

**FACTORS AFFECTING THE FUTURE TRANSFORMATION OF THE
NORTH AMERICAN AUTOMOTIVE INDUSTRY**

**Prepared for
Gemini Consulting Inc.**

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16. Abstract Forces of change internal and external to the North American automotive industry that are likely to impact the industry over the next ten to twenty years were identified and characterized. These forces are globalization, customer desires and needs, technology, competition, economic factors, human resources, government policy, environmental issues, and societal issues. While there is ample interaction among these nine forces of change, of them, the first four were considered to be the most comprehensive and likely to cause changes in the industry. These resultant changes will encompass knowledge acquisition; decisionmaking; and taking actions that will affect the management of finances, products and processes, and human resources as well as the structure of the firm, the market, and the industry.			
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EXECUTIVE SUMMARY

In 1996, Gemini Consulting and the Office for the Study of Automotive Transportation (OSAT) of the University of Michigan Transportation Research Institute (UMTRI) began a project whose major goal was to plot the future transformation of the North American automotive industry by examining the forces of change that were likely to shape it. That project was completed in April 1997 and is entitled, *Factors Affecting the Future Transformation of the North American Automotive Industry*.

Primary project participants were Richard Wells and Douglas Gross, of Gemini Consulting; Barbara Richardson, Michael Flynn, Jeffrey Davis, and David Cole of OSAT; and Morgan Edwards, a consultant, formerly with Ford Motor Company.

The North American automotive industry is changing at a rapid pace in response to both internal and external forces. In order to understand the necessary changes in the North American automotive industry over the next ten to fifteen years, the project team identified a set of forces of change, characterized them to the extent possible, and suggested changes in the industry required to respond to those changes.

The project team conducted frequent working sessions, during which hypotheses, predictions and insights were formed, examined, supported, or discarded, and when appropriate, incorporated into the intellectual framework that is the basis of this document. Members of the project team drew on past and present research endeavors, consulting and business experiences, and surveys and analysis of current literature to shape their ideas. In addition, this effort, to which the project team devoted over a year, was guided by an advisory board composed of forward-thinking executives actively involved in management of the auto industry. For further insights and suggestions, a collection of experts critiqued portions of this work according to their area of expertise.

Key Findings

The research team initially identified nine forces of change, all of which are expected to influence the future transformation of the auto industry in varying degrees:

- Globalization
- Customer desires and needs
- Technology
- Competition
- Economic factors
- Human resources
- Societal issues
- Government policy
- Environmental factors

These forces served as reasonable categories in which to place the fundamental forces of change that the project team sought to identify. However, it is important to recognize that such discrete boundaries are analytical conveniences for identifying and evaluating what will drive an industry toward change. In reality, there is ample interaction among them, as when, for example, technological change can itself become a competitive factor. Analysis indicated that the first four categories were the most comprehensive and contained the most powerful forces driving change in the North American automotive industry.

Globalization

Globalization is a force both driving and being driven by the North American automotive industry. Among many others, forces at work driving globalization include increased competition within the industry and the maturation of the North American motor vehicle market. In an uncertain global context, the ability of a company to be a global participant will derive from its domestic profitability. In becoming global, a company will have to choose a corporate structural strategy that will best meet its needs in each of its various markets. A parallel corporate structure involves largely self-sufficient groups that function mostly within a designated market. An integrated corporate structure uses groups that perform their functions from one location, but which draw on and service global design, manufacture, and marketing of vehicles.

Rapid advances in transportation, communications, and computer technology will increase the rate of globalization through changes in the ways manufacturers do business, consumers buy vehicles, and organizations regulate and set standards for the industry. Almost instantaneous worldwide communication and computer technology will speed product development and homogenization of consumer tastes. International organizations will strive toward commonization of regulations and vehicle components. While there are many drivers of globalization of the automotive industry, there are some counter-forces. These may include development of isolationist policies and exclusive trade blocs.

As globalization increases, North American automotive manufacturers will be facing greater competition worldwide and need to make a wide range of decisions on how to do business in a changing context. Not only will established manufacturers become more competitive, but also, it is expected that there will be increased competition from countries with emerging markets as they acquire significant automotive export capabilities. Within this context, automotive manufacturers will need to make hard decisions on the numbers and locations of the markets they choose to serve; on all the functions that support a global enterprise: investment, product development, design, manufacturing, and distribution; and on the allocation of human resources to meet domestic and global needs.

Customer Desires and Needs

Industry attention to customer wants and needs will increase. As a means to gauge customers needs, and to help differentiate makes and models, brand management will become a more widely used marketing approach.

Several issues and concerns in the future will determine what customers buy, how they buy, and if they buy at all. What customers buy pertains to more than the great many offerings from an increasing number of manufacturers. It includes the increasing acceptability of the used vehicle, as well as competition from nonautomotive products. How customers buy cars and trucks in the future will be largely determined by changes occurring today in a distribution system undergoing major changes as new players enter the retail system, old players consolidate or get out, and technology introduces new ways for consumers to gather information and even place an order. Changes in distribution systems are driven by a need to provide quicker delivery times, better service, and a more customer-friendly buying experience. Vehicle prices have become high enough that some consumers' ability to buy new ones may be in jeopardy. High prices, vehicle durability and quality, and increasing acceptance of buying used vehicles may combine to give consumers greater discretion when considering buying a vehicle.

Technology

Technology will continue to influence change in the automobile industry in ways both revolutionary and evolutionary. Innovation in technology will occur in three broad categories: enabling, product, and process. The first refers to the kinds of technology, such as electronic networks, that permit or facilitate action, such as communication and the sharing of information. Product technology encompasses the changes to materials and machines that provide better performance, greater reliability, and lower cost. Innovation will likely be most visible in engine and fuel systems, but the entire vehicle will benefit from advancements in materials, computer electronics, and communications technologies. Process technology denotes the kinds of innovations that occur when improving product design capabilities, for example. Technological changes will alter the ways that people work and interact with each other while at work. For instance, digital technology will continue to increase in power and efficiency, with decreasing processing time, leading to new relationships among designers, producers, and consumers.

Competition

Competition in the auto industry will extend beyond the traditional rivalry that exists between vehicle manufacturers. Competitive success will hinge on effectively exploiting technology and harnessing employees' technical and interpersonal skills. Because of cost pressures and shifting responsibilities, vehicle assemblers may find their relationship with their suppliers more competitive. Powerful suppliers may be more selective in choosing the customers they serve. Those who are given more responsibilities from those customers may be less vulnerable to manufacturer pressure

to compromise on price, for example. The retail channel will see increased competition between the various buying and selling institutions, such as national retail chains, traditional dealers, and the Internet. Changes in this distribution arena will likely result in stronger retail organizations vis-à-vis the manufacturers. Perhaps of most urgent concern is the competition of the car or truck with other goods and services. Owning a new car no longer has the cachet it once did.

Industry challenges abound, and the increasingly complex environment only serves to accentuate the critical importance of rapid, flexible, system-level responses.

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OSAT Team Members

The project was managed by Barbara Richardson and Michael Flynn, who with David Cole, Morgan Edwards, and Jeffrey Davis comprised the project team. Significant contributions were made by Wendy Barhydt, Lee Burge, Bruce Belzowski, David Graham, Cathy Rowe, Karen Shears, Robert Sweet, Francisco Tarin, and James Thompson.

I. Introduction

There is nothing constant except change. This truism will surely be played out over the next fifteen years in the North American automotive industry. A continuing reliance on private vehicles for most of the travel in North America accompanied by change in both quantity and character of the vehicles demanded are core assumptions underlying this study. Further, these changes will be driven by technological advances as well as changing needs. The drivers for these changes can be sorted into those that might increase demand for travel and vehicles, decrease this demand, or cause the demand to change with regard to the character of the vehicles.

As North America experiences growth in population, number of households, and suburbanization (possibly compounded by the advent of intelligent transportation technology), more disposable income, and a decrease in household size, we will see an increase in the demand for travel and vehicles. However, this increase in demand will be tempered by forces that have an opposite effect: maturation of the North American vehicle market; increased life of vehicles; more opportunity to spend disposable income on things other than vehicles (e.g., computers, vacations); telecommuting; and a growing concern for the role of the automobile in the loss of farmland, the decay of central cities, and the polluting of the environment. Other forces affecting demand levels are changing demographics (more women and handicapped in the work force, aging of the population, and immigration from third-world countries), awareness of technologies that will provide increased safety and security, and perceived needs for differentiated vehicles such as light-duty trucks, minivans, and others. All of these forces will occur in the context of consumers' insistence on more value.

Many of these same forces will cause change in developed nations outside of North America. The forces of change and their impact in developing countries, where there will be enormous opportunities for North American companies, are still to be determined. It is clear that changing global factors, which include economic, political, environmental, societal, and business conditions, will affect all markets.

Conditions are also changing at a rapid pace within the automotive industry itself and the environment in which it functions. There is a constant striving to keep up with new advances in technology, to meet the needs of customers, and to streamline functions within the organization. At the same time, the industry is in a state of flux, both enhanced and confused by the vanishing of boundaries within and outside the automotive assemblers, among them and their suppliers and distribution networks, and across national borders.

Purpose

Given all these changes and the need of the industry to consider the future, the first purpose of this study is to identify and characterize those technological, social, and other factors (from outside and inside the automotive industry) that could lead to major

changes over the next fifteen years in demand for motor vehicle transportation of both people and goods and in the way that the automotive business will be conducted. The second purpose is to characterize and identify the likely resultant changes in the roles, structure, and responsibilities of the North American automotive industry.

