.S. automotive factories. We do not claim that one of these scenarios must inevitably occur. In fact, as the NRC report argues, the U.S. industry eventually may display some elements of all three scenarios in varying degrees, depending in part on the strategies of automotive manufacturers and U.S. and world trade policies in the future. Indeed, it is easy to describe other credible scenarios. However, these three scenarios imply different trends for U.S. auto-manufacturing plants in the future, starting from a 1983 base. The NRC scenarios, therefore, are extended to provide plausible consequences for the technology and configurations of our factory assembly and fabrication facilities.

In each of these scenarios it is assumed that the U.S. auto market grows slowly, if at all, and that the consequences describe the U.S. industry circa the year 2000. However, since a complete replacement and updating of all U.S. automotive facilities by the year 2000 is improbable, depending on the scenario, a partial emergence of our examples of the future automotive-factory design should occur.

This study has its origins in the Joint U.S.-Japan Automotive Study at the University of Michigan. The models proposed here are the outgrowth of an exhaustive review of trade and technical journals about automotive production and trends in manufacturing technology. A series of discussions with manufacturing engineers and management in both the U.S. automotive industry and the machine-tool industry were especially helpful in suggesting visions of what might be. Visits to U.S. factories in widely diverse industries provided a benchmark of realistic rates of factory innovation and an appreciation of the complexities of domestic manufacturing management. To the hundreds who provided these insights, I extend my appreciation and my assurance of anonymity in the likelihood that they prefer to work toward their own factory visions.

The Three Scenarios

In this section, the three scenarios proposed by the NRC for the future evolution of the U.S. auto industry are discussed. New names for these scenarios are provided in order to reflect the context within which U.S. domestic manufacturing will operate.

Scenario: Multinational Domestic Industry

It is commonly accepted by the U.S. auto industry that the Japanese enjoy a substantial advantage in landed costs over U.S. manufacturers in the U.S.

market. The "multinational" scenario assumes that the Japanese firms exploit this advantage by substantially lowering their vehicle sticker prices in U.S. markets and that no trade restraints are imposed. As a consequence, U.S. manufacturers experience a loss of market share and extreme pressures to lower their production costs to be competitive.

These realities would motivate the domestic OEMs to move component production and final assembly to off-shore countries able to offer the lowest-cost labor and production capability. To enjoy the benefits of international manufacturing economies, off-shore production would tend to emphasize "world-car" designs whose modularity would permit the same components to be used in vehicles shipped to a large number of world markets. Thus, the U.S. markets would be dominated by standard-designed vehicles manufactured off-shore and sold below U.S. production costs, possibly through new mass-merchandising channels such as Sears or K-Mart. The U.S.-owned domestic plants would be competitive in the production of vehicles specially configured for U.S. market niches, such as large luxury cars and cross-country vehicles whose price is not critical. The NRC report estimates this market as about 35 percent of the total, clearly less than the present U.S. domestic capacity.

Scenario: Sheltered Industry

In this scenario the NRC projects a continuation of the current trend toward a smaller share of the domestic market for U.S. manufacturers. In response, the U.S. OEMs are forced to concentrate their marketing and product efforts toward their most popular, standard lines. As the Japanese continue to develop improved standard products and specialty lines (such as minicars), price competition increases, idle domestic capacity increases, and the profit margins of U.S. OEMs continue to decline. The situation creates a trade-policy confrontation between the U.S. and Japanese governments. To avoid (or because of) trade constraints, the Japanese begin using their industry's accumulated capital to build production facilities in the U.S. and other sectors of the international market. Thus, the share of the U.S. automotive market enjoyed by U.S.-owned OEMs declines although the domestic industry, now jointly owned by U.S., Japanese, and other non-U.S. firms (e.g. Renault), continues to be viable and profitable.

Since the foreign-owned domestic plants would import a portion of their parts and components from their own nations or purchase from foreign-owned domestic suppliers, the U.S.-owned domestic supplier market is reduced. The U.S. share of value-added content in the domestic automotive market declines, and U.S. leadership in the worldwide auto industry is weakened. Nevertheless, the U.S. domestic manufacturers continue to produce those standard product lines most popular with U.S. markets.

Scenario: Technology-Driven Industry

NRC's third scenario assumes that circumstances such as a renewal of the increases in the costs of fuel create intense new competition to provide acceptable vehicles in an increasingly transient context. High-volume production of standard car lines tends to move off-shore in order to achieve lowest-cost production. This enables the standard models to compete with the new technological product and process innovations that are devised as a domestic response to the changing circumstances. Domestic manufacturers resist U.S. trade barriers so that they can compete worldwide without retaliatory trade limitations.

Car designs become more innovative, and technology becomes the most important market force. New technologies command premium prices; vehicle diversity increases; and production methods and technologies become highly varied. Existing technical competence becomes obsolete, and facilities are abandoned. Some new raw-material industries are created, and others destroyed. With a continuing high rate of technological change (now considered typical, for example, of the semiconductor industry), domestically produced vehicles would be specialized for different uses and performance. The value-added content of the U.S.-manufactured car stays high, but the domestic share of the market decreases from today's levels since the high-volume lines of standard cars are manufactured abroad.

The range of specialty cars provided by this scenario might include different cars for different activities: recreational cars (sports cars, vans, convertibles, muscle cars), commuter minicars, four-wheel-drive and light trucks, taxicabs, vehicles for handicapped use, and limousines. In time, the specialty cars may be marketed with a variety of engine options (gas turbine, electric, Stirling, stratified charge, rotary, flywheel-hybrid), alternative fuel sources (hydrogen, fuel cell, methanol), continuously variable transmissions, and structural plastic bodies. Demand and a relatively short product life, as new technologies foster new products and new market demands, drive the rapid growth of specialized car lines. Because of the variety of specialty cars, the proportion of families with multiple cars increases. Technology and change dominates the industry, and the management of innovation becomes a requisite skill rather than an incremental cost reduction or multinational management skill. Firms with the requisite technology but no prior experience in automotive products may enter the market in competition with traditional domestic manufacturers. Annual demand for any given specialty car often peaks at 30,000 to 80,000 vehicles per year.

Table 2 summarizes under each of the three scenarios the assumptions about the future production emphasis for U.S.-owned domestic and off-shore manufacturing facilities, and for foreign-owned companies that participate in the U.S. market. Under the multinational domestic-industry scenario, domestic automotive manufacturing accounts for only 35 percent of the market, the

remainder being satisfied through imports from off-shore U.S.- or foreign-owned plants. The "sheltered" scenario projects that the domestic market is satisfied by U.S.-owned domestic production of standard and luxury cars and by foreign-owned domestic production of small and/or specialty cars. Hence, the domestic manufacturing base is viable, but the prospects for U.S.-owned domestic manufacturing depend upon the size of the U.S. market demanding standard and luxury cars. The technology-driven scenario projects that U.S.-owned domestic plants manufacture technology-based specialty cars. High-volume standard lines and some specialty cars are imported from U.S.- or foreign-owned off-shore plants.

Implications for U.S. Manufacturing Facilities and Methods

Regardless of the scenario, several technological developments are of overriding importance to the viability of the U.S.-owned auto manufacturers. The U.S. industry can and will maintain product quality equal to any competitor, but while immediate improvements can be achieved through improved management, in the long term, quality improvements will require an application of new technology. The requirements for high-quality components will mandate use of state-of-the-art technology for on-line dimensional checking and quality assurance. Thus, machining and part fabrication processes (welding, forming, grinding) will be monitored by new vision, tactile, or proximity sensors for conformance to quality requirements. Either adaptive adjustment or automatic shut-down of the process will occur when tolerance limits are violated. Data will be selectively aggregated for statistical analyses and corporate-wide assessment of quality performance via global communication networks. Within-plant and among-plant communications technology will be upgraded to the latest state of the art, and industry-wide bar-coding standards, scheduling protocols, and production monitoring will be used for global management of multinational production facilities. In addition to latest communication technology, the use of programmable robots for the assembly of pumps, engines, filters, and motors will expand in domestic component plants because of the high rate of assembly labor and the increased potential for improvement of capital utilization through second-shift operations using reduced manning. Limited-function pick-and-place robots will become an integral part of machining centers so that localized machine loading and unloading will be performed without operator assistance.

Domestic Manufacturing Under the Multinational Scenario

Except for the preceeding developments, the prospects for future domestic automotive facilities under the multinational scenario are likely to be bleak. With shrinking demand and depressed prices for automobiles, U.S. firms will be unable to justify capital for the renovation of their facilities. All but the most efficient

plants will close, with no alternative use in sight. In time, due to the absence of capital for product and process innovation in the U.S., the domestic contribution to international automotive technology will decline; the leadership in that technology will migrate to off-shore facilities; and new generations of U.S. engineers will no longer see the industry as creative or challenging. United States manufacturers will seek to prolong the life of existing auto designs and domestic facilities with minimal investment in modernization. In this scenario the survival of the U.S. firms will depend upon their ability to manage multinational production and marketing of "world-car" designs, using production facilities located wherever the necessary low-cost skills can be obtained. Domestic production facilities will diminish in size and capacity and slowly age, a situation similar to what has already happened with the U.S. steel industry, the U.S. ship-building industry, the British domestic auto industry, and the taxicab production of Checker Motor Co.

Under this scenario the surviving domestic automotive-assembly plants will be a subset of the existing plants. Since most of the innovation capital of U.S. OEMs will be committed to off-shore facilities, domestic assembly-plant technology will basically resemble today's assembly-plant technology. Plants will tend to focus on the production of fewer platforms and body types as each concentrates on the national market for specialty vehicles. The number of accessories and options may be high, with concomitant requirements of space and investment for inventory. Manufacturers will try to extend the life of current vehicle designs rather than to emphasize innovative technology. Thus, under this scenario, material usage will follow existing patterns. Steel will continue to constitute the largest proportion of specialty-vehicle weight, and plastics, aluminum, and cast iron will share equally most of the remaining weight.

Although each specialty line would have unique assembly requirements (four-wheel-drive Jeeps compared to rear-wheel-drive Continental compared to performance-car Corvette), body shops will continue the present use of unitized body assemblies, employing robotic spot welding and automatic body-clamping fixtures for dimensional control in final welding. Some frame underbody designs will persist, especially for heavy-duty vehicle applications, and the use of in-process buffer inventory between body operations will tend to increase as equipment ages and downtime failures increase.

Paint departments will continue the trend toward phosphate cleanup, electrodeposition primer coating, electrostatic application of corrosion-resistant paint and high-solid enamels supplemented by sealers, antirust wax, and underbody deadeners. Manual application of electrostatic paint will be replaced by robotic paint-spray systems, and the trim and final-assembly lines will be synchronously paced by continuously moving conveyor systems.

Production rates of assembly plants will tend to be beneath today's average (fifty-five cars per hour) because of the nature of the product and the need to

achieve quality. Because each assembly line will focus on a specific vehicle line, the model mix will be simpler, and line balances and release sequences, which provide minimal idle time and station interference among workers, will be easier to achieve. Schedule instabilities will be a problem, however, since orders will fluctuate and each plant will be dedicated to a single specialty line; alternative products cannot quickly fill idle capacity, nor can additional capacity be provided quickly if demand exceeds expectations.

Assembly plants will operate in currently existing facilities since capital will be limited. Since drastic structural modification to permit effective just-in-time delivery by suppliers is unlikely, five- to nine-day inventories of feeder parts and components will be maintained within final-assembly plants. These stocks, however, will be on consignment so that inventory costs will be only indirectly an expense to the OEM. Thus, the main immediate detriment of part and component inventories will be the cost of hourly labor to handle stock from receiving to assembly stations. Given the instability of production orders for specialty lines, however, these inventories will help smooth plant work-load fluctuations. Surplus plant space will be available.

In order to achieve the reduction in capacity that this scenario projects, domestic manufacturers will tend to retain the most efficient plants for each specialized line. There may be instances in which these plants and their suppliers will be chosen because of the benefits of their mutual proximity, but in general, delivery-cost savings through just-in-time concepts will not be dominant. For example, many of the components will be economically purchased from off-shore suppliers or plants, which, however, may be subsidiaries of U.S. firms.

The continuing erosion of the domestic auto industry under this scenario will seriously reduce the membership of U.S. hourly workers in labor organizations. However, the history of other declining industries suggests that the remaining membership may become more militant and less inclined to relinquish wages and benefits attained during halcyon eras. Thus, hourly wage rates and benefits for auto workers will continue to exceed the national average; quality circles and other worker-participation programs will not become the norm; and job classifications will not become significantly broader or more flexible.

As a consequence of the production of engine, transmission, and other component parts at off-shore, low-cost locations, those components that are produced in domestic plants will tend to be low-volume specialty items for the domestic market. The restricted capital resources of the domestic manufacturers will lead them to use high hurdle rates and short payback criteria for evaluating investments. Investments in flexible machining systems will decrease in favor of low-priced, standard, numerically controlled machining centers. Following current trends in international machine-tool markets, Japanese machining centers will be marketed in the U.S. at lower prices than their U.S. or European

equivalents. Thus, like domestic auto suppliers, the U.S. machine-tool industry will also face decreasing sales to domestic plants.

This scenario also projects substantial excess capacity in body-stamping plants. Given the poor prospects for the domestic industry, it is difficult to foresee any significant technological improvements in stamping-plant processes or management. In fact, the excess unused stamping capacity may permit many existing press lines to be dedicated to one product, thus achieving schedule flexibility without the discipline and development required of quick die changes. Given the continuing absence of trade barriers under this scenario, foreign manufacturers may succeed in supplying a major portion of the steel to domestic auto manufacturers.

Domestic Manufacturing Under the Sheltered Scenario

The long-term response of the U.S.-owned domestic manufacturers to the sheltered scenario may be characterized as "incremental innovation," using existing facilities and product lines. Individual platform volumes will remain large, as will the array of configurations for the internal-combustion engine, but the rate of change in product platforms will decrease in the 1990s after mileage and environmental requirements are achieved. Because of the tendency to lengthen the time between platform changes, U.S.-owned domestic assembly plants will change slowly, continuing existing trends. Both product design and manufacturing methods will be modified through incremental refinement in order to achieve cost reduction, rather than through radical departures from previous practice. Domestic research and development of new technology will be secondary to the application of ideas developed abroad.

A number of factors will contribute to the trend toward larger floor-space requirements in domestic assembly plants. Plant floor area and the number of assembly-line workers will be increased to achieve higher final-assembly production rates, which will plateau at about seventy vehicles per hour due, in part, to quality degradation at higher rates. If investments in body assembly or painting equipment dominate capital expenditures for assembly plants, several trim or final-assembly lines in parallel may become more commonplace. The number of accessories and options available to the purchaser will continue to increase beyond the additions typical of the last decade: air conditioning (manual versus automatic temperature control); seat types (bench, bucket, reclining, disappearing); radio options (AM/FM, cassette tape deck); color/trim combinations, stripes, and moldings; manual or remote controls, power-assist brakes, steering; computer options; and interior colors and fabrics (cloth, vinyl, leather). These options will increase the space requirements for active and reserve storage and the picking, material handling, and assembly complexity but will decrease the prospects of quality.

Increased automation and quality levels also tend to increase floor-space requirements. Improvements in door fits require more and larger fixtures; improvements in finishes require additional or longer-cycle ovens, dip tanks, and spray booths, as well as auxiliary power facilities for high-voltage electrostatic painting. More rigorous EPA environmental requirements result in higher and wider spray-booth designs with improved air supply and filtration capacity. The reduction of material thickness and material substitution to achieve weight savings also increases the variety of parts and welds and the complexity of vehicle assembly because of additional brackets and reinforcements. Today's floor-mounted robot typically requires at least as much, and often up to twice as much, floor area as the human operator, partly because space must be available for maintenance. Buffer space will be available to permit portions of the plant to continue operation when automatic equipment fails.

The tendency toward a larger assembly-plant size will be offset in part by the increased attention to doing the job right the first time and by the reduction in space used for active and reserve inventories. Thus, the number of cells for repair after final water test, the length of the conveyors for final-assembly, paint, and metal repair, the length of the bake-oven conveyors, and the capacity of the trim- and final-assembly selectivity-storage conveyor will shrink as fewer units must be sidetracked for repair. Furthermore, plants will learn to minimize the use of inventories to smooth disruptions due to equipment failure, fluctuating work loads arising from unstable schedules, and absenteeism.

Trim and final assembly will continue to be performed on a conveyorized production line of sequential work stations. With fewer platforms but a high variety of options, assembly will increasingly use nonsynchronous or unpaced movement between work stations, which will permit assemblies to remain stationary during the work cycle and allow the use of fixed-position robots to place some parts and components into the assembly. Furthermore, workers will not be pulled out of their stations for long-cycle operations. Assembly quality will improve and worker satisfaction will increase.

In this scenario, domestic production capacity would be provided by a mix of U.S. and foreign owners. U.S. owners would adapt the appropriate management techniques of competing facilities and ultimately achieve profitability and survival in the domestic market for standard cars. However, in the near term the U.S. owners would be handicapped in their ability to aggressively compete with the foreign-owned domestic specialty vehicles because of capital shortages and the limited adaptability of their older physical plants to the production of radically new products.

Domestic engine, transmission, and component plants of U.S. ownership that continue to operate under this scenario will be similar to improved plants of today. Transfer-line technology will continue to dominate in machining plants

since the variety of engines produced in the U.S. will be small and typical volumes will exceed 300,000 per year. Furthermore, transfer-line technology and management will continue to improve. On-line monitoring and diagnosis of operations will improve tool replacement and preventive maintenance and reduce machine downtime. In-process inventories will be reduced. Controls will be provided with standardized interfaces to communication networks so that operations can be monitored on a plant-wide basis. Except for shipping and receiving, forklifts will virtually disappear, being replaced by continuous-path high-volume conveyor systems. Some machining stations in the transfer lines will be provided with numerical control so that a limited number of dimensional variations of the same part can be sequenced in random order through the line. The amount of machining required per part will be reduced due to advances in near-net-shape technology. Programmable robots or manipulators will be commonplace methods for integrating systems of transfer lines into computer-controlled plants. Engine and transmission assembly lines will be highly automated, with only a few human assemblers remaining.

In time, the productivity of domestic assembly, engine, and transmission plants will increase and become profitable. Thus, in-process inventories will decrease, and capacity utilization will improve as management and operators become more proficient in equipment maintenance. More unmanned operations will be feasible, and automated sensing and monitoring of process output will permit achievement of high levels of quality with minimum scrap and rework.

The number of domestic hourly workers will decrease, but not as drastically as in the multinational scenario. As production rates stabilize, job security will increase and pay scales will remain high. Although union-management relations will retain their adversarial bargaining postures, training programs will be widespread. Skilled workers will dominate the component plants, and there will be many multiskill job classifications.

Stamping plants will benefit from continuing improvement in effectiveness as they learn quick-die-change technology and improve their internal scheduling and capital utilization. However, reduction in domestic demand will lead to the shut down of many U.S.-owned stamping plants or to the marketing of their capacity to foreign-owned domestic auto plants.

Just-in-time management will be used in a limited number of plants and within a few plant complexes. However, the national dispersion of existing final assembly and supplier plants for standard domestic models will continue to minimize the achievement of significant benefits.

Domestic Manufacturing Under the Technology-Driven Scenario

Because of the variety of specialty-car sizes, diverse engine options and fuel sources, and radically different structural materials, no single manufacturing process can be selected to serve as the generic model for automotive manufacturing in the technology-driven scenario. Increasing attention to composite metals, structural plastics, ceramic and plastic engines, and electronics is expected. A high premium on quality, precision, short-term flexibility to accommodate to rapid changes in manufacturing product mix, and long-term flexibility to minimize cost and disruption in product innovation will be needed.

Many existing domestic automotive plants will not adapt to the new products and manufacturing technologies because of limited ceiling clearances (eighteen feet), single floor configurations, inadequate services and waste-treatment facilities, or structural incompatibility to accommodate a different process technology (structural plastic molding rather than body welding). As a consequence, completely new concepts of plants for specialty automobiles may appear. The traditional pattern of body shop, paint, trim, and final assembly may no longer characterize the automotive assembly plant. Stamping plants may give way to plastic-molding plants, and engine casting, machining, and assembly may be replaced by battery and electric-motor fabrication or hybrid fuel cell/flywheel technology. Each new specialty configuration may require a new manufacturing process for efficient fabrication and assembly, but the specifics of many of the required production processes have yet to be identified. Since this scenario suggests a technological response to a rapidly changing market, some similarity to the aerospace and electronics industries is present. Embryonic instances of this technology are also found in some auto manufacturing today.

Given the dynamic rate of change in product design and process technology projected for this scenario, a prime criterion in the design of production facilities must be the ability to respond to change. Plants must be able to accommodate easily to shifts in the demand mix for an existing production rate, and to changes in the work load even if the mix is relatively unchanged. The introduction of new parts and components, or the elimination of existing parts, should not seriously disrupt the ongoing operations. One method for dealing with these changes in part mix or part family is to lay out the manufacturing process with alternate routes for parts. The ability to reroute parts also permits operations to continue when a process breaks down.

In final assembly the vehicle-assembly-carrier concept pioneered by Volvo's Kalmar Plant[2] provides the desired flexibility. Carriers serve as mobile work

2. Stefan Aguren, Reine Hansson, and K.G. Karlsson, *The Volvo Kalmar Plant: The Impact of New Design on Work Organization* (Stockholm: Rationalization Council/Swedish Trade Union Confederation, 1976).

platforms as the vehicle body moves through trim and, on a slightly modified carrier, through final assembly. The customized carriers are automatically guided vehicles (AGV), individually battery powered and computer controlled through in-floor wiring or local manual override. In normal operation, the carriers move from work group to work group as required by a particular assembly sequence. Some work groups, of perhaps twenty assemblers each, have considerable latitude in their choice of work methods, ranging from the conventionally paced assembly line to teams working off-line on one vehicle at a time at a fixed work station.

The flexibility of the carrier to bypass some work groups or extend the work cycle in other groups permits wide mix, process, and volume flexibility not available in assembly lines with synchronous conveyors. In some instances, kits of parts may be assembled at off-line storage areas from miniretrievers or carousel storage systems and sent to a work group on a designated carrier.

The requirements for active stock at each work group are complicated by the changing component designs and demand mix. In order to accommodate the demands for change, the ideal assembly plant in this scenario will have interior clear heights of at least sixty feet in the trim and final-assembly areas. This high-cube space permits use of high-rise, automated storage and retriever systems (AS/R) for both active and reserve materials and in-process material. Physically, both active and reserve materials are stored in the same AS/R. However, the storage slots on the side of the racks located within reach of the various work groups are designated for active storage; the slots inaccessible to the work group are used for reserve storage. The AS/R, operating behind the racks, lifts pallets of parts into reserve storage from AGVs loaded at receiving, exchanges pallets of parts between reserve storage and specified active storage slots at a work group as demand calls for a new mix of accessories, replenishes active storage as its stock becomes depleted, and places emptied pallets on AGVs for delivery to shipping. All of these functions are executed under computer control, based upon the broadcast production schedule, the routing of the carrier to work groups, and the available inventory levels. Forklift operators are not required for feeding active stock used on the line.

In some work groups, general- or special-purpose robots can be used to retrieve parts from pallets and position them for assembly. This capability becomes increasingly valuable as product engineers redesign vehicles for ease of assembly. Thus, concepts for modularizing bodies to facilitate trim and final assembly will be devised to reduce or eliminate manual tasks such as installing headliners or feeding wire harness and tubing through the firewall. Furthermore, if the rack faces are parallel, component subassembly groups can be located on mezzanines between the racks. For example, instrument-panel buildup may be located on a mezzanine with its own active storage. Each completed instrument panel is placed onto a pallet by a robot. When full, this pallet indexes into an

adjacent slot in the rack. Depending on the location of the assembly work group that installs the instrument panels, the pallet either descends directly to the trim assembly station on a vertical conveyor contained within the storage racks or is carried by the AS/R to the appropriate active or reserve storage slot for panels. Part, component, and assembly movement throughout trim and final assembly are vertical through the racks as well as horizontal on automated carriers; inventory is delivered exactly when and where needed. When the building cube is utilized not only for compact rack storage but also for assembly work groups on mezzanines, land area required for assembly functions and storage is reduced, hourly labor utilized for material handling is minimized, inventory is under computer control at all times, and substantial capability to adapt to changes in part and process design is obtained. The elements of this concept can be seen in General Electric Company's Appliance Park East plant in Columbia, Maryland, and in Fujitsu Fanuc's new motor plant in Japan.