Figure I-1 illustrates the key forces of change that will be pivotal in affecting the course of the North American motor vehicle industry over the next several years. Required industry responses, including knowledge, decisions and actions, are also shown. These two sets will interact with each other over time.

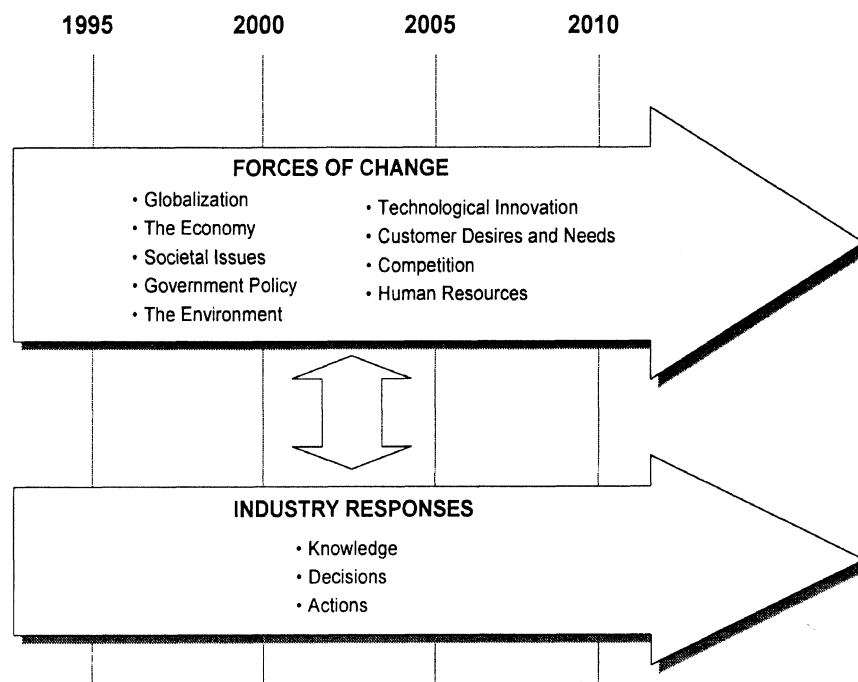


Figure I-1. Project Overview

Method

To meet the goals of the project, the initial task was to identify as explicitly as possible the major forces that will result in North American automotive industry change over the next ten to twenty years. This task was accomplished by a series of meetings of the project team, including members from the project sponsor, Gemini Consulting. Additional information was provided by the project advisory board, which suggested a set of key forces for change.

Following the identification of nine key forces of change (globalization, the economy, societal issues, government policy, the environment, technological innovation, customer desires and needs, competition, and human resources), literature searches were performed to identify forecasts for each of them. Project staff then summarized the findings into brief reports, included as an appendix. The nine reports were then subjected to further review, either by a leading expert in the subject, an interview with an industry executive, or as the topic of a focus group composed of knowledgeable industry representatives. The descriptions and analyses of the forces of change were again revised and refined.

Review of the nine forces of change revealed a great deal of interaction or combined effects among them. These interactions were plotted and analyzed. Four factors emerged as the most likely to impact the North American automotive industry over the next fifteen years: globalization, customer desires and needs, technological innovation, and competition. The data collected in the project were then synthesized into an outline and shared with the project advisory board. This final report was prepared with consideration given to the interaction of the forces of change and the responses most likely to be required from the industry.

Structure of the Report

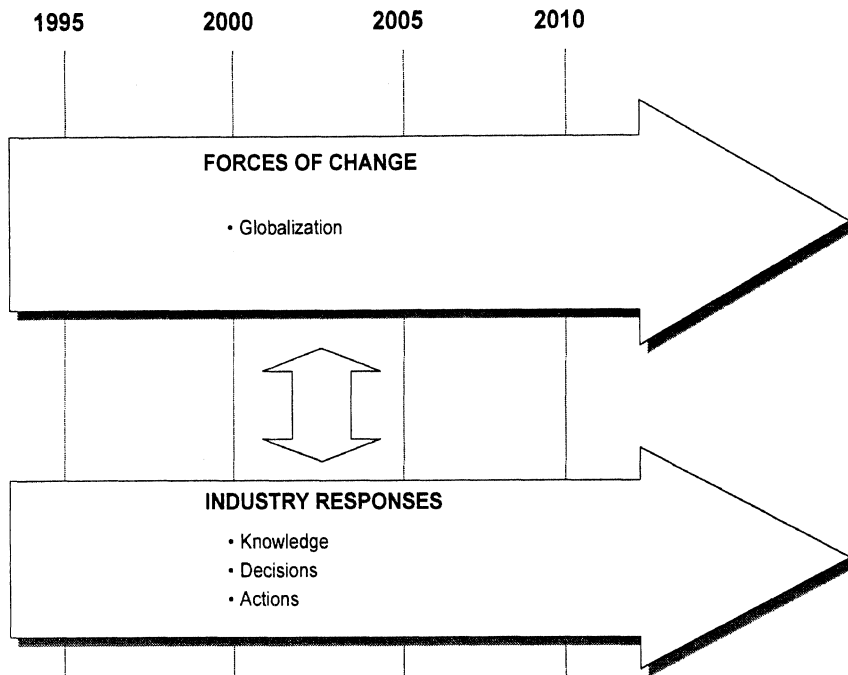
This report is divided into four main sections. The first is the introduction and sets forth the background, purpose, method, and structure of the report. The second, the bulk of the report, presents a discussion of the forces of change that will affect the North American automotive industry and actions that the industry will need to pursue to respond to these changes. Each of the four primary change factors is addressed. The third section presents the summary and conclusions of the study and is followed by recommendations for future research in the fourth section. There is an appendix that summarizes the findings on each of the nine forces of change.

II. Forces of Change

There is a wide range of factors that act primarily independently of the automotive industry but, nevertheless, do now and will in the future have an impact upon the industry. Among these forces of change are globalization, the economy, societal issues, government policy, the environment, technological innovation, customer desires and needs, competition, and human resources. The industry has some impact upon these factors, but for the most part they can be viewed as operating externally to it. The importance of addressing these forces derives from the certainty that they will change, although in unknown magnitudes; that they will impact the automotive industry, often in unforeseen or unexpected ways; and that the industry needs to be prepared to respond to them.

Of the nine forces of change noted above, four stand out as the most prominent: globalization, customer desires and needs, technological innovation, and competition—not only because of their inherent importance or interest, but also because of the intense level of their interactions with the other factors.

Following is a discussion of these four forces which includes identification of the key items of importance, a characterization of the transition of those forces over the next fifteen years, a discussion of how those forces interact with other forces, and what they might mean for the automotive industry in North America.



A. Globalization

Introduction

Globalization is a force within and outside of the North American automotive industry that is causing change at a momentous pace. These changes appear as vehicles are produced and marketed in different ways, as traditional markets become saturated and new ones expand, and as boundaries within organizations, between companies, and between countries begin to vanish. Within the automotive industry, globalization can be defined as going beyond national boundaries with regard to integrating or closely coupling one or more functions such as design, production, personnel, knowledge acquisition and use, sales, and purchasing.

There are several forces at work driving the North American automotive industry to be global. Among these forces are:

- increased competition within the worldwide automotive industry
- maturation of the North American automotive market—causing North American manufacturers to seek markets elsewhere
- need for scale economies

- need for efficiencies in product development and distribution worldwide
- need to please the customer worldwide
- need to utilize human resources worldwide to bring international diversity into the world market
- reduced tariffs and nontariff blockages to trade and capital flow
- technology that facilitates global management
- technology that instantly diffuses information (consumer issues and technological insight)

The need or desire on the part of a company to become global is set within the context of a changing global environment characterized by great uncertainty. This uncertainty encompasses numerous dimensions and spans cultural, economic, and political conditions. One's own company values and ethics may conflict with others'. There are clear trends toward homogenization of tastes, but the vanishing of esthetic and national boundaries may be countered by strong isolationist and nationalistic policies. In the uncertain global context, internal strength is required. For most global participants, domestic profitability will be the financial engine to fund international investment. Flexibility, agility, and perseverance will help lead the way into the future.

At the same time that the industry needs to become more global, globalization in general is enabled by tremendous improvements in transportation, communications, and computer technology. Without these three factors, there would be little globalization in any industry.

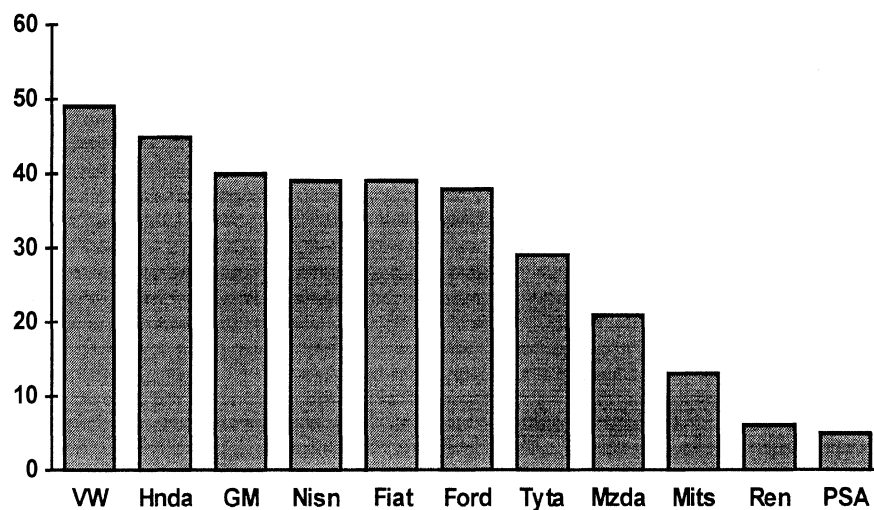
The impact of advancements in transportation, communications, and computer technology covers a wide range of developments that increase globalization through changes in manufacturers of vehicles and components, customers, and nonautomotive organizations interacting with the industry. These developments include a greater ease of producing vehicles and parts for worldwide consumption for the manufacturers, a greater likelihood of people worldwide buying those vehicles, and a higher probability of governments and professional societies behaving in ways that will foster the ability to conduct business in a global fashion. Figure A-1 lists some of the enablers, drivers, characteristics, counterforces, and impacts of globalization.