In speculating about future assembly plants under this scenario, a detailed description of paint and body fabrication must be omitted. In some specialty lines, today's paint and body fabrication will be replaced by structural-plastic modules. Not only will automated body welding be minimized, but many of the primer, corrosion-resistant, antirust coatings and underbody deadeners will be unnecessary. Painting, if any, may be largely for appearance only. In those specialty lines where bodies continue to be made from metal formings, automation of body welding and assembly will continue the trends in today's plants. Because of the smaller model volumes, most blanking and stamping operations will be located in the same complex as the final-assembly plant, thus eliminating material handling and shipping costs. To achieve maximum model flexibility, quick-die-change technology will be the norm.

In the fabrication and assembly of components and parts (such as power sources and transmissions), flexible production will be needed for the high-technology competition of specialty vehicles. Many of the concepts described as part of final assembly will be equally appropriate for power-source and other component assembly. In general, because component assemblies are smaller than the final vehicle, the number of layout and material-handling choices for the assembly of components will increase. For example, the assembly carriers may be replaced by automatically guided vehicles that are used only to move assemblies from one work station to the next. At each work station the assembly is automatically off-loaded from the vehicle onto a fixed work platform or bench. Since the vehicle itself does not serve as a work platform, it is immediately free to continue its tasks. Thus, fewer vehicles will be required.

Because parts and components will be smaller, some assemblies will be completed at one work platform, thus minimizing the number of moves required. Alternatively, for small components (circuit boards, motors) assembly stations

may be fed by kits of parts in tote trays dispatched under computer control on a belt conveyor from central storage. When the tote arrives at the designated work station, it is diverted to an input buffer until the assembler finishes the current component. This component is placed in an available empty tote, deposited on a return belt conveyor, and delivered to the storage location for central stock. These conveyor systems, called "transporters," are now widely used in the electronics industry, where they provide assembly flexibility yet maintain control of work loads and work-in-process inventories.

In this scenario the machining and fabrication of parts will be executed in the manufacturing systems of machining centers and automated handling. The National Machine Tool Builders' Association defines a machining center as a metal-cutting machine that performs drilling, boring, reaming, tapping, milling (but not turning) and incorporates numerical computer control and automatic tool changes. At greater cost, additional capability can be obtained from multiple machining heads mounted radially on a turret, known as a "head-indexing" machining center. "Head-changing" machining centers are provided with computer-controlled automatic systems for swapping machining heads between the work station and storage. In principle, an unlimited variety of multiple drill heads could be stored to meet the hole-pattern requirements of a wide variety of parts. A machining center that includes numerical control, an automatic tool changer and tool magazine, automation for loading and unloading parts, and a magazine for storing part fixtures or pallets is called a "flexible module." The loading/unloading mechanism may be one or more general-purpose robots or pallet/fixtures indexing onto work positions. When several flexible modules are combined into one system with a single load/unload station and several machining centers are linked by roller conveyors, shuttle conveyor lines, or tow carts all under computer control, the term "flexible machining system" (FMS) is commonly used. When the FMS is linked to automated storage and includes functions such as assembly or forming, it is called a flexible or integrated manufacturing system. For this scenario flexible manufacturing systems will be widely adapted.

Like transfer lines, FMSs must be specially configured to the family of parts that are to be manufactured. Thus, the machining heads, tooling, fixturing and pallets, NC programs, layout, handling hardware, and number and mix of machining centers in the system are all dependent on the processing requirements. More importantly, the monitoring and controlling computer software must be tailored to the specific machining center for control, material-handling guidance, failure diagnostics, start-up and shut-down procedures, quality monitoring, operating status, and scheduling protocols. It must also provide reports for management needs and plant communication interfaces. The experience in system software design possessed by the U.S. FMS manufacturers will provide them with an edge in the domestic market for the immediate future.

Since only a limited number of integrated manufacturing systems will be purchased in any year and a large capital investment will be required ($10 million or more), standardized designs seem improbable. One of the distinct advantages of flexible systems is their ability to be extended and modified as process requirements change. This is in sharp contrast to transfer-line technology, which possesses little salvage value if process requirements change. Thus, investment criteria that reflect the different capabilities of the two technologies need to be used. A payback-period criterion, for example, might completely overlook the savings of reprogramming a flexible system for a product change in three years, compared to the extensive reinvestment required to replace a transfer line. In this scenario, therefore, decisions concerning manufacturing facilities will reveal the extent of a corporation's dedication to high rates of technological change as a marketing strategy.

Investment decisions in plant and machine tools of this magnitude and complexity, with a major implication for corporate profitability, will use the most advanced planning tools. Financial-planning models will be tied to production simulations to assess the profit implications of alternative factory configurations. Computer simulation will be the standard analytic tool for assessing the capacity and ability of proposed systems to respond to product-mix changes. Dynamic displays on CRTs of simulated product flow and bottlenecks will be commonplace for planning capacity changes and projecting the impact of alternative schedules and work loads. Process engineers will use group technology and part-classification systems that have access to part, component, and product CAD/CAM data bases. Kanban scheduling methods will be found inappropriate because of the rapidly changing mix and product lines. Instead, computerized-scheduling systems developed from planning manufacturing resources, with master scheduling and on-line shop-floor control, will be employed.

In view of the rapidly changing technology in this scenario, highly dependable, dedicated, and skilled employees will be essential. Good communication within the organization will be needed to resolve quality issues and equipment failures. Management will find it necessary to train workers continuously in new manufacturing methods and computer technology. Hourly workers will participate in management of the production facilities from re-layout to maintenance decisions. Skill and pay levels will be high, making employee retention an important economic consideration. A smaller percent of the hourly workers will be hands-on employees since many of the operations will be unattended. For example, a flexible machining system may be manned during the day shift by a system loader/unloader, several maintenance workers, one computer operator, a scheduler, an NC programmer, and a group leader. Worker recreational amenities and plant environments will be given high priority. Flex time, group incentives, investment options, lifetime employment, and fringes will be generous. Union organizations will be supportive of the need for employee productivity and

reduced work rules and will tend to exhibit a strong corporate loyalty. However, those corporations that find themselves lagging in the technological and market competition will quickly lose their workers because of the demand for their skills.

Epilogue

We have taken three scenarios for the future domestic automobile industry and postulated their implications for future automotive factories circa 2000. Table 3 provides a comparative summary of our observations. Our emphasis has been on the technology of the factory rather than the social considerations and issues. Since most of the technical pieces for each of the scenarios is already in place somewhere, we have merely composed these pieces into plausible factory systems. The reality may prove to be more of a composite of the scenarios rather than any single scenario. Even more likely is that the projections will prove to be too conservative and that unforeseen technological breakthroughs will occur because of the many new efforts being initiated toward improvement of manufacturing technology. Regional centers for robotics, new university instructional and research programs in manufacturing engineering, and industrial efforts to promote CAD/CAM and to market "factories with a future" reflect a resurgence of attention to the factory and its operations.

The introduction of new process technology and the construction of modern manufacturing plants regrettably will move slower than we may wish because of the risk, the large amounts of capital, and the technological development and learning that is required. In the interim, the domestic automotive industry must strive to improve its management-based manufacturing skills, so that the existing system will be as efficient as possible, and to improve its communications, so that the U.S. domestic worker may retain pride in his workmanship. The ability of today's automotive management to improve communications networks among its employees will certainly affect the viability of the domestic industry and the plausibility of our speculations.

TABLE 1: THREE SCENARIOS FOR THE FUTURE EVOLUTION OF THE U.S. AUTO INDUSTRY

Scenario	*Assumptions*	*Market Implications*	*Plant Implications*
Multi-National Domestic Industry	Japanese begin exploiting landed cost advantage in U.S. World car designs lead to worldwide sourcing, reductions in model change frequency, and standard designs.	U.S. OEMs shift production to low-cost labor regions outside U.S. Foreign penetration of U.S. market increases mass merchandising through Sears, K-Mart. 65% of cars sold in U.S. are imported. 35% produced in U.S. are specialty vehicles. Prices are lower.	Greatly reduced U.S. assembly and fabrication capacity. Technology innovations in U.S. plants are limited due to lack of capital and noncompetitive costs. U.S. OEMs lose auto-production technology innovation. European and Japanese machine tools dominate. Multinational auto-management skills are critical.
Sheltered Industry	U.S. loses market share; concentrates on most popular lines. Japanese build production capacity in U.S. to avert trading threats. Japanese improve products and develop specialty lines (small cars). Price competition increases due to excess capacity; margins drop. U.S. and Japanese address worldwide markets. Japanese source U.S. plants from Japan.	Domestic industry is mixture of U.S. and Japanese owned. U.S. share of auto value added declines, but industry remains viable. U.S. world auto leadership weakened. U.S. auto-supply industry declines.	Incremental innovation of existing facilities and products. Reduction in product variation. Emphasis on cost reduction, inhibited by existing plant. Domestic industry is smaller in number of plants and employees. Nonsynchronous assembly plants. Transfer-line machining technology.
Technology-Driven Industry	Fuel costs escalate and new technology drives up the rate of product change. Standard car lines move offshore to benefit from low-cost volume production. Car designs become more innovative with specialized producers (electric cars; commuter cars, muscle cars, etc.) catering to local needs. Technology becomes market wedge.	Cars become more specialized and performance oriented. Local content of U.S. market stays high but value added decreases since standard volume lines go off-shore. Multicar families increase.	New assembly and fabrication technologies emerge to deal with rapid design and technology innovations. New assembly plants are smaller with nonsynchronous stations and mixed model capability. Fabrication plants emphasize use of U.S. systems technology in flexible machining systems.

TABLE 2: FINAL-ASSEMBLY SOURCES FOR DOMESTIC AUTOMOTIVE MARKETS UNDER THREE U.S. AUTO-MARKET SCENARIOS

Scenario	*U.S.-Owned Plants*		*Foreign-Owned Plants*	
	Domestic	*Off-Shore*	*Domestic*	*Off-Shore*
Multi-National Domestic Industry	35% of market in specialty cars tailored to U.S.	Some world-car lines imported to U.S.	—negligible—	Some world-car lines imported to U.S.
Sheltered Industry	50-60% of market in standard and luxury U.S. lines.	World-car lines for off-shore markets.	Small and specialty cars for U.S. markets.	World-car lines for off-shore markets.
Technology-Driven Industry	Technology-driven specialty cars for U.S. markets.	Standard cars imported to U.S.	—negligible—	Technology-driven and specialty cars for off-shore markets.

TABLE 3: DOMESTIC AUTO-MANUFACTURING TECHNOLOGIES CIRCA 2000 A.D.: COMPARATIVE SUMMARY OF MAJOR DIFFERENCES IN THE THREE SCENARIOS

	Multinational	*Sheltered*	*Technology-Driven*
Assembly Plants			
Product Demand	Few platforms, many options. Specialty cars.	Few platforms, many options. Standard cars (slow change).	Many platforms, short life. Frequent mix change.
Final Lines	Synchronous, 55 cars/hour conveyor. One floor. Schedules unstable. High inventories, J.I.T. minimal.	Nonsynchronous, 70 cars/hour conveyor. One floor. Schedules stable. Lower inventories, some J.I.T.	Variable-routing assembly carriers. Multifloor. Schedules fluctuate. Lower inventories, AS/Rs.
Management	Multinational manufacturing management.	Incremental cost-reduction management.	Innovation management.
Paint	Current paint systems.	Improved paint systems (robotized).	Minimal paint on plastics.
Body and Stamping			
Capacity	Excess idle. Dedicated lines.	Excess sold to foreign plants. Quick die change.	Move to assembly plants. Reduced metal stamping due to plastics.
Component and Engine	Mostly off-shore. Japanese NC machining centers. Low volume only. High hurdle and short payback criteria.	High volumes remain. Transfer lines. Robotics for assembly and pick place.	Variety of types. FMSs with AGVs. Transporters.
Labor	Declining production workers. High wage rates.	Drop in number of workers. High wages, job security.	High skills. Retraining, worker participation.