Enablers
<ul style="list-style-type: none"> •Transportation •Computers •Communication
Drivers
<ul style="list-style-type: none"> •Increased competition within the worldwide automotive industry •Maturation of the North American automotive market •Need for scale economies •Need for efficiencies in product development and distribution worldwide •Need to please the customer worldwide •Need to rely on the vast pool of human resources worldwide •Reduced tariffs and nontariff blockages to trade and capital flow •Technology that facilitates global management
Characteristics
<ul style="list-style-type: none"> •Instantaneous voice, data, and image communication •International work assignments •Consumer awareness of worldwide tastes, customs, culture, etc. •International travel •Harmonization of standards •Structuring of corporations for global business
Counterforces
<ul style="list-style-type: none"> •Isolationist policies •Disparities among levels of economic development
Impacts
<ul style="list-style-type: none"> •Increase in competition •Overcapacity •New ways of marketing vehicles •Decision needed on serving few or many markets •Human resources complexities

Figure A-1. Some Enablers, Drivers, Characteristics, Counterforces and Impacts of Globalization

Manufacturers

The process of functioning globally is made possible by technology that allows virtually instantaneous and complete communication of voice, data, and images. This means that a vehicle designer in Michigan can share ideas, images, and data with a marketing colleague in France and an engineering colleague in Japan. Products can now be planned with current input from participants worldwide. Figure A-2 shows the percentage of production of eleven of the world's leading vehicle manufacturers done outside the home country. In 1995, the percentage of such non-home-based production for these eleven manufacturers ranged from about 5 percent to 50 percent. These percentages are expected to grow in the future as globalization progresses.



Source: 1996 *Ward's Automotive Yearbook*. Southfield, MI: Ward's Communications, n.d.

**Figure A-2. Percent of 1995 Vehicle Production
Away from Home Base, by Maker**

The enormous, increasing power of contemporary computers is supplementing instantaneous communication. This technology allows the development—and modification for worldwide consumption—of vehicles using digital technology to eliminate much of the time required for traditional development.

If computers and communication technologies do not meet all the demands of worldwide purchasing, design, engineering, manufacturing, and distribution, improved transportation allows people to travel quickly to remote locations to have the face-to-face interactions. It is commonplace for an employee of an automotive company to fly to a foreign country on very short notice; to expect to live and work in a foreign country for an extended period of time; and to work with people (suppliers, customers, governments) of foreign countries. Advances in transportation are more than likely to continue to enhance globalization.

Consumers

Consumers, as well as manufacturers, are affected by transportation, communication, and computers—creating an unprecedented awareness of the characteristics of other populations worldwide. Computers function as communication devices—providing access via the World Wide Web to information about other people, their customs, and their vehicles. Similarly, international broadcast communication media such as television (e.g., CNN broadcast of the Gulf War), newspapers, and radio (presently primarily one-way communication devices) are key facilitators of globalization of the automotive industry. They offer insight into the customs, culture, politics, religion, life style, and fashion of people worldwide. From this communication, which is expected to increase in global coverage, may come a homogenization of tastes in vehicles, as well as other goods. In the future, consumers around the world may well be purchasing more similar products.

Variations in tastes for vehicles will remain, however, driven in part by resource differences, cultural differences, and expectations about styling, handling, speed, functionality, etc. These variations may require more niche and country-specific vehicles. This will likely be the case in countries without a modern highway infrastructure. Further, varying levels of income will mean that many consumers will have a taste for goods that they may not be able to afford.

As consumers have the ability to travel more easily across national borders and become more aware of vehicles used in other parts of the world, we expect they will show an increasing indifference to the national origin of vehicles. Some purchasers will choose vehicles of their home country for individual personal, cultural, and nationalistic preferences or because of government-imposed local content requirements for manufacturers. Others will not care—as evidenced by the large share of the United States light duty vehicle market that is held by foreign-based manufacturers (almost 26 percent in 1996¹).

External Organizations

Many forces come together in the marketplace to foster the sale of a product. One is the technology push from the manufacturing company; another is the consumer pull: that is, their desires and needs. A third, and very important one, is the influence of external organizations such as governments and trade associations. These organizations may regulate industry and develop standards or protocols for the product, processes or behavior of the companies involved in the transaction. They seek to protect the consumer and coordinate or standardize appropriate parts or processes across companies. In the United States, the Society of Automotive Engineers develops various engineering and manufacturing standards. Internationally, the International

¹ *Automotive News 1997 Market Data Book*. Detroit: Crain Communications, Inc. May 28, 1997: 48.

Standards Organization (ISO) has been developing process standards since 1946. Its role is to examine various processes for manufacturing, quality, and other activities in an effort to create a consistent standard for product look, feel, quality, etc. ISO's goal is to have a world where products are ranked or rated in such a way that the ranking or rating is universally meaningful and equivalent.

In the United States, one role of the federal government is to regulate motor vehicles with regard to functions such as emissions, safety, and fuel economy. The National Highway Traffic Safety Administration of the Department of Transportation regulates automotive safety and fuel economy, and the EPA controls vehicle emissions. Elsewhere, while individual governments now promulgate regulations (e.g., vehicle dimensions, crashworthiness, emissions levels, recycling) of their choice, the future may move them toward a commonization of regulations across national borders.

A further move toward globalization on the part of governments is the lowering of trade barriers through 1) the global General Agreement on Tariffs and Trade, which has sought to lower tariffs and nontariff barriers, and 2) the development of trading blocs such as the European Economic Community (EEC), the Association of Southeast Asian Nations (ASEAN), and the North American Free Trade Agreement (NAFTA), which serves to further stimulate trade in large regions. Other factors contributing to the decline of trade barriers will be increased political stability, economic development, the decline of the state enterprise model, as well as the development of common currencies and an international monetary policy.

Countertrends

Some forces over the next fifteen years will operate counter to globalization. Some of these have to do with the inability of individual countries to function at world-level standards. A developed nation may be capable of meeting ISO standards, while a developing country may simply be unable to do so. Some standards, such as those governing fuel economy, safety, or the environment and its contaminants, may be too severe in developing countries. A counterpart to this issue is the "energy tax effect." In North America, the gasoline taxes are low compared with taxes in the rest of the world—creating a market for vehicles in North America that is very different from markets elsewhere.

As noted above, trade agreements such as NAFTA, ASEAN, and EEC facilitate trade among their members. But they may hinder trade, especially imports, with nonmembers. At best, trading blocs can encourage economic development in less-developed countries; at worst, they may represent a "counter-reformation" to the principles of free trade.

Globalization may slow because it is driven largely by the private sector. Because the nation-state is not likely to disappear, the increasing ease of trading and communication globally could create tensions between national and corporate interests. For instance, manufacturers are increasingly free to locate plants according to economic imperatives, such as lower-cost labor. This freedom could create insecurity in the labor force of high-

wage nations who could pressure their governments to slow job loss to overseas countries. Many governments, especially those not popularly elected, may feel threatened by the easy access their citizens have to information about the world. Still other governments may have legitimate concerns about their eroding cultural identity. The issue of intellectual property, where the proprietary work of a corporation is essentially left unprotected in some markets, remains an issue of conflict.

Corporate Structural Strategy

Assuming that the forces driving globalization will prevail, decisions need to be made regarding corporate structural strategy. There are two kinds of strategies that have emerged in the automotive industry's current globalization activities: parallel and integrated. Parallel corporate structures generally mean that a company establishes free-standing organizations in different countries or regions, each capable of a significant degree of independent decision-making and functional operation (design, manufacturing, etc.). The company may be organized regionally but integrates its strategy globally (particularly in product architecture and its functions). These operations are suited to the local markets and the requirements of the applicable governments. General Motors runs its European and American operations with this organizational structure.

An integrated structural strategy, on the other hand, calls for formally organizing a company functionally on a global basis. It tends to assign specialized responsibilities to each region to achieve worldwide efficiency and economies of scale while avoiding duplication. Ford Motor Company, for instance, plans to develop small- and medium-sized vehicles for global markets in Europe and large-sized vehicles in the United States. Its intent is to move from a parallel to an integrated organizational structure. To be sure, a company may have an integrated structural strategy for some markets and parallel ones for others, depending on many different factors. Honda and Toyota seem to be pursuing parallel strategies in the United States, while following a more integrated approach in Asia, sourcing specific components from different countries, fostering specialization across countries.

Finally, many other vehicle manufacturers are not committed to fully developed global strategies, but follow a more eclectic or opportunistic approach, pursuing some opportunities while letting others pass. These companies conduct business internationally, but global presence itself is not a major corporate goal. Chrysler is the most open about electing this option, but others probably include some of the smaller European and Japanese manufacturers. Of course, even these more restricted global efforts are greatly facilitated by speedy transportation and communications.