THE AUTOMOBILES OF THE FUTURE

Teruo Maeda

Introduction

Today, the auto industry faces many difficulties. Although some came from the temporary slump in the world economy, as everyone recognizes, others originated from the mishandling of basic changes in customer demands. Customers who once wanted a large luxury car now want an economical, well-built, multipurpose car or a specialty car. What will they want next?

Consumer trends interrelate with the changes in the societal environment. The need for fuel economy makes the customer want to buy smaller cars. Furthermore, consumer demands are often influenced by technological developments. For example, the turbocharger reminded the customer that engine performance is an essential ingredient for an automobile. This relationship between changes in consumer demands, societal changes, and technological development is not easily formulated. The auto industry also has an *inner* impact caused by in-house human resources and management. Today, quality control, robotics, and other often-used concepts are deeply rooted in these in-house elements. All these *environmental changes* have some impact on the auto industry as a whole.

With these thoughts in mind, I will give a brief history of the auto industry, with an analysis of technological development. I will then proceed to a discussion of the future automobile designed to meet the needs of tomorrow's environment, from the perspective of both the external and internal changes that may occur.

Automobile Development in the Past

By the beginning of this century, innovative technology had given birth to the basic configuration of automobiles—engine, transmission, steering, four

Teruo Maeda is General Manager, Product Development Office, Nissan Motor Company, Ltd.

wheels, chassis, seats, and their combinations. Although the fundamentals of that configuration have changed little since 1900, technological developments have changed the automobile and its role in society. In the next decade, until 1910, the technology was developed to make this new machine more competitive with other means of transportation. These efforts, made by people with an *entrepreneurial* spirit, created the demand for personally manageable powered vehicles. Then, due to the effort to cut the cost of automobiles by introducing the assembly-line system, through the 1920s the automobile started to become less exclusive. In the 1930s the reliability and endurance of automobiles were improved, and the automobile could now be counted on as a major household durable good.

After World War II, as world trade expanded and the standard of living for the majority of people rose, the automobile became popular, and the customer began to dictate the nature of the product. In the 1950s the auto industry responded by supplying upgraded products with accessories, such as power windows, power steering, *power everything.* In the next decade, a much more affluent society demanded diversified model lines with a variety of options. By the end of the 1960s the automobile had become the symbol of the throw-away society in the United States. It ceased to be a product of a society dedicated to preservation and accustomed to high-quality long-lasting goods.

The 1970s was the era of socialization. Exhaust emission, safety, and fuel economy became societal concerns and were regulated by the government. A great deal of effort was expended to develop the technology to incorporate these new requirements into customer-acceptable vehicles. All of these technological developments, arising from different social conditions, illustrate the relationship between the technological development of the automobile and changing societal demands.

Types of Technological Development

Technological development can be generally categorized as follows. First, there is *inventive technology.* As is the case for most merchandise, inventive technology brings the product (in this case, the automobile) into the world marketplace. The next inventive breakthrough in the auto industry was assembly-line production, which was followed by the uni-body structure. Of course, this inventive technology did not arise by itself. Some reliable components of the automobile, especially reliable engines, had to already exist before the first car was ever introduced; the interchangeability of parts and inventory-control techniques had to be established prior to the adoption of assembly lines; and certainly, the aeronautic technology of a monocoque fuselage served as a model to hasten the adoption of the unitized body.

Second, there is *improvement technology.* After the basic configuration of the automobile was established, most of the industry's efforts were devoted to improvement technology. Advances in performance, decreases in manufacturing costs, and improvements in quality and reliability depended on this type of technology.

Third, there is *adoptive technology.* The more an industry matures, the less inventive technology it creates. It is apparent that the automobile industry, now mature, has entered into the stage where it adopts electronics, materials, and other technology from other younger industries.

The Nature of Technological Development

Technological development should respond to consumer demand, but it sometimes also creates demand. When this interaction between demand and technology does not function properly, both the auto industry and the customer are unhappy and often complain to each other. Societal needs, such as exhaust-emission control, safety, or fuel economy, although their necessary levels are sometimes controversial, often induce customers to alter their demands. Thus, the industry must always be aware of these demands, since only consumers, never regulations or the energy crunch, buy automobiles.

In a broad sense, the term "demand" can be sorted into two categories. On the one hand, demand comes from external environmental changes, such as the above-mentioned regulations. Along with economic conditions, demography and the customer's personal desires, derived from psychographics and value consciousness, should be taken into consideration. On the other hand, demand is based on changes within the industry in areas such as human-resource management and technology. This category includes the motivational force inside business to create products that may make the external environment better.

Future Automobiles Derived from External Change

Informational Society

An informational society is one in which everyone shares the same pool of information and enjoys the daily use of informational machines, such as the telephone, the facsimile, the video deck, and the personal computer. Some people are almost addicted to information and withdraw if they are isolated from it; their private space must have some informational devices. In reaction to this trend, the auto industry has already begun to install some informational devices into automobiles: the electronic message panel, the drive computer, and the drive guide for navigation. At present, the accuracy of these devices is not always adequate,

and some are not yet beyond the level of gadgets. Verbal communication between the driver and car is, however, a most promising field. For example, when the light remains on, the car says, "Please turn off the light." The driver follows the direction, and the system responds, "Thank you." When the driver says, "Open the window," the car identifies the driver's voice pattern, responds either "Yes, sir" or "Yes, ma'am," and then opens it. And since the driver employs all of his senses, except taste, to manage the automobile, the driver-vehicle system will become more intelligent if the industry can develop a system that uses the eye in tandem with the voice as another one of the actuators to the automobile. For example, on a rainy night, if the driver stares at the dark edge of the road in order to avoid bicycle riders, the headlight would automatically focus on that area.

Energy Situation

The worldwide crude-oil price continually fluctuates, and there are many unpredictable factors that affect it. However, in the long run the price of energy will increase at a faster rate than the price of other commodities. In the not-too-distant future, the price of gasoline derived from crude oil will be higher than that for alternative fuels, and gasoline or methanol derived from coal or natural gas will probably offer the most potential for future automobile usage. The auto industry should pay further attention to this progress. If a shortage of petroleum arises in the future, it should be ready to employ alternative fuels.

On the other hand, fuel economy is always subject to improvement. In order to operate the engine and power-train combination more efficiently, electronic controls will be applied to a greater extent. Although the aerodynamic concept has already become a buzz word, there still remains much that can be done by the stylist. A lighter automobile is the ever-present target, but material substitution always presents a cost trade-off: How much the customer pays for an increase of 0.1 MPG and the resultant savings at the gas pump is the key point in the discussion. Needless to say, the shell-structure theory states that the lightest structure per unit volume is a sphere. The car of the future may have a round body with an upright seating position. The *religion* of the low-profiled, square body style no longer prevails. I can tolerate sitting in a Pan Am Clipper seat on a nonstop flight from Tokyo to New York for thirteen hours, watching two movies and having two meals and a couple of drinks, but no car with a current low-profiled body style can offer that kind of comfort.

Diversification of Value Consciousness

The so-called "New Value Age" has passed; a different and still uncertain age awaits. The only certain facts are that peoples' value consciousness has

diversified; their life-style varies; and they have become knowledgeable customers. They will never believe the propaganda from manufacturers. From those who respect the traditional family formation to those who practice the single life-style, variety is appreciated in this advanced, open society. The automobile industry should respond individually to what these different customers want.

A small, stylish multipurpose vehicle with lively performance might be necessary for a young business woman; a comfortable and gorgeous but fuel-efficient and easily driveable car might be necessary for a retired couple. With these alternative customer demands, the auto industry must produce diverse car lines for this segmented market and yet maintain its ability to use the advantage of mass production. In any event, it must insure that its products attract customers. Otherwise, even when the recession is over, the level of demand will never completely recover.

Traffic Efficiency and Automobile Control

Advanced traffic-control systems, using a guidance system, could increase traffic capacity and the ease of driving and decrease the accident rate, exhaust pollution, and noise by ensuring a smooth flow of traffic. This system would be based on an electromechanical linkage, which is more reliable than humans. A drowsiness control could compensate for the weakness of the human-mechanical linkage, and a radar brake would appear as a component of the total traffic-control system.

Research on the fully automated guidance system has been going on for many years. In this system, steering is controlled by a signal from a cable buried in the road so that an automobile can be driven from Point A to Point B without any action by the driver. Since automobile technology and computer logic has advanced rapidly, in the near future in some areas, probably in a highly congested zone of an urban area, this guidance system would pay for the cost of its installation. In the transition stages of such a system, if a man-controlled vehicle hit a computer-controlled vehicle, the man would be at fault provided that the computer was functioning properly.

Future Automobiles Derived from Internal Change

Utmost Utilization of Human Resources

The utilization of human resources in all fields of the auto industry, from R&D to manufacturing, sales, and servicing, means obtaining the employees' cooperation by tapping their maximum abilities and efforts. In the workplace, if a machine can perform the task of an employee, that job is not important enough to

be done by a human being. If an employee cannot produce something without making mistakes, a machine should be considered as a substitute for him, and he should be taught to manage the machine. Computer-aided design, automated assembly lines with robotics, and self-diagnostic systems in the service shops are some good examples.

If the industry transferred the application of the human resource from a later to an earlier stage in the product cycle, it could increase the productivity and technical level of the entire industry. The industry could then, for example, design a maintenance-free automobile, and the customer would get a more sophisticated product that does not require regular service. The displaced service personnel could be taught new skills. Through these kinds of adjustments, the technological level of the entire industry would rise.

Global Scale Movement

It has been a long time since the auto industry became a worldwide business. Today, industry leaders are trying to find the right resources worldwide in order to build their automobiles more efficiently, and the design and development can only be done in those countries where a company can utilize large amounts of highly educated human resources. This design and development requires a dense process of information handling, and the information consists of much data that are obtained worldwide and are treated by many concerned persons. Throughout this process, past experience, corporate philosophy, enhancement of employees' morale, and other elements must not be neglected. Even a top M.B.A. graduate who performed an excellent job in his classroom might not be qualified to participate in this work because of his lack of experience.

Manufacturing has two aspects, depending on the nature of the products. Units such as engines, transmissions, and chassis components can be manufactured and transported to a distant place easily. For this reason, their production can be centralized. However, bodies and trims are affected by local tastes, and their transportation is not easy. Thus, final assembly is becoming *globally localized*, which necessitates more industry concern for worldwide interchangeability at each level of production and the grade differentiation of automobiles.

Changing the Nature of the Auto Industry

As I mentioned before, from the time when the auto industry applied innovative technology, it has been consistent with the once-established configuration of automobiles. But, in producing the automobile, it is possible to adopt techniques from other industries. For instance, during the war the ship-building industry introduced the block-building technique. This technique not only made the

production of variations among ships easier and the modification or repair of ships convenient but also shortened the total man hours and the building period necessary to complete production. If the auto industry adopted this kind of *modular* manufacturing system with the use of fully automated robots, it could respond to customer's requirements with fewer difficulties and service its products easily by changing a defective module or rebuilding the module at central shops. But if the computer mistakenly assigns a part, there could be a car with two front ends rolling off the assembly line.

Another idea is to transform the auto-manufacturing plant into a process plant by adopting plastic body shells and their appropriate bonding methods. Like a petrochemical-process plant, all the controls could be monitored by instruments.