Impacts of Globalization

Just as there are, and will be, virtually irreversible enablers (transportation, communications, computers) and drivers (commonization of tastes and standards,

increased competition, etc.) of globalization, there will also be many impacts of globalization upon the automotive industry. One of these impacts will be a cyclical increase in competition worldwide. Competition will thus be both a driver and a consequence of globalization.

From a corporate perspective, competition across national boundaries is largely the same as competition within a country's borders. However, there are some differences that warrant discussion. First, emerging industries and markets can represent a competitive threat as well as an opportunity. Some developing countries already have significant raw material resources and see an indigenous auto industry as a necessary step to building a strong, diversified economy. The more ambitious among them, such as South Korea, plan to acquire significant additional export capabilities and may prove to be major competitors to North American producers in about ten years' time. China remains the great unknown.

Second, when a manufacturer builds a plant in a developing nation, it trains local people to build its product. If that company also requires its suppliers to establish a local presence or even to build its own parts or components plants, it establishes a source of parts and components for that product. With or without a government policy regarding an automotive manufacturing industry, having a local presence helps facilitate the transfer of technological and managerial know-how that was once a competitive advantage. In some ways, therefore, globalization sows the seeds for both commercial opportunity and commercial threat. The competitive threat will be enhanced as companies expand production capacity beyond their borders. If demand does not keep up with production potential, the industry will face a condition of overcapacity for vehicle production. As suppliers attempt to do business in too many markets, they may become overextended.

Most manufacturers start by exporting products designed for their home market. There are limitations to this strategy since consumer wants and needs can vary considerably from market to market, depending on income, vehicle operating conditions, and many other factors. Consequently, auto manufacturers will have to make decisions about product development and design that determine whether vehicles will serve few or many markets. In North America, brand management (discussed in the next section) seems to be taking hold as a strategy for understanding individuals' wants and needs. Brand management may also have a role in global markets, in light of the possibly conflicting desires of consumers in different markets and manufacturers' desires to minimize production variation. A strong brand may allow a manufacturer to do less tailoring to specific markets. It is this manufacturer who will be able to come closest to offering a true, same-in-every-market "world car." Manufacturers must thus decide whether to serve a few or many markets.

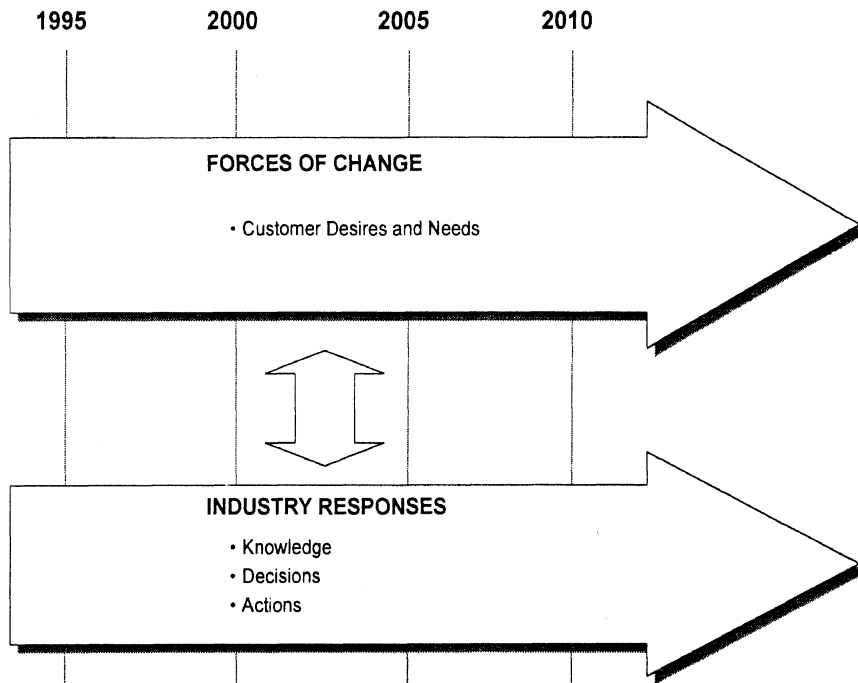
The manufacturing and marketing requirements in other countries may vary greatly from those in the home market. Adopting one kind of structure over another in a given market reflects, in part, a company's particular needs but also its commitment to global success. Companies that wish merely to sell their home products in markets willing to purchase them may need nothing more than an export office. Companies interested in designing products for particular markets, and possibly even building them there, will

require a substantially different organization. The decision to pursue and implement a global corporate structural strategy, be it integrated, parallel, or opportunistic, and to pursue its own market and production areas, will be based in part on the characteristics of the country under consideration. For example, if Chrysler follows its current pattern, it will continue to export vehicles, except where required to produce them locally (such as in China, Mexico, and Brazil). Additionally, companies in the process of developing their global structure will have the opportunity to partner with companies across product and national boundaries.

As a company becomes more global, human resource management issues will become more complex. Not only will the usual issues of dealing with human resources in the home market be of importance, but the complexities of employing foreign nationals and transplanted North Americans will add to the challenges of conducting business worldwide. Decisions will have to be made on how to allocate scarce human resources between global opportunities and the domestic market. Future employees in the automotive industry may be asked to work in foreign locations. They may be in competition for jobs with workers from other countries. Or, there may be a requirement to team with members from many countries. Strong interaction skills on the part of virtually every worker will be required, in foreign as well as domestic places of employment. It is expected that foreign assignments of staff will be made at all employee levels. In particular, management level employees will need to be successful at foreign assignments in order to advance within their own companies.

Implications

Globalization by the North American automotive manufacturers will be enabled by the significant advances in computer, communication, and transportation technology in the next two decades. This will be driven by the virtual saturation of the North American and other developed markets as well as opportunities in undeveloped markets, facilitated by a wide range of global, economic, social, and political factors. These factors will impact the way North American automotive companies structure themselves and find themselves competing in a newly fashioned industry in a different world market. Auto companies and their suppliers will find themselves making hard decisions about designing, marketing, purchasing and manufacturing in locations worldwide. They will not have control over many of the factors impinging on their decisions. Consumers will have a global mindset, with an indifference to the national origins of a company or the location of its plants and the rubrics of "imported" or "domestic" become less meaningful. Overall, the process of globalization will, in theory, make it easier for manufacturers to sell around the world (albeit with many practical difficulties), but also make it easier for new manufacturers to enter the market fray. The winners and losers in the new world marketplace will be determined by their understanding of and response to globalization trends.



B. Customer Desires and Needs

Introduction

Customers are forcing changes upon the auto industry in ways unknown in the past. Car companies could once create a product based on their own perceptions of what was appealing and desirable, much as artists create works of art using their own ideas of form or content. The days of transportation as an art form are over. Science will help shape the cars of the future.

The industry is changing and will continue to change because, very simply, there is much less margin for market error when total vehicle sales are essentially flat, consumers are increasingly knowledgeable, and many competitors provide appealing products. In such an environment, that success will result from identifying customer wants and needs and producing a product that satisfies those wants and needs. Wants and needs are by no means limited to product features like air conditioning or behavior such as handling. Consumers value perceived qualities, like status or the solid sound of a slammed door, in determining the car or truck that they want.

Consumers have become increasingly sophisticated about the automobiles they buy. Years ago, many buyers took pride in repeatedly buying a particular make or even model, spending little time considering competitors' offerings. Today, and perhaps even

more in the future, consumers are more likely to change this behavior. They know there are many choices that can meet their needs, and they seem committed to weighing the pros and cons of these choices. A myriad of information sources that were not available years ago, such as consumer magazines and most recently, computerized information sources will help them reach a decision. The manufacturer may have less ability to influence consumers than before.

Not only are customers increasingly savvy buyers, they have more choices than ever. They can choose among manufacturers, among segments, whether to buy new or used, whether to lease or buy, and more. The future is likely to promise even more choices, such as bypassing the traditional dealer network and buying over the Internet, or shopping at megadealers whose inventory contains samples from many, if not most, of the vehicle manufacturers. Because of increased customer sophistication, lack of owner loyalty and a multitude of choices, car manufacturers will need to be more in tune with their buyers than ever before.

Identifying Customer Wants and Needs

Defining what consumers want and need in cars and trucks remains the most important task of the North American auto industry. Sophisticated, demanding consumers, an increasingly saturated market, and a multitude of choices have combined to make the North American market more competitive than ever. This intense competition shows no sign of letting up in the next ten to fifteen years. Consumers are in control, presented with marketplace choices and power they previously had not possessed. Consequently, there is little room for error; products that do not meet the expectations of their intended buyers will fail to reach their maker's expectations in the market.

When someone buys a vehicle, the choice is based on a complex set of needs and desires. Desires may reflect personal considerations of both objective or measurable attributes and subjective or emotional factors. Often there is a compromise between the two, as in the buyer who wants a sports car but who must have enough seats to transport family members.

To answer the question of what consumers want and need, manufacturers must examine a set of factors and trends that involve tastes, their customers' personal circumstances, and evolving societal and economic conditions, some of which may be discoverable through social science research. Tastes will always be difficult to determine but will include a vast array of preferences for vehicle size, features, colors, and many other factors. Personal circumstances include income levels, mobility requirements, age, family size, and commuting patterns. Evolving trends relate to the disparities in the distribution of wealth and income, rapidly changing technologies, etc. Affordability of vehicles is a major concern and is discussed later in this section.

However, success will also depend on *cultivating* wants and needs, since even today's jaded consumers can still be surprised and delighted by the unexpected. Manufacturers must continue to take the lead in determining the vehicle's features and attributes. "Listening to the customer" still leaves a great deal of responsibility on the

manufacturer's shoulders. The industry is filled with examples of products or features for which there was no discernible clamor by customers, but which were enthusiastically embraced when they reached the market: minivans, upscale utility vehicles, remote-locking, and antilock braking, to name a few. An example of this is the customer who recently purchased a new minivan that came equipped with a remote access key fob. The customer initially regarded this remote access feature with indifference. After several weeks, however, the feature was regarded as all but indispensable. We think this provides an example of the manufacturer exceeding customer expectations. Competitive assessment and traditional benchmarking may ensure parity with rivals, but are no assurance of exceeding what customers expect, much less originating exciting new features. Manufacturers will continue to influence tastes through the products they bring to market. Despite well-intentioned and valuable efforts to obtain customer inputs into future products, manufacturers should remain "thought leaders" in the design of their products.

On the other hand, giving customers what they don't want or need can be wasteful. For example, manufacturers have come to realize the excessive expense associated with designing unique parts that provide no added value. Electrical connectors are often cited as an example of components that could be standardized across several vehicle platforms, instead of being uniquely designed as they are now. Wheel bearings provide an excellent example of unnecessary component variation in the auto industry. Auto manufacturers have specified for their suppliers a variety of designs, all of which serve the same function. Consequently, suppliers and their customers lose the potential cost savings that result from economies of scale. In addition, they tie up engineering resources by designing such unnecessary component variation.

Customer needs may be defined, in part, by their circumstances. Income, age, vehicle use patterns, etc. help define the set of needs. In the future, many developing trends will influence what customers need. For one, life expectancy is increasing—as is the number of elderly. The U.S. Bureau of the Census estimates that the elderly population "will more than double between now and 2050." Most of that increase should happen between 2010 and 2030.² While most persons enjoy robust health and unimpaired mobility during advanced age, many older Americans will have special transportation needs, based on limited vision or use of wheelchairs or walkers. Automakers are already anticipating these needs by developing controls and door openings that accommodate arthritis sufferers or those whose bodies are simply less nimble than they used to be.³ Other people will be limited by physical handicaps, age and other circumstances in using traditional modes of personal transportation.

Specific groups in society may require special attention from vehicle manufacturers in the future. With more and more women becoming the primary or sole driver of a vehicle, women's concerns about vehicle design and operation now receive increased consideration.

² "Sixty-Five Plus in the United States." [World Wide Web site]. U.S. Department of Commerce, Economic and Statistics Administration, U.S. Census Bureau, May 1995: 23-90.

³ David McGinn and Julie Halpert. "Driving Miss Daisy—and Selling Her the Car." *Newsweek*, 129, no. 5 (1997): 14.

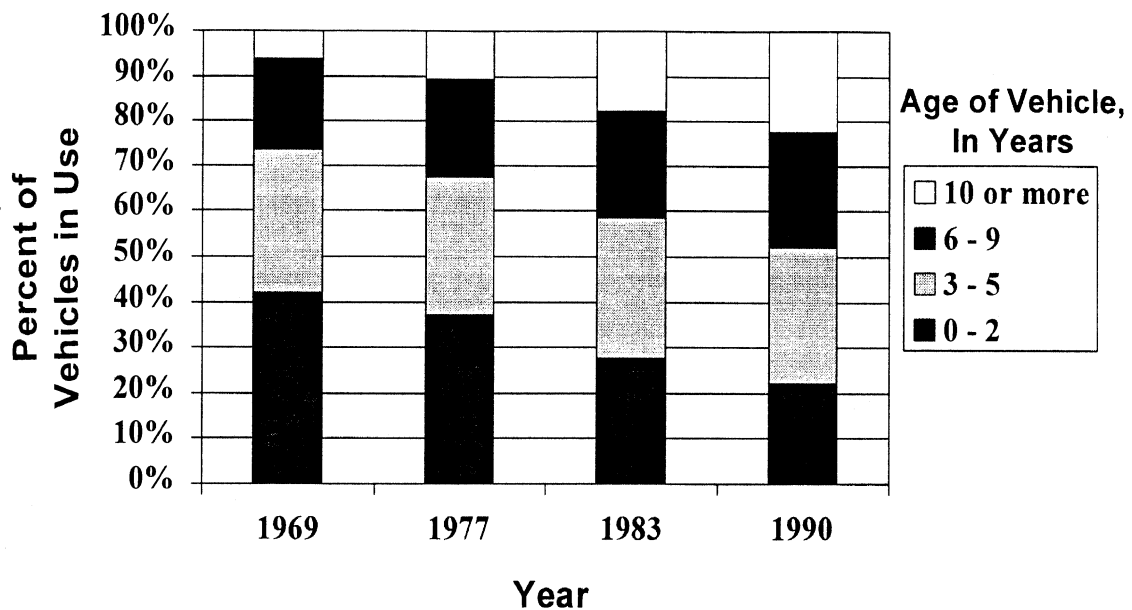
Initial efforts by manufacturers to consider issues that might be of concern to women often centered around paint schemes and upholstery fabrics. These efforts were more superficial than they could have been. More serious efforts might consider women's smaller size and generally lesser strength, relative to men. In addition, women often have more security concerns. They are still more likely than men to be concerned about their physical safety in public places. Getting stranded on a deserted stretch of road at night is more threatening to a woman than to a man. Women, then, may value vehicle reliability, security devices, or emergency assistance services more highly than do men.

Women are not the only group in society whose needs may differ from those of the largely male population who design and build vehicles. Forecasts suggest that America may continue to welcome new waves of immigrants, many of whom may not speak English well or at all. This might mean that vehicle controls must be clearly marked with icons, as well as warning labels and vehicle instruction manuals using signs and symbols, if not multiple languages. Interestingly, manufacturers on all continents might see their designs becoming more similar as global interaction grows and tastes for many goods converge.

General Vehicle Issues

Changes in the vehicle itself and how customers perceive it also need to be considered in meeting customer needs and desires. First, consumers are finding that, with greater reliability and durability and fewer maintenance requirements, they can keep their cars longer than in the past. Consumer demand for high quality, long-lasting vehicles is not likely to diminish. Customers expect proper fit and finish and few if any defects. Consequently, since vehicles now last longer and require less periodic attention, people can buy them less frequently. While still subject to wear and tear, cars and trucks retain their peak performance characteristics longer, while maintaining a high level of reliability and dependability. What that means to the auto industry is that consumers have more discretion in determining when they *want* to replace their vehicles, as opposed to when they *have* to replace them. Figure B-1 illustrates the increasing life span of vehicles from 1969 to 1990 and the increasing use of older vehicles.

The greater longevity and reliability of vehicles, coupled with higher new car prices, has changed some people's attitudes about owning a new vehicle versus a used one. In the past, buying a used vehicle was decidedly a second-choice option. The used vehicle buyer had legitimate concerns about buying someone else's "problems," since the potential for unreliable behavior was large. With today's higher quality, backed by longer warranties, buying a used car is a much less risky proposition, with potentially greater savings. Combined with the fact that many consumers no longer place so high a value on new car ownership (relative to other products and services) the used, or nearly new as it has been called, vehicle becomes a competitor to the new vehicle.



Source: *Our Nation's Highways: Selected Facts and Figures*. Washington, D.C.: U.S. Department of Transportation, Federal Highway Administration: 30, Publication No. FHWA-PL-95-028.

Figure B-1. Increasing Use of Older Vehicles: Age of Vehicles as a Percent of All Vehicles in Use

Much has been made of the shifting acceptance of owning used vehicles. Some observers have even suggested that this trend could have a serious impact on new car sales, with many former new car buyers opting for used cars. Such forecasts contend that this changing preference could cause sales of new cars to plummet. This gloomy prediction may ignore some important economic considerations. For one, the supply of used cars depends directly on the sale of new cars: Every used car must start life as a new car. If shoppers increase their consumption of used vehicles, supply falls, forcing prices up. These now higher-priced used vehicles will look like less of a bargain compared to the new vehicles. At the same time, falling new car sales will depress new car prices. There is, then, an equilibrium relationship between the sale of new and used vehicles.

Moreover, designs will continue to generate excitement in the market and appeal to the desire among most people to acquire new things. New designs often incorporate the latest technology, including advances in safety, crashworthiness, etc. Consumers who want the latest in safety or security will be moved to replace their outdated model with something new. Although it is less compelling, some consumers might be interested in

buying something new to have the latest in environment-protecting technology. Of course, there are also unexpected events, like oil shortages, which can cause a migration to different vehicles—smaller, more economical ones, which are usually new.

The industry may need to look beyond the products it produces to the environment in which they operate. The condition of the infrastructure could have a great impact on consumer tastes. If roads and bridges decay, or thoroughfares congest, drivers may opt for other forms of transportation. The same holds true if the price of gasoline increases significantly.

If the future looks uncertain for new car sales, the manufacturer might try to participate more fully in the “transportation value chain.” For example, today’s vehicles contain an extraordinary amount of electronic devices, controlled by software. Some of that software could be updated, as well as the components themselves, to make the vehicle perform better or just differently. The manufacturer could provide consumers who choose to postpone the purchase of a new car or truck with software updates. In this way, assemblers can more fully participate in the value chain—beyond design, manufacturing, and distribution.