Although these concepts are not new or unique to the Japanese, I personally believe that the U.S. automakers will be the first to introduce such innovative technology. They have not only the financial and technological resources but also, and more importantly, the power to lead consumers away from old, traditional products and toward new vehicle concepts. Even though everyone believes that the automobile is absolutely required in our society, the industry has entered the mature stage of the product life cycle. We can sit and watch our industry go into a decline, or we can reverse this trend by applying innovative technology, which will be the catalyst to make the industry young, active, and stronger than ever before. Then we can all look forward to the future.

Conclusion

There is no question that the auto industry is encountering many difficulties. However, if we clearly see the nature of emergent demands, and if we can meet those demands, we can survive. The solution to our problems depends upon how well we obtain and evaluate demand trends from all different parts of the world, and our success will be measured by how well we respond to these demands with our available worldwide resources.

Now that our business scale has expanded to include all of the trading nations, no company can monopolize information. Any company must be able to share the resources from any part of the world. To pursue this, international cooperation is essential. In the past there was never a time when international cooperation, especially between the U.S. and Japan, was more important than it is today. I do hope, with this spirit of cooperation, that all of us will grow and prosper together toward the future.

COMPARISON OF U.S.-JAPAN PRODUCTION COSTS: AN ASSESSMENT

Michael S. Flynn

Introduction

There is an elusive but highly publicized number that has come, for much of the industry, I suspect, as well as for much of the public, to symbolize the competition between the U.S. and Japanese automotive industries. That number is the difference in manufacturing costs, the extra dollars required to produce an automobile in the United States compared to what it costs to produce a similar vehicle in Japan. It has certainly played a role in the competition, cooperation, and change that has been present over the last few years not only between the U.S. and Japanese industries but within the U.S. industry itself (and, more widely, within U.S. society). Whether or not the role of this difference is more causal or more symbolic cannot be answered, but even if it is only symbolic, its importance for these issues should not be underestimated. It is referenced in discussions of the voluntary trade restrictions undertaken by the Japanese industry—a form of competition or cooperation, depending, perhaps, on which side of the bargaining table one happens to sit—and it has received publicity in the context of the recent Toyota-GM agreement to jointly produce vehicles in California. At the same time, it has undoubtedly spurred some segments of the U.S. industry to argue for tariffs, domestic-content legislation, quotas, or other barriers to the entry of Japanese vehicles into the U.S. market. Mr. Perkins and Mr. Smith have touched on some of these issues.

Since current prices of equivalent U.S. and Japanese vehicles are comparable, if the Japanese manufacturers can land a vehicle in North America for a substantially lower cost than such a vehicle can be produced here, the competitive implications are clear. First, the advantage in manufacturing costs would yield capital for the Japanese industry to undertake technological, design, and capacity alterations that might convert to numerous further competitive edges in areas

Michael S. Flynn is Associate Research Scientist, Center for Japanese Studies, The University of Michigan.

such as quality, reliability, and styling. At the same time, the U.S. manufacturers would have little choice but to go to the expensive (by historical standards) capital markets to fund their own programs.

Second, whether or not the voluntary trade restraints are lifted, the Japanese could lower prices substantially and perhaps capture an even larger share of the North American market than they currently hold. Third, these retained earnings could be used to finance the penetration of Japanese cars into other markets than North America through price-competitive strategies. Thus, the cost advantage might give the Japanese an edge in opening markets and make North American penetration of those markets more difficult.

Short-term and long-term scenarios for the North American industry are beginning to reflect these conceptualizations of the competitive relationship with Japan and the implications of the difference in manufacturing costs. Some observers have gone so far as to suggest that, in view of this difference, the economic "law" of comparative advantage now requires the United States to abandon the manufacture of motor vehicles—if not all manufacturing activity—and pursue less labor-intensive industries, such as those in the "high tech" area of robotics and computers. Indeed, some suppliers already appear to be diversifying and moving away from the automotive industry.

The difference in manufacturing costs has also been used as a rationale for the possible restructuring of competition and cooperation within the U.S. industry. The OEMs have announced their intentions to restrict the number of suppliers, either directly, or indirectly through the development of longer-term relationships, an increased emphasis on quality, or the requirement of supplier proximity to their plants—all touted aspects of the Japanese manufacturing system. This new era of cooperation between OEMs and suppliers would replace an often hostile relationship but, of course, assumes a prior period of perhaps intense competition among industry suppliers. The new spirit of cooperation between management and labor, so especially hailed in the most recent Ford-UAW agreement, involves not only wage freezes or roll backs but also an invitation to loosen restrictive work rules. This undoubtedly reflects concern over the implications of the Japanese advantage in manufacturing costs and its sources. In short, we are dealing with a set of comparative numbers that have vital implications for the future of the U.S. automotive industry and those who depend on it for their livelihood.

Estimates of the Differences in Manufacturing Costs

Table 1 displays twelve estimates of the difference in manufacturing and landed costs between the U.S. and Japanese industries. (The three tables reported for Abernathy, Clark, and Kantrow reflect the three separate estimates they provide, based on different data, analytic procedures, and methods.) In the area

of manufacturing costs, if we drop the lowest estimate ($983), which may reflect a more restricted portion of the manufacturing process than do the others, the full range of the estimates is $1300 to $2200. This is not a small range, but one that, at first glance, might reasonably be accounted for by differences among data sources, variables, and analytic strategies pursued by the various authors. Yet they are so often repeated that they are taken as independent confirmations of the size of the cost difference rather than as a range of estimates. They have come to have, for both the industry and the public, an aura of precision, accuracy, and reality beyond what they can reasonably support.

This is not to say that there is no difference in manufacturing costs between the U.S. and Japanese industries. There is, and it is fairly substantial. At the same time, the low and high estimates have different implications for both the magnitude and urgency of the responses required by U.S. manufacturers. My major disagreement with these reports is the way in which the total cost differential is allocated among or attributed to different possible sources or factors. My major concern about these reports is that incorrect inferences might be drawn from these specific analyses for decision making by industry participants, government, and the public.

The reports from the Big Three reflect estimates based on their own analysis of proprietary data. Since I have not had full access to either their data or methods—and only the Chrysler estimate provides much information about exactly how the calculations were made—I can say little about them. However, my remarks on the published estimates should at least raise questions whether or not these reports provide independent confirmation of the proprietary studies. Many companies that lack the resources or access to information that is necessary to conduct studies of their own specific competitive situation may rely on these published reports as indications of both the magnitude and source of the cost differential they might face. I hope to alert these readers to some problems with these studies and some potential limitations to the generality of their results.

The focus of my analysis is the contribution of two key factors to the difference in manufacturing costs—the wage rates and productivity levels of the two industries. It must be understood that their contribution to the total cost difference, as identified by these studies, reflects particular analytic decisions made by the authors. These analytic decisions involve, first, differences in the method of allocating the total extra direct cost of production between differences in production time, on the one hand, and differences in wage rates, on the other. Second, there are differences in the methods used to eliminate the effects of variations in product mix among manufacturers. This is important because it may take a longer time to produce a large car than a small car. Third, there are differences in the methods used to control for vertical integration, which are important because there are differences among the OEMs in the portion of the

vehicle they actually manufacture themselves and the portion they purchase. All three of these variations in analytic procedure have implications for the inferences that legitimately can be drawn from the results.

In addition, some Japanese data, predicated on different definitions of productivity, suggest that the focus on labor productivity in these reports may distort the overall cost comparison between the industries. There are also data that suggest that many, but not all, of these comparisons may be based upon low estimates of wages and benefits for the Japanese auto worker and the costs of this compensation package to the Japanese manufacturers. But even so, the difference in the compensation systems characteristic of the two industries is itself a source of competitive advantage to the Japanese, over and above any difference in the level of compensation.

The Factors Involved in Estimating Costs

A major problem with the estimates displayed in the left-hand column of table 1 is that it is difficult to determine the extent to which the variation among them simply reflects consideration of different possible sources. Hence, it is difficult to assess the extent to which they are either compatible or inconsistent. Mateyka, for example, drawing on Harbour's earlier work, estimates a differential in landed costs of $1709, remarkably close to the revised Harbour estimate (1983) of $1718. However, we find differences between these two totals in the factors considered, as well as major differences in cost estimates within categories. Mateyka attributes about $770 to better management systems while Harbour's later work attributes almost twice as much to that category. Mateyka assigns $812 to wage and fringe-benefit differences while Harbour (1983) reports $550 for this category, in spite of an adverse movement in the exchange rate. Mateyka attributes $430 of the total cost differential to differences in material cost, but this category is completely absent from Harbour's later estimate. In other words, although there is agreement between the total estimates, substantial disagreement exists in the estimates for individual categories.

It is problematic whether one can safely add different factors from different analyses to arrive at a grand total. Hence, GM's and Chrysler's estimates of the cost difference, $1500 and $2200, respectively, might be quite compatible if we add the $650 tax disadvantage from the Chrysler analysis to the GM estimate. The problem is that GM in all probability has included at least some of these tax differences, for example, employer taxes on wages, in its cost estimates. One must be careful, then, in assuming that similar numbers constitute independent verification, and one must be cautious about taking cost estimates for specific factors from different reports and adding them together to arrive at a grand total.

Productivity and Wage Rates

There are two factors that are included in virtually every estimate of the difference in manufacturing or landed costs: labor hours required to produce a vehicle and wage rates. As is clear from the GM and Chrysler example just given, these estimates reflect both the way in which researchers allocate various costs and the factors that they include in deriving an estimate of the total. Although other factors, such as material costs, may be critical, they are not covered in all analyses. But all the reports identify the specific cost differences of "hourly productivity" and "wage." An examination of these categories will clearly delineate two disadvantages that decision makers must address and will illustrate some of the problems with these analyses of the differences in manufacturing costs.

The ratio of Japanese to U.S. productivity in the automobile industry, which underlies the cost estimates displayed in table 1, range from about 1.20:1 to 2.40:1, that is, the Japanese industry is portrayed as producing anywhere from six to twelve vehicles in the labor time it takes the U.S. industry to produce five. The cost difference associated with these hourly productivity differences ranges from about $170 to about $1060. In these reports, the percentage of the total difference in manufacturing costs accounted for by hourly productivity ranges from about 10 percent to about 54 percent of the total. Both these ranges are quite large and certainly suggest less consistency in these studies than has been assumed.

In these studies, the cost difference attributed to wage rates ranges from about $550 to about $1300, about 25 to 80 percent of the total cost difference. Again, wide variation rather than consistency is the picture that emerges.

Table 2 reveals one source of this variation. If the cost difference associated with both productivity and wage differences is analyzed, consideration must be given to the difference between the total production hours multiplied by the wage rate for the U.S. industry (B x D) and the total production hours multiplied by the wage rate for the Japanese industry (A x C). The lower portion of table 2 indicates that different reports have followed quite different methods of allocating this total difference to the wage rate and productivity factors.

The most useful and defensible way to allocate these total costs to productivity and wage rates is to recognize three components: pure productivity—U.S. excess hours charged at Japanese labor rates; pure wage—Japanese hours charged at the difference between the wage rates; and a joint effect—the difference in wages during excess U.S. hours of production. To assign the joint effect to either productivity or wages or to split the difference between them, as some of the reports do, obscures rather than clarifies the role of these two factors. Note that GM appears to have used this three-way allocation.

The important point, of course, is that a reduction in the difference in *either* productivity *or* wage rates will also bring savings associated with the joint effect, which is important when evaluating strategies for cost reduction, especially when it is likely that rapid changes in the industry will occur.

Table 3 displays the effect of this three-way allocation of productivity and wage rates on the reports. (Because Harbor's estimate in table 1 cannot be broken into realistic productivity and wage estimates, an estimate in Harbor's assembly-plant report was substituted.) The absolute range for the factors is still quite large even if Harbour's estimate is ignored. In addition, substantial variation exists among the reports in the proportional allocation among pure productivity, pure wage, and their joint effect—all reveal a range of about 3:1 between the high and low proportional allocations.

This data shows the inconsistency in the role attributed to each of these two factors in the overall differences in manufacturing costs, even when the influence of differences in both the absolute number of dollars and differences among allocation methods are removed. It certainly suggests that these reports support quite different inferences about the possible sources of the cost difference and thus, by implication, the value of different ameliorative strategies.

Vertical Integration and Product Mix

Two other analytic decisions influence the results reported in these studies—how to eliminate the effects of vertical integration and product mix from the comparison of the two industries.

There are a number of ways in which these reports control or eliminate the contaminating effects of product mix from their comparisons. Some authors compare the actual cost of producing small vehicles while others adjust their data or estimates for U.S. costs to reflect differing assumptions about the extent to which small cars are cheaper to produce. But the basic problem with comparing only small cars is that the comparison then reflects the strength of the Japanese producer and the weakness of the U.S. producer. Even those who forecast an increasingly small-car-oriented market—in spite of some recent shifts back to larger cars—need to be careful about assuming that these data, largely from 1979, reflect the reality of the next few years. For one thing, the volume of U.S. small-car production has increased, and so has our experience in making them. These factors have likely led to increased efficiency in U.S. production (indeed, some specific plant comparisons support this expectation).

There is nothing wrong with eliminating product mix by comparing only small cars, but there are limits to the inferences that can be drawn from such comparisons. The statistical adjustments made to reflect the lower production

cost for small vehicles are quite different across these reports, and that in itself reveals problems with these methods. First, reasonable people may disagree as to what the proper adjustment estimate should be; second, there is no way to check the accuracy of the assumptions.

The issue of vertical integration—how much of the vehicle does the manufacturer actually produce—also raises similar problems. Authors again follow quite different strategies to eliminate this factor. One strategy is to compare only those operations that all assemblers perform; another strategy is to adjust cost structure and levels to reflect assumptions about how the differing actual levels of vertical integration may have influenced these factors. But the problem with these statistical adjustments for vertical integration is that they are financial measures, and what must be adjusted is a manufacturing process. The impact of this adjustment upon the cost difference depends further on whether the lower Japanese costs are adjusted up, or the higher U.S. costs down.

Examining only common production processes fails to control for variations in the amount of finishing work done in the assembly plants of highly integrated and less-integrated manufacturers. It further fails to control for possible variations in the quality of parts, components, and subassemblies received from divisional and independent suppliers. These have implications for rework and scrap and thus influence cost estimates.

Unfortunately, taking into account the different strategies for controlling product mix and vertical integration does not resolve the contradiction in the amount of cost associated with differences in productivity and wage rates. Table 3 displays my two revisions of the estimates presented by Abernathy, Harbour, and Henn. Their actual procedure fails to equate the levels of vertical integration between the two industries because they first made a financial adjustment for verticle integration, and then one for product mix. The subsequent adjustment for product mix has the effect of reintroducing differences in verticle integration. Revision I displays the results when the adjustments are made in the proper order. Revision II uses a somewhat different definition of vertical integration for adjustment. Although these changes produce little impact upon their estimates of the total cost difference—a decrease of just under 10 percent—they shift the source of the costs much more heavily into the material category (not shown here) and reduce the estimate of the cost difference associated with the productivity and wage factors by about 25 percent. The changes also alter the distribution of the cost between the productivity and wage factors from the balanced allocation of their initial results to one in which wages play a relatively larger role than productivity, albeit over a smaller portion of the total.

There is a further issue here, as there was with product mix—the utility of these results in projecting costs into the future. Vertical integration is adjusted to higher levels for these comparisons, but one might well ask if that is the likely

pattern for the future. There are reasons to believe that the most likely shifts might involve a decrease in vertical integration for U.S. assemblers and an increase in vertical integration for the Japanese assemblers. If this is the case, then decision makers need to keep in mind the specifics of how these results were obtained when making any extrapolations about the future.

The Exchange Rate and Other Factors

Lately, a fair amount of attention has been paid to the impact of shifts in the value of the yen upon these estimates. Not all the studies reported the exchange rate that was used in their calculations. The ones that do use 212 or 218 yen to the dollar while some of the estimates that do not report the rate appear to use estimates in the low 220s. This clearly underestimates, everything else being equal, the current Japanese advantage in manufacturing costs. The yen has fallen below 270 this year, and lately it has been hovering around 236.

One must be careful, however, in assessing the impact of fluctuations in the exchange rate upon both the total cost difference and the relative role of different factors. The change in value of the yen does not operate directly upon the difference; it operates upon the Japanese cost, and therefore, it has more impact when the base estimate for Japanese costs is higher. If the difference in manufacturing costs is $2000, based upon a Japanese cost of $5000, then a strengthening of the yen from 240 to 220 per dollar would reduce the difference to about $1545, about 77 percent of the initial difference. If the Japanese cost were $4000, the same movement of the exchange rate would lower the $2000 difference to about $1636, about 82 percent of its original level. So too, it has more impact upon those factors for which the base estimates for Japanese costs are higher and less impact upon those factors for which the base estimates for Japanese costs are lower. This, of course, alters the contribution of the factors to the adjusted, total cost estimate.

Only one of these estimates, to my knowledge, corrects for differences in capacity utilization. This factor, too, has implications for the stability of these estimates. For instance, although the U.S. industry has begun to show signs of recovery, it is still functioning well below full capacity while Japan appears to be operating near full capacity. This difference influences not only total production costs but also the allocation of this total among factors such as wage rates and capital costs.

One other general caution about the use of these estimates is in order. The Big Three have all reported major cost reductions over the last two years. While the exact impact of these reductions on the cost differences is unclear, it is difficult to believe that they have not had some impact. One company president states in a December interview that the differential between manufacturing costs

has been reduced substantially—to the extent that imbalance in the yen-dollar exchange rate is seen as a bigger problem than the differentials between productivity or wage rates. I am not that optimistic although I do believe that some reduction in the difference has occurred, and more will occur as U.S. capacity utilization increases with a hopefully improving market.

Summary of Published Estimates

Any estimate of the total cost difference depends upon the data one uses, the assumptions and procedures one relies upon to adjust that data, and the rules one follows in allocating costs. Decision makers should be highly sensitive to the influence these procedures and assumptions can and do have on the final information provided them, as well as their differing implications for a variety of scenarios concerning estimated market size, product mix, capacity utilization, industry strategies for vertical integration, and the exchange rates among world currencies.

Productivity

A few comments must be made about the general issue of productivity comparisons between the Japanese and U.S. industries, both about the focus of these productivity comparisons and their generality. These reports by and large calculate labor productivity in terms of unit output per hour of work. Some attention is paid to nonlabor costs associated with this measure, and some attention is given to unit costs other than labor. But the thrust of most of these analyses is to measure productivity and associated cost differences between the two industries by the differences in labor costs for the time required to produce an automobile.

These U.S. reports estimate, on the average, that the Japanese industry produces about 1.9 units in the labor time it takes the U.S. industry to produce one unit. This would drop a bit due to the slight decline of productivity and the stable work force in Japan over the last two years. But even if these estimates are accurate for the specific comparisons made, questions about their generality can certainly be raised. Time-series data from the Japan Productivity Center's 1982 report suggests that since 1979—the year for which most of these U.S. estimates were made—the unit productivity of the Japanese industry was about 140 percent that of the U.S. industry. Another time-series extrapolation from Japanese data puts the Japanese level lower—about 10 percent above the U.S. industry. While these estimates are quite different, they are both considerably below the estimates derived for most of these U.S. reports on the difference in manufacturing costs.

One possible reason for this discrepancy is that the U.S. estimates focus upon the OEMs and tend to focus upon the relatively more efficient Japanese assemblers, such as Toyota, while the Japanese estimates are industry wide. It may be that differences in labor productivity between the industries depend upon whether we examine assemblers or suppliers.

The Japanese tend to emphasize two alternative measures of productivity—value added per hour worked and value added in terms of labor and capital. Using a value-added definition of labor productivity, a Japanese research institute has reported that the Japanese auto industry in 1978 was less productive than the U.S. industry in 1977, but that the degree of difference depended on the sector. Thus, the Japanese assemblers were about 92 percent as productive as U.S. OEMs, but Japanese suppliers had only attained 66 percent of the value-added productivity per worker of U.S. suppliers. In fact, by using a value-added definition of labor productivity, the U.S. industry, as of 1980, still exceeded the productivity of the Japanese industry, according to both the Japan Productivity Center and the American Productivity Center. Only in 1981 did the U.S. industry fall behind—to 99 percent the value-added productivity of the Japanese industry.

It is somewhat speculative to jump from a value-added measure of productivity to a unit measure. The differences in the value-added measure between the sectors of the two industries may reflect differences in the profit structures of the two industries. Nonetheless, these results, combined with the disparity in U.S. and Japanese reports on unit productivity, suggest that productivity differences may be less at the supplier than at the OEM level. There certainly are implications here for U.S. OEMs who follow a decreased vertical-integration strategy as to whether or not that strategy necessitates off-shore sourcing and whether or not outside purchasing is sufficient.

If we expand our consideration to include capital productivity, some interesting results emerge. A study of automobile manufacturers by the Japan Productivity Center found that while unit labor productivity at Toyota and Nissan exceeded GM in 1977, GM's total productivity was 16 percent and 58 percent higher, respectively, because its capital productivity was about three times as high. These results, consistent with analyses for 1979 by the Industrial Bank of Japan, suggest that the Japanese edge in unit productivity partially reflects a substitution of capital investments for labor investments. While this seems obvious, a number of industry observers have chosen to ignore or even deny this aspect and focus exclusively upon organizational or management aspects of productivity. One must be cautious, then, in taking these reports or the role of productivity differences in estimates of manufacturing costs as either comprehensively assessing productivity or as applying throughout the entire industry.

Wages

As with the discussion on productivity, Japanese sources present us with a different view of the extent of wage differentials in the two industries. The hourly wage estimates used in these U.S. reports suggest that the wage of the Japanese auto worker is about 53 percent that of his U.S. counterpart. But estimates from a number of Japanese sources suggest that the wage of the Japanese auto worker may well be about 70 percent of the wage of the U.S. worker. Again, it appears that at the assembler level the proportion of Japanese wages may be a bit above this, and in the supplier sector, a bit below.

This discrepancy between Japanese and U.S. estimates of the wage differential is, I believe, due to a number of problems with our estimates of Japanese wages. The Japanese worker is salaried, receives pay in the form of a variable bonus, and receives many benefits in kind. Most Japanese companies provide some form of housing subsidy—either housing, or savings and mortgage plans, or a direct subsidy. Yet these costs are often reported as simply administrative and maintenance costs, or, in a number of cases, not reported. Exactly how other payments in kind are accounted for and costed out is unclear. Some wage costs—for example, provided housing, company buses, recreational facilities, and resorts—may in fact show up in capital accounts. Thus, some differences in capital productivity between the industries may be exaggerated and based upon underestimates of wage costs.

To the extent that these U.S. reports overestimate wage differences, some may underestimate differences in production time, and others may overestimate the total difference. Again, the relative role of the differences in productivity and wage rates is a key problem, and one's answer is strongly affected by the assumptions made about comparative hourly wages in the two industries.

To a certain extent, wage differences and their associated costs reflect social choices and experiences. The different experiences of inflation between the two societies—reflected in the U.S. in accelerating COLA costs—and the different choices on how to provide medical care have clear implications for the level of direct costs the companies must bear to provide equivalent levels of benefits. The Japanese, for example, have a national health insurance program in which the workers participate; in the U.S., however, the industry provides medical insurance. In most, if not all instances, the U.S. companies are at a disadvantage because of these differences.

The Japanese compensation system for the auto worker is quite different than the U.S. system. Payments in kind are much higher, the worker is salaried, and in some areas he probably experiences a very high ratio of benefits to company cost. The payments in kind and the direct provision of services serve to tie many of his activities directly to the company. The U.S. worker, on the other

hand, would simply collect his hourly pay and go out into the marketplace. The repetitive tying of benefits to the company, the level of benefits (as in the case of the bonus) reflecting company performance, and the encapsulation of the worker's life within company precincts increase the commitment of the worker and his on-the-job motivation to perform. These exist within a system of permanent employment and an organizational and management structure that further promotes the identification of the worker with his company and releases him from the fear of working himself out of a job.