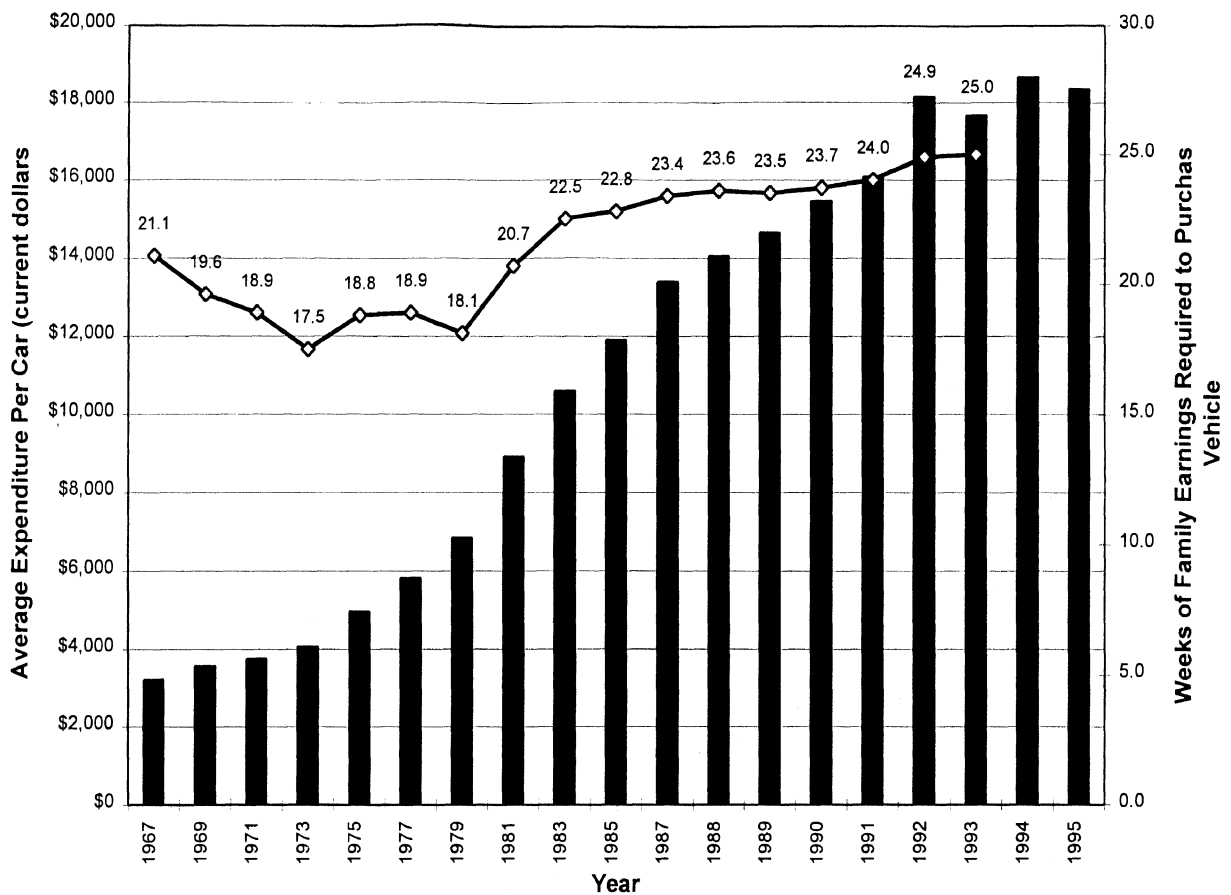
However, manufacturers should probably limit themselves to providing transportation products that fall within a scope defined by their core competencies. American car companies have expanded into nonautomotive transportation products (such as airplanes) without great success. Perhaps concentrating on personal mobility needs, and continuing to design products that meet those needs, is the best approach.

Affordability

Income levels and spending priorities are likely to change in the next ten to fifteen years. New vehicle prices as a percentage of income have reached historic highs in recent years. It takes more weeks’ pay to buy an average new vehicle now than in the past.⁴ New vehicles, therefore, will continue to be out of reach for some consumers because of high cost. For other buyers, it is simply personal preference: At some price level, even the financially able may opt for a used car (or keep a car longer than planned). The issue of affordability is a complex one. Figure B-2 illustrates the average expenditure per car from 1967 through 1995 in equivalents of percentages of weeks’ earnings.

The concern in the industry should be about pricing new car buyers out of the market—an issue with two sides. First, there are consumers who lack the means to buy a new car, or at least all but the least expensive ones. Secondly, there are those who can afford to buy a new vehicle but choose other products. Such people may prefer to purchase computers, vacations, or education, and either postpone the purchase of a new car or buy a used one. It is this latter group of consumers who may be more worrisome for the industry because they have the means to buy the high-margin, expensive cars and trucks, but choose not to do so.

⁴ *Motor Vehicle Facts and Figures*. Detroit: American Automobile Manufacturers Association, 1996: 60.



Source: *Motor Vehicle Facts and Figures*. Detroit: American Automobile Manufacturers Association, 1996: 60

Figure B-2. Average Expenditure Per New Car, 1967-1995.

Affordability is a double-edged sword. It is true that buying the average new car consumes more of a paycheck than in the past. However, many buyers continue to buy high-priced, option-laden vehicles. It seems a truism to say that if only manufacturers would offer less costly vehicles, more people would buy new cars. But is this really true? Perhaps buyers opt for nearly-new used cars to get all the features and equipment they desire. They might not want more affordable, less-equipped models. A great deal of research would have to be done in this area (beyond the scope of this project) to be able to draw reliable, meaningful conclusions. Anecdotal evidence suggests that "high" prices are due to a combination of factors, including more niche vehicles with lower sales volumes and the consequent reductions in economies of scale, consumers desiring feature-rich vehicles, and government regulations that require fitment of costly devices. An aging population of baby boomers, many of whom have reached their peak income-earning years, have the resources to buy expensive cars and trucks. As a group, they are likely to have even more resources in the future. So, while some consumers decry rising prices, many of them still have the ability to buy what they want.

Brand Management

The basic foundation in building a brand is to develop a position for that brand: who you are going to sell it to—maybe the whole world or maybe a niche market. That takes research, thinking, logic, everything that's important in business.⁵

In a market that offers consumers a great number of choices, there is the potential for much product overlap. This can occur both in the mind of the consumer and in the mind of the manufacturer, especially those manufacturers with several divisions. A marketing practice new to the auto industry, brand management, is attempting to bring order to what is sometimes a chaotic and confusing marketplace. Overall, brand management, targeting a specific group of customers and focusing market research on them, will help define a product's image and thereby attract specific kinds of buyers. In addition, it will help identify customer wants and needs for the product development team. Effective brand management will provide consistent messages from both the manufacturer and the retail channel, consistently across both the shopping and aftersale experiences. It is potentially a way of differentiating products from each other and allowing them to stand out from the crowd.

It is also a way to maximize customer satisfaction. By using customer research to fine tune the features and attributes of a vehicle, a company can more closely meet customer needs and desires, and better satisfy a targeted group of customers. In fact, by tailoring a vehicle, shopping, or aftersale experience to more closely meet the desires of fewer customers, rather than trying to satisfy everyone, manufacturers might be able to charge a premium for their products. That may cause a significant change in mindset in the industry. By attempting to maximize customer satisfaction, instead of sales, carmakers may be able to better optimize profits and sales, as well as encourage repeat sales.

As a sustainable competitive strategy, brand management may have its shortcomings. Any manufacturer can adopt the practice of managing his brands. This is a strategy that could likely be duplicated throughout the industry. Manufacturers have been using marketing tools, like advertising, to build image for years. Defining a product's image and its intended users has its risks. A product with too narrow a focus may face inadequate sales, as potential buyers who believe they do not fit the buyer profile turn away. Similarly, manufacturers risk alienating past buyers if an image is switched mid-stream.

Second, it is hard to create a brand image, particularly if the product is not really new. Consumers familiar with it have already formed an opinion. It is not easy to change that opinion. In fact, any image must be rooted in some kind of observable reality. A manufacturer cannot simply decide that his vehicle is sporty or safe without product attributes or features that elicit that perception. On the other hand, some manufacturers developed a reputation for certain vehicle attributes or behavior and retained that reputation long after their vehicles no longer matched the image, or other

⁵ Elinor Selame. President of Brand-Equity International, quoted in "Brand Management" by Frank McKenna. *Industry Week*, (March 20, 1995): 51.

manufacturers' models more clearly matched or exceeded it. Third, if the brand messages are not consistently delivered through the retail channel, the investment may not reap significant results.

Brand management can help manufacturers internally as well as externally. Car builders with several divisions sharing vehicle platforms stand to gain, as marketing staffs clarify customer desires and vehicles are focused on satisfying those desires. Some observers believe that automobiles have become commodities; that future areas of competition for customers will involve nonproduct attributes like sales approach and service. This may be true to some extent. However, just because there are many choices in a segment does not mean that those choices are necessarily commodities. If they were, people would buy solely on price, and they do not. Brand management will help marketers identify those unique properties of their vehicles and emphasize them to the appropriate customers.