The structure of the Japanese compensation system is an important aspect of Japanese organizational life, and even if the compensation costs in the U.S. and Japan were identical, the perceived benefit by recipients and the actual benefits to the companies would, in all probability, still be higher in Japan. U.S. companies, then, face an area of competitive disadvantage that reflects the preferences of members of our society for arms-length relationships and a rejection of the old company-town concept. These will likely remain and undoubtedly continue to be reflected in the specific cost structure of the two industries, and they have competitive implications over and above the actual level of cost differences at any particular moment.

Implications

First, in light of the variations among these estimates of the differences in manufacturing costs, no clear picture emerges of what the total cost difference is, how it may vary over sectors of the industry, or how it might fluctuate with changing circumstances. That it is substantial and of extreme competitive importance, however, is clear.

Second, and more importantly, no clear idea emerges of what the role of many factors in the cost difference may be. Our understanding of these factors must be sharpened in order to develop appropriate responses. In particular, what is needed is a clearer picture of the relative contribution of productivity and wage differences, compared to other factors as well as to each other, to the overall cost difference. Partial measures of productivity and inaccurate estimates of Japanese wage costs may obscure and distort overall comparisons and result in inappropriate assessments of their relative contribution.

The assessments of wage and productivity factors made in these reports have been a source of friction not only between union and management but also, I believe, between manufacturing and financial managers. This friction can prevent concerted efforts to address the problem, and the lack of clarity may obscure proper remedies. For example, if wages are the "real" source of the cost difference, is the effort to learn more from the Japanese about management and manufacturing techniques misplaced? If productivity is the real source, then the

current emphasis on rolling back wage rates may be counterproductive since in real wages the Japanese appear to be closing the gap. It may only serve to heighten acrimony between the union and companies. If productivity is the real source, what are the roles of manning levels, inventory systems, scrap and rework, and job assignment patterns?

Third, while the proprietary studies may be completely accurate, it would be dangerous to assume their general applicability throughout the industry without knowing what factors were considered or what assumptions were made in developing them. One company's problems are not necessarily another's. The variability they themselves reveal should alert us to proceed with caution.

Fourth, to the extent that some differences in manufacturing costs reflect societal choices and preferences, these issues must be examined from a different perspective. Blaming the industry for bad management and high labor rates will not resolve these kinds of issues.

Those who face the real, practical, and immediate dilemmas placed upon the U.S. industry by the Japanese advantage in manufacturing costs are likely to find the analysis presented here somewhat remote and academic. As one industry wag put it, "The industry is asking what time it is, and this paper tells it how to build a clock." Knowing how a clock is made, however, can tell us something about the confidence and reliance we can place in the time it displays. When time is critical, it is important to know whether 3:00 P.M. means 3:00 P.M. plus or minus two minutes, or simply sometime after 12:00 M.

TABLE 1: REPORTED TOTAL COST DIFFERENTIALS

	Asserted Cost Differential	
Source	*Manufacturing*	*Landed*
Abernathy, Clark, Kantrow (ACK)		
Table A (total)	1673.00	1273.00
Table B	1973.00	1573.00
Table C	1304.00	904.00
Abernathy, Harbour, Henn (AHH)	2050.00	1650.00
Chrysler	2200.00	1800.00
Ford (F)	1800.00	1400.00
General Motors (GM)	1500.00	1100.00
Harbour—Subcompact & Compact (HSC)		
Studied	983.00	
Estimated	2163.00	1663.00
Harbour Revised (AHH)	1861.00	1461.00
Mateyka (M)	2109.00	1709.00
Harbour (1983)	2203.00	1718.00

TABLE 2: DETERMINATION AND CALCULATION OF COMPENSATION RATES AND PRODUCTIVITY FACTORS

Determination

	Hours	*Compensation Rate*
Japan	A	C
United States	B	D

A < B, C < D

Calculation

	Productivity	*Compensation Rate*
HP	(B-A)D	A(D-C)
Chrysler	(B-A)C	B(D-C)
AHH	(B-A)C + ½(D-C)(B-A)	A(D-C) + ½(D-C)(B-A)
GM	(B-A)C	A(D-C)

TABLE 3: PROPORTIONAL ALLOCATION OF TOTAL PRODUCTIVITY-WAGE COST DIFFERENCES TO PRODUCTIVITY, WAGES, AND JOINT EFFECT

PAPER	*Cost difference due to productivity/wage factors*	*Proportion due to productivity (B-A)C*	*Proportion due to wage (D-C)A*	*Proportion due to joint wage/productivity (B-A)(D-C)*
ACK - Table A (OEM only)	856.00	.13	.74	.13
ACK - Table B	1973.00	.35	.27	.38
ACK - Table C	1304.00	.25	.48	.27
AHH	1910.00	.37	.35	.28
AHH (Rev. I)	1437.00	.29	.48	.23
AHH (Rev. II)	1363.00	.30	.47	.23
Chrysler	1352.00	.46	.23	.31
GM	1500.00	.18	.60	.22
Harbour Plant Comparison	395.00	.45	.27	.28

RESPONSES OF CONFERENCE PANELISTS TO AUDIENCE QUESTIONS

Panelists for the afternoon question and answer session were Michael S. Flynn, Teruo Maeda, and Richard C. Wilson. The moderator was Gilbert Whitaker.

WHITAKER: The first question is for Mr. Wilson: Your discussion of the three scenarios was very interesting, but the Japanese are not standing still in a manufacturing sense. Do you believe that the U.S. OEMs and their supply base will be able to catch up to the Japanese and equal their advancements over the next five to ten years?

WILSON: The answer is yes, if they are given the market opportunity to do so. One problem is that there is a great deal of ignorance about precisely how the Japanese supplier industry is structured. From a study of that industry conducted by the Auto Study Project at the University of Michigan, the Japanese supplier industry appears to be a multitiered industry. The first tier is specifically related to the major manufacturers and is equivalent to the captive supplier divisions of our own automotive manufacturers. The second tier is composed of suppliers to those companies and is, in some sense, equivalent to the independent suppliers in the U.S. industry. Independent suppliers in the U.S. industry are quite technologically aggressive and sophisticated, and that supplier industry is already worldwide and is likely to be very viable in the next five to ten years.

WHITAKER: Thank you. Mr. Maeda: Do you see anything on the horizon to displace the auto as a primary transportation system?

MAEDA: No, I do not think that future events will cause the automobile to disappear or that the automobile will be taken over by mass transportation or a similar mode of transportation. It is a fundamental cultural concept that people love privately owned, manageable machines. Any type of mass transportation will run parallel to automobiles, not displace them. In the future, although the automobile will probably be guided by electronic controls, to which I referred in my discussion, and will be more sophisticated, it will still be an automobile. In short, the automobile will exist forever.

WHITAKER: Mr. Flynn: Your paper seems to indicate that "little can be said about cost differences." In your judgment, is there a differential? If so, and assuming current exchange rates, what is a reasonable estimate of the lower and upper limit of this difference?

FLYNN: Yes, I think there is a cost differential, and I think we do know something about it. I would reiterate, however, that we do not know as much about it as we think we do. At current exchange rates, I would not find it very difficult to believe that there is a difference in manufacturing costs on the order of $1500 to $2000. Much of that, however, has to do with the cost of material, and disagreement exists concerning the importance of productivity and labor-rate factors that are reflected in the cost of material. At least at the assembly level, little attention has been paid to the total cost of the material that goes into the automobile, from the viewpoint of both the amount of material originally purchased and the amount of material present in the finished product. Despite these considerations, I do not have any problem with the estimates of $1500 to $2000. I would only add that industry would call that estimate a differential in landed costs, and I would consider it a differential in manufacturing costs.

WHITAKER: Mr. Wilson: Do you see an evolution of the industry based on comparative advantage and componentry? Will the auto manufacturer simply turn into a final assembler?

WILSON: Under the pessimistic multinational scenario it is reasonable to assume that domestic production would be limited primarily to assembly plants. Under the other scenarios, however, that situation is less likely, and the current diversity that exists today in the auto industry, as both a component and final assembler, would probably persist.

WHITAKER: Mr. Maeda: If the U.S. continues to place some form of restriction on Japanese auto imports, will Japanese automobile companies shift their mix of exports into segments of the U.S. market that provide a higher profit margin?

MAEDA: Trends in the U.S. marketplace indicate that if the availability of any product is limited—not necessarily automobiles—its price increases. In addition, consumers often choose the higher-priced product because they think that if the total number of commodities is limited, they should obtain a better, more expensive model. So, to respond to that question, Japanese manufacturers do not have any plans to introduce higher-priced product lines into the U.S. even though, fortunately or unfortunately, customers in this country often choose higher-priced cars.

WHITAKER: Mr. Flynn: It has been stated that the Japanese worker is less satisfied than the U.S. worker. How does that relate to your statement that the Japanese worker is more committed because of the structure of benefits?

FLYNN: I do not think that a simple correlation between satisfaction and a motivation to perform—or, for that matter, commitment—has ever been demonstrated. In fact, some social psychologists such as George Homans would argue that if there is a correlation, it is a negative correlation, that is, a more satisfied worker is less motivated to perform. What I mean to stress by the term commitment is that a large part of the meaning of life is wrapped up in the company. The Japanese worker is not a robot, but his identification and social definition of self is immersed in the company to a higher degree than is the case with U.S. workers. There are companies in the U.S. that have the same kind of impact on their workers, but they tend to be smaller companies.

WHITAKER: Mr. Wilson: The technology-driven scenario assumes the application of technology to specialty cars. Why would the use of high technology as a means of improving competitiveness not exist in other segments, including small cars, rather than having those cars imported from off-shore sources?

WILSON: The technology-driven scenario assumes that specialized market requirements are coupled to the technology. In general, these requirements would be high priced and outside what I chose to define as "standard transportation." The standard automobile would be built off-shore at the lowest price in order to meet U.S. market demands, whereas specialty cars, which would command a premium price, could be built competitively in the U.S. because of the technological edge that would exist in the U.S. industry.

WHITAKER: Mr. Maeda: When do you expect the Japanese car manufacturers to meet the standards for crash tests at and above thirty-five miles per hour, standards that already exist in U.S.-designed cars? Do Japanese manufacturers cooperate on this issue?

MAEDA: Japanese manufacturers understand that the Department of Transportation is conducting head-on collision tests at thirty-five miles per hour, and they recognize that this is one approach to enhance auto safety. But there should be compromise. From the technical point of view, it is easy to meet collision standards at thirty-five miles per hour. The problem is that manufacturers must increase the weight and cost of the auto in order to conform to those standards. There are many other important key issues—I should say more important than compliance with collision standards at thirty-five miles per hour—such as the enforcement of the use of seat belts, prohibitions against drunken drivers, and more understandable safety signs. We are very careful about the kinds of safety

features we put on our products. If we select only the items that will not cause any discomfort to the customer, we are not being responsible. Collision capability at thirty-five miles per hour is one way, but at the moment that is not our first priority.

WHITAKER: Is there cooperation among Japanese manufacturers on these issues?

MAEDA: Washington's Department of Transportation has already picked up some collision data on our cars, as well as on those of Toyota and Honda, and we have cooperated with government officials to evaluate the test results.

WHITAKER: I think the question was, Do you cooperate with each other in trying to meet these standards? Toyota with Nissan, etc.? Is there research cooperation on safety issues?

MAEDA: With various experimental safety vehicles we have cooperated with each other in Japan, especially in fifty-mile-per-hour tests sponsored by the DOT, but we concluded that that was not a practical way to ensure safety on the road. Since then, our attitude is that safety can best be achieved through better seat belts and high-performance handling that can help the driver to avoid an accident.

One further thing I should mention concerning safety is that Nissan is trying to develop cars that will meet collision standards in tests at thirty-five miles per hour without a significant increase in cost and with a much more substantial front-end structure. Of course, we hope that in the future we can attain those standards without any price increase or any sacrifice in maintenance. I am confident that Nissan can achieve this objective, but in the meantime we are sharing our knowledge and technology with your government officials, who will make this information available to anyone who wants it.

WHITAKER: Mr. Flynn: As a result of your analysis of the twelve cost studies that you mentioned, how should this total differential be broken down between labor rates, productivity, material, and yen value?