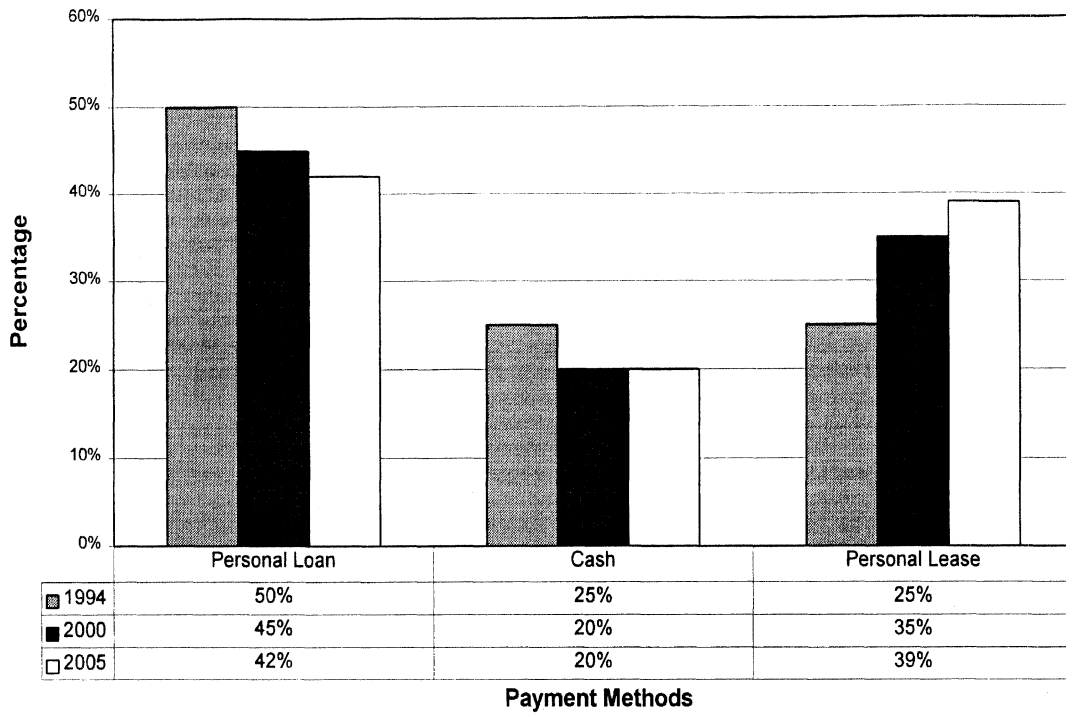
Brand management is likely to help clarify the vision: Which customers will find a particular model appealing and how will they be treated? There are risks, but a system of customer-focused marketing can only provide consumers with products that more closely meet their needs and enhance the potential for owner loyalty.

Consumer Choices

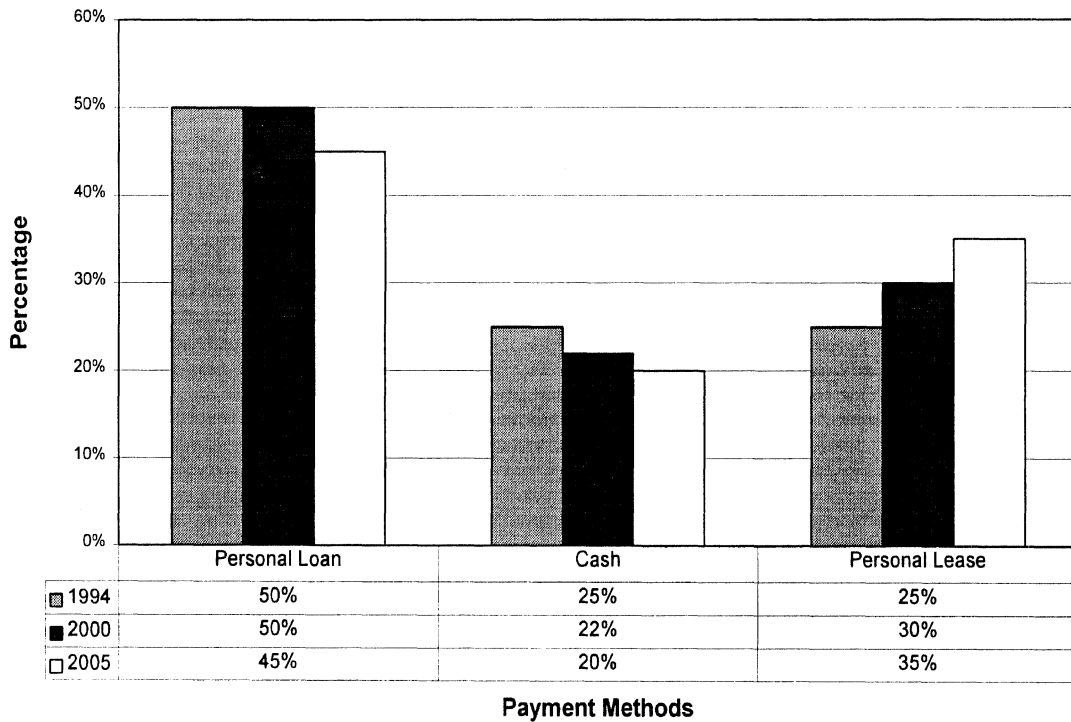
It goes without saying that consumers have a great array of choices in makes and models. There are other choices relating to financing, ownership, and even the environment that may alter the industry significantly.

As discussed above, affordability has become an issue in the auto industry. One way the industry has coped with higher prices is through leasing. Although it started as an arcane and infrequently used financing method favored by business users, leasing has become much more widespread. Figure B-3 shows the expected growth in leasing as a means of payment for new cars and light trucks between 1994 and 2005. There is some disagreement, however, as to why it has grown in popularity. Some say that leasing is the consumer's answer to high prices. Typically, monthly payments are lower than for conventional financing, since the consumer is not gaining equity in the vehicle. The other side of the coin, however, is that because of the lower monthly payments, people may opt for leasing in order to acquire a more expensive vehicle than they might be able to afford through buying. This affordability conundrum remains.

New Car Purchases



Light Truck Purchases



Source: David E. Cole et al. *Delphi VIII Forecast and Analysis of the North American Automobile Industry: Technology*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 105.

Figure B-3. Payment Method for New Passenger Car and Light Truck Purchases

Leasing has become so commonplace that its popularity suggests some interesting possibilities for the future. First, the popularity of leasing, which is really just another term for renting, says that people may not be particularly wedded to the notion of owning their vehicles or keeping them for long periods of time. The market has already become "nichified," with enough variation in vehicle body styles and options to satisfy very personalized tastes. A logical next step might be that those who participate in leases sign a long-term lease agreement that includes either access to a number of vehicles that suit different needs and tastes or else involves frequent changes in vehicles used by the lessee. Larger manufacturers with a full array of products might be better suited to develop this kind of long-term arrangement with their customers. Obviously, the traditional sanctity of ownership has been breached, and leasing may merely be the first step along a path to other creative forms of providing consumers' transportation.

Nonautomotive products compete with cars and trucks for consumers' dollars. One poll has shown a steady decline in the relative preferences of buyers for new cars versus other products.⁶ As shown in figure B-4, a new vehicle was once a top choice of consumers for discretionary spending, but now a new vehicle often just makes the top ten, while used vehicles have increased in importance in the last five years. Home computers and vacations are taking dollars that might have otherwise been spent on a new vehicle.

1984		1990		1995	
Long foreign trip	40.2%	Upgrade housing	29.2%	Long US vacation	41.6%
Upgrade housing	36.2%	Long foreign trip	25.2%	Remodel kitchen	37.6%
NEW CAR	31.2%	Remodel kitchen	25.1%	Buy/start business	33.8%
New furniture	29.7%	Long US vacation	22.5%	In-home computer	31.6%
Remodel kitchen	29.6%	Home electronics	19.2%	Used car in household	29.8%
Boat	27.2%	New furniture	17.6%	Home electronics	28.4%
Long US vacation	26.4%	Buy/start business	17.4%	New furniture	27.2%
Personal investment	19.5%	Personal investment	16.2%	Long foreign trip	24.2%
Home electronics	19.5%	In-home computer	15.3%	Antique furniture	21.3%
Vacation home	19.2%	NEW CAR	14.7%	Upgrade housing	20.3%
Investment artwork	19.2%	Home addition	14.3%	Personal investment	17.6%
Buy/start business	16.4%	Big screen TV	12.9%	Home addition	17.2%
Used car for household	15.3%	Buy/replace boat	12.6%	NEW CAR	16.2%
Antique furnishings	13.7%	Investment artwork	12.6%	Big screen TV	13.3%
Home addition	9.4%	Antique furnishings	12.2%	Vacation home	10.6%
In-home computer	9.2%	Used car in household	11.4%	Buy/replace boat	11.7%
Acoustic piano	5.6%	Motorcycle (incl.H-D)	9.6%	Motorcycle (incl. H-D)	9.3%

Source: "Lease Trak, Money Trak, Auto Sales Trak Sales Guide," CNW Marketing/Research, 1997: 15-16.

Figure B-4. Consumers' Wish Lists

⁶ *Lease Trak, Money Trak, Auto Sales Trak Sales Guide*, CNW Marketing/Research, 1997: 15-16.

Distribution and Selling Today

Despite all the changes occurring elsewhere in the auto industry over the last decade, relatively few have occurred in the distribution system. The current retail system, for example, is largely the same as it has been since before the Second World War. A somewhat complex system of franchise agreements, reinforced by increasingly rigid state franchise legislation, has limited the amount and kind of change that can occur. The latest development is in nationally-operated chains (such as CarMax or AutoNation) which use money from public offerings or parent corporation sponsorship to develop a string of dealerships nationwide. These new, larger dealerships offer a break from the past, at least theoretically. They may be able to convince vehicle buyers that they will get better service through larger inventories and no-haggle prices. With a larger network of outlets, these national chains will sell multiple brands at higher volumes and may be able to garner quantity discounts—from manufacturers for vehicles and from suppliers for expenses like advertising. They will be able to sell at lower prices than smaller competitors.