FLYNN: I have not worked out that kind of an appraisal of these results so, in a sense, I really do not know. Clearly, however, I feel we have overestimated the difference in wage rates. I am not sure about productivity, but it is very important to recognize that productivity differences may be disparate in different sectors of the industry and may change very rapidly. From my own reanalysis of Abernathy, Harbor, and Henn's data, material cost is a very significant component that has been underplayed where it has been identified. In that study, for instance, the actual dollar amount that properly should be associated with material costs has been underestimated. As far as the yen-dollar exchange, I am not going

to touch that one with a ten-foot pole. I do not know whether it is a strong dollar or a weak yen; I will leave that to the economists.

WHITAKER: A question for both Professors Flynn and Wilson: Despite the cost differences between Japan and the United States, do you believe Japanese operations in the United States can be successful, not politically but economically?

WILSON: I do not see any reason why not. They can use essentially the same technology; they would certainly have access to the same labor; and they will probably use almost the same plants. Thus, I see no reason why they could not compete very effectively. In addition, there is the history of a large number of not only Japanese-owned but also foreign-owned companies that have competed very effectively in the U.S. domestic economy.

WHITAKER: You want to add something to that, Mike?

FLYNN: I would certainly agree that the Japanese firms would be competitive producing in the United States unless, of course, the market stops growing and permanent employment continues. Then, any Japanese production in the U.S. would ultimately cost more because they would need to maintain high levels of employment in Japan. The cost advantage would be lost, and the profit structure would change very radically. I am assuming that they keep selling the same number of cars and that they are required by tradition, if not by law, to maintain similar levels of their work force in Japan. Certainly, I think that they could compete here technologically.

WHITAKER: For Mr. Maeda: Would you describe in terms of size, power, and utility the popular Japanese passenger car of 1990 to 2000? It sounds like a competitor asking the question.

MAEDA: I'm sorry, I missed part . . .

WHITAKER: They want your forecast of what the Japanese passenger car will be like in terms of size, power, and utility ten to twenty years from now.

MAEDA: Well, this is not an easy question. As I mentioned in my discussion, by that time the automobile will have to comply with many different customer demands and needs. The smallest car will probably be a commuter car that is stylish and comfortable; the large cars will be roomy but very light and fuel efficient. There will be a number of different intermediate cars ranging in size between General Motors's J and X car. They will be made of light-weight material, and they probably will not be shaped like today's cars. The three-box body style—front end, passenger compartment, and trunk—will be replaced with a round

shape in order to utilize space and reduce weight. The engine will still be the reciprocating engine, but a larger percentage of them will burn methanol, mixed gasolines, or low-grade gasolines derived from coal or natural gas.

WHITAKER: Professor Wilson: All three scenarios conclude that the domestic U.S. auto manufacturers will vacate a significant segment of the U.S. market, which in turn leads to the conclusion that terminal manufacturers and their supply bases must diversify their businesses, enter into joint ventures, or go abroad to survive. Please comment.

WILSON: That is an extreme generalization but a possible inference from what I said. In the sheltered-industry scenario, however, the total manufacturing capability in the U.S. might very well be at least as large and perhaps even larger than it is today. The distinction in that case was that a number of the domestic manufacturers might be owned by overseas firms. One could make an assumption, then, that the overseas firms would source a lot of their components from their home countries and that, as a result, the U.S. supply base would find itself shrinking and in serious difficulty. In the technology-driven scenario, which is even more speculative than the other two, the supply industry would not necessarily be similar to what it is today because of rapid change and differences in the nature of the product. In fact, a number of the high-technology participants might not be current auto suppliers; there may be firms from the aerospace industry, for example, trying to move into domestic automobile manufacturing. In that case, the supply base, as well as the OEM base, may be substantially different.

WHITAKER: Mr. Flynn: Your paper was on cost differences; the interest here is in competitive differences. How much of the competitive difference is due to different profit margins between U.S. and Japanese suppliers?

FLYNN: If the questioner is asking about the comparison in the value-added productivity, I do not know. We certainly have had the misconception that the Japanese auto industry has been very successful solely because of the Mom and Pop sweatshops in the back streets of Nagoya. Although that image does not exist anymore, we have shifted to a view that the Japanese suppliers are very much dependent upon the manufacturers, dependent to the point that they must scrape along at a subsistence level. I do not know if that view is accurate or not, but it is a real possibility. Assuming that the questioner is curious about the fact that the Japanese OEMs operate at 92 percent of U.S. value-added productivity but the suppliers at only 66 percent, I would consider it likely that some of those value-added productivity measures are clearly influenced by profit structures. That may be part of the difference between the two industries.

WHITAKER: Mr. Maeda, this is a question on technology. Please comment on future power-train components, six cylinder versus four cylinder, high output versus economy axle, and so forth, over the next five years.

MAEDA: Over the next five years there will not be a dramatic change. Four-cylinder engines will occupy a higher percentage of the market than six-cylinder engines since fuel efficiency is still the first priority. There will be some demand for high-performance engines, and that demand will be met through the use of turbochargers or superchargers on conventional engines. Front-wheel drive will be the dominating power-train configuration because of the utilization of compartment space, lighter weight, and smaller size. Even in full-size sedans front-wheel drive will become a standard configuration.

WHITAKER: Mr. Flynn: All of our analyses show that Japanese automotive plants are smaller in size, have fewer machines and people, and yet have higher productivity. How do analysts conclude, therefore, that the U.S. manufacturers have an advantage in capital productivity?

FLYNN: What kind of capital investment is there within the plant is the first question that I would ask back. These reports tend to assume that the Japanese and the U.S. industry function at the same level of technology. We certainly have access to the same technology, but it is my impression that we have not implemented it as much. Much of the difference in capital productivity is dependent on how widely capital has been substituted for labor in the U.S. versus Japan. In addition, when capital and productivity are measured, total land value must be included. The smaller Japanese plants are not as cheap to purchase, construct, and maintain as an equivalent size U.S. plant.

WHITAKER: Mr. Maeda: Do you envision that vehicular electronics will result in lower production and service costs?

MAEDA: Whether in-car electronic devices and diagnostic systems will increase the quality of servicing and decrease its costs is difficult to answer, but in time I think that they will be a necessary aspect of servicing. Whether these systems will lower production costs is also a difficult question to answer. With the limited production of more diverse models, however, lower production costs will be more dependent on whether the industry can produce efficiently with robots or FMS even when it cannot apply mass-production techniques.

WHITAKER: Those are interesting forecasting questions. For Dr. Wilson: Your scenarios are mainly technology defined. Do you anticipate a more effective use of human resources that would significantly alter these scenarios?

WILSON: The answer to that has to be yes. I specifically downplayed that aspect because it was not within my area of focus. In a lengthier version of my paper, however, I speculated that in the mature industry the drastic downsizing implied by that scenario would lead to or maintain the adversarial relationship that exists between workers and management. And, in fact, the absence of job security might aggravate that situation and lead to severe unrest within and disruption of the domestic industry. Severe downsizing could also change the operators' view of their security so that they would be willing to exchange a decrease in wage rates for job security. It is difficult to determine, however, which scenario is likely to happen since to some extent both of them exist now. But it is true that a whole set of new scenarios, which are dependent upon social conditions in this country rather than technological conditions, can be constructed.

WHITAKER: I am going to ask you a question related to that, and then I will turn to Dr. McCracken to summarize today's proceedings. Could you please describe a cheerful scenario so that the audience will not go home depressed?

WILSON: Either of the last two scenarios can very easily be cheerful. The mature industry scenario is gloomy only to the extent to which the total market demand in the U.S. grows slowly. If there is a sudden surge in market demand, that scenario, which would largely be a continuation of today's industry, could be very profitable and very attractive. The question is, Can that situation persist until the year 2000? I must say that I have a little uneasiness with that extrapolation. Being a technologist by orientation, I have no difficulty in believing that the technology-driven scenario is also a very happy scenario; it would certainly put the U.S. industry in a very attractive, internationally competitive position. The product that the industry would be producing would be a high-priced product. It would sell because it would have the attraction and appeal of innovative high technology. The industry, therefore, would be very profitable and could be very exciting. We can say, therefore, that these two scenarios are pessimistic only if the market does not rise to satisfy the potential of the industry; the first scenario, unfortunately, is very pessimistic.

WHITAKER: Thank you, panelists, for your candid responses.

SUMMATION

Paul W. McCracken

A sure way to be nominated as villain of the program is to proceed with a dreary blow-by-blow summary at the end of a long day. That kind of summation insults both the speakers and the audience, the former by implying that they really did not make their points very well and the latter by suggesting that they would not have understood them anyway. I do think, however, that it is interesting to speculate on the perceptions that we may have a year from now on the issues presented in these papers and discussions.

First, will the general economy be continuing on the path of expansion in the year ahead? On that I think we can be reasonably confident. It would be quite a departure from history if an expansion or upturn in business activity that is as well defined as the current one is were to falter before two or three years from now.

Second, will the normal response of the automobile market to an improving economy show up again in 1983? This question is one that is perhaps more urgently important and about which we are entitled to be nervous—not in the sense of apprehensive, but where the answer is perhaps a little less clear-cut. In general, the history of this stage of the business cycle indicates that the automobile industry has tended to be an early-bird indicator of economic recovery. But while sales are a little bit higher than a year ago, the industry's recovery is not what one might expect in view of what seems to be happening to the economy. Still, there is a good probability that strong gains in the automobile market will occur in the year ahead.

The data from the monthly surveys of the Survey Research Center at the University of Michigan indicate a significant turnaround in the last two or three months in the answer to the question, Do you think this is a good time to buy a car? A much higher percentage of people who indicated at the turn of the year that it was not a good time to buy a car now indicate that it is. That data are significant because experience has shown that a much better indication of what the market is apt to be doing is provided by asking that question than by asking the question, Are you going to buy a new car in the year ahead? The latter

question does not give a very good indication of what is going to happen because people who say that they were going to buy a new car do not, and because most new cars are bought by people who said they were not going to buy a car. That question is not very useful. When the next question is asked—Why do you say that it is a good or bad time?—not surprisingly, people indicate an improvement in credit markets and interest rates. This marked change shows a more favorable direction for the market and a good chance that a normal response in the automobile market will occur.

Third, there is no question that one of the problems in our relationship with Japan is the exchange rate. There are differing opinions, but in my judgment the yen has been undervalued. I want to point out, however, that some of the things that we are trying to press on the Japanese would, if they occurred, further weaken the yen. For example, we are pressing the Japanese to open their domestic market to our agricultural products. That is a very understandable position on our part, and certainly, reasonable people would say that Japan ought to move on that more rapidly than they have. However, if they begin to purchase substantially more agricultural products from us, the exchange rate vis-á-vis the dollar would tend to deteriorate further. One major change that will have to occur in the period ahead is that the yen will have to become one of the major international currencies. As a demand for the yen develops, not only to buy products from Japan but also to hold as foreign exchange, then a major effect will be an equilibrium of the exchange rate. But in order for this to occur, Japan must free up its credit and capital markets; that is the area where progress must be made and where Japan is at its weakest in trying to defend its policies.

Fourth, what will happen to free trade? Economists tend to be advocates of free trade, and it is certainly easy to argue that free trade produces more benefits for more people than any other system. But what can be done when other countries close their doors? What constitutes a rational international economic policy in that case? Governments generally can point to the academic profession, the intellectuals, and say, "While you have delivered a very good sermon on the virtues of free trade, you are not very helpful in formulating a rational strategy for the world in which we live." Unfortunately, businesses will just have to feel their way along for some time; a world with significant restraints is a fact of life.

In the final analysis, I think we can consider ourselves fortunate in one important respect: automobiles are not apt to fall suddenly from consumers' favor. The fact of the matter is that in humanity's long march to achieve greater and greater personal freedom, few things have made such a significant contribution to that search as the automobile. This, incidentally, is why those who prefer a society in which people are controlled focus their wrath on the automobile industry more than anything else. My guess is that in this struggle between people who are going to defend their personal freedom and those who want to move the other way, the former will endure, and that is good news for the auto industry.