Changes on the Way

It is not likely that the entrenched retail system is in danger of disappearing but its composition will evolve. Large national retail chains would operate large outlets requiring a sizable customer base to be profitable. Smaller communities will still depend on locally-based dealers who rely less on high-volume sales. In addition, many shoppers may prefer shopping at a smaller, "boutique" outlet concentrating on just one or a few makes, instead of the massive "superstore" outlet. In fact, there may be the opportunity to establish dealers who specialize in various market segments: dealers who sell primarily or exclusively sport utilities, or family sedans, for example. Comparison shopping seems to be a component of a consumer-driven market with many choices. Why not make the choosing easier by having like makes or models situated close to each other? Such a dealer might more effectively serve customers, if indeed the customer comparison shops similar models in reaching a final selection. In addition, if customers more frequently order products directly from the factory instead of settling for something in inventory, quantity purchases by national chains may become irrelevant.

Overall, there are several factors driving changes in the distribution system. First, distribution (including marketing efforts, delivery and expenses at the dealer) is often reported to comprise up to 30 percent of a vehicle's cost. That is a great deal of money, and since manufacturers have been carefully paring costs out of the manufacturing side, it makes sense that they would examine the distribution side, too. Second, customers have bemoaned the buying experience for years. Buying a car has been a battle of wills, as buyer and seller negotiate a final vehicle price. Buyers have become accustomed to paying less than retail prices for so many goods. Many buyers believe that dealers make enormous sums on the sale of new vehicles. These buyers might be surprised to learn that many dealers barely break even on new car and truck sales: Parts and service as well as used vehicle sales are far more profitable. Ironically,

customers complain about the negotiating process, which is, of course, initiated by the customer. It may be largely due to this pricing policy that Saturn has been so successful. Saturn dealers sell their products at fixed, nonnegotiable prices, and do not undercut each other.

Manufacturers are implementing ways to reduce the time it takes to get a vehicle to its customer. Changes at two important time periods are occurring: between vehicle order and assembly, and between vehicle assembly and delivery to its intended customer. In the latter stage, some manufacturers are using regional distribution centers to store completed vehicles so they can be quickly shipped to retailers at a customer's request. General Motors, for example, has implemented a system at Cadillac, and is testing with Chevrolet and GMC, whereby some of its models are built to popular specification, stored in distribution centers, and shipped to a dealer within twenty-four to forty-eight hours of a customer order. Further, this system supports delivering customer-ordered vehicles in two to three weeks. Early results suggest that the system works well and will be expanded to include other models. Volkswagen of America is working on a similar approach.

Compressing assembly time and using it more judiciously may be more complicated than reducing distribution time. Assembly plants have to juggle enormously complex production variables, including varying customer specifications, to produce desired products when they are wanted. Ultimately, manufacturers will try to operate plants that have the flexibility to build essentially unique products, faster. Logistics are also key, as well as the crucial "backend" to mass customization.

A potential shift in power could result from impending changes in distribution. In the past, retailers have been somewhat captive to the manufacturers, relying on manufacturer formulas for equitable distribution of product, financing, and incentives. If a redesign of the system in the form of national, publicly held chains takes significant hold, the manufacturers may find themselves with less power than in the past. Some of this is just an extension of what happens when dealers start to "dual," putting competing makes on the same showroom floor, and simultaneously diluting the influence of any one manufacturer. This latest development is of an order of magnitude greater, because if national new car chains develop, they will carry several, if not most, manufacturers' models. They may have enough inventory to sell (on the lot or through access to the factory) enabling them to begin to set terms for sharing marketing and distribution costs, sales training, etc. Large chains may be able to exercise considerable power in their relationships with the manufacturers.

Adopting New Technologies and Practices

In addition to the change in the structure of dealerships, there is a growing automotive marketing presence on the Internet. Most manufacturers have home pages which describe their products and identify local dealers. Some of these home pages list prices. It is illegal for the manufacturers to sell their products directly. However, it is possible to buy a vehicle through an independent broker's home page. In theory, the opportunity to bypass the traditional dealer is becoming greater, but most consumers

will probably want to test drive a vehicle before they buy it. For buyers who already know what they want, buying from a broker (whether via the Internet or telephone) is a good solution. Many other buyers will prefer the assistance they get from a dealer's salesperson. The salesman can offer insights and decision-making criteria to assist the customer in selecting the appropriate vehicle. Sunday "window shoppers" visit car dealers when they are closed to examine merchandise without having to encounter a salesperson. This would suggest that people still want to look and touch before they determine what they will buy. Like catalogs or television shopping networks, the latest developments in automotive distribution offer alternatives—not replacements—to the traditional way.

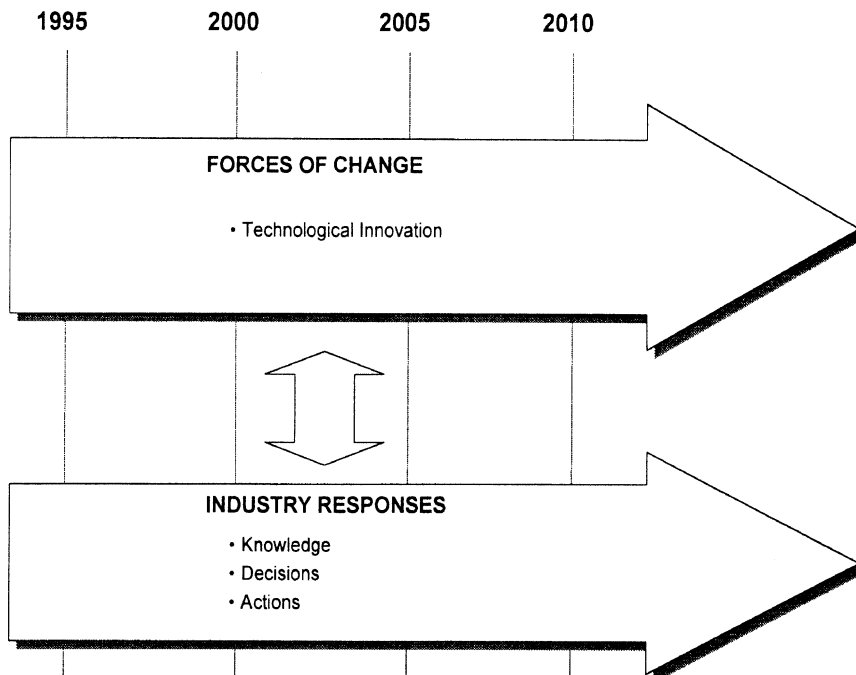
Buying through the Internet is not the only way to take advantage of computers in the retail or distribution environment. As manufacturers strive to shorten the amount of time it takes to build and deliver a custom-ordered vehicle to a buyer, more buyers will be willing to wait to get exactly what they want. Ordering systems that accept customer inputs on color, options, and other vehicle specifications systems could be set up at the dealership. A completed order would then be transmitted directly to the factory, where manufacture and dealer delivery dates would be calculated.

Implications

Vehicle manufacturers must give increased attention to the wants and needs of consumers to meet competition. The circumstances of the competitive North American automotive market is such that mistakes are costly. Products will have to be carefully designed and executed. Consumers will have little tolerance for settling for less than exactly what they want because they have so many choices. Similarly, how they are treated throughout the buying and owning cycles will play a major role in the product ultimately selected.

It will be important, therefore, that the industry devise ways to determine with pinpoint accuracy just who its customers are and what it is they want and need. Ideally, techniques like brand management will create processes that monitor consumer desires as well as promote new ideas, help differentiate products from one another, and maximize the value of the brand name by associating it with certain features and attributes. Tomorrow's vehicles will also be competing with other goods and services for consumer dollars. In addition, with reliability and durability at their highest levels, the timing for new vehicle purchases is becoming more discretionary.

Despite the uncertainty and the changing rules of the game, there are many opportunities for success. Success in the future will come to those manufacturers who can best and most quickly design products appropriate to their customers.



C. *Technological Innovation*

Introduction

Technology is changing at a rapid rate. Competition for customers, together with government regulation, is driving the ever increasing speed of technological change and the explosion of technical knowledge. For customers, technological changes are aimed at improving the products and services they consume. In productive organizations, technological change should mean improving operations, by doing more. More, better, faster, and cheaper has become a mantra for responding better to the needs and wants of customers.

Three types or hierarchies of technological innovation are occurring simultaneously and will continue to accelerate:

- *Enabling technologies.* A few underlying electronic technologies that pervade all human enterprise are currently changing very rapidly, and facilitate other technical and nontechnical changes.
- *Product technologies.* This is an area where changes typically directly impact *what* the customers sees and experiences—the shape and performance of the product.

- *Process technologies.* This is an area where changes affect *how* the product is conceived, developed, produced, and consumed.

To be viable, new technology must add value, not be technology for technology's sake. The application of new technology alone will not solve all problems; a systems approach is required. Technology is but one part of the much larger social and economic system. Attempts to copy technology without recognition of the market and social context of the technical problem have often failed.

There are likely to be strong interactions between technological innovation and globalization (figure C-1). Technological developments, particularly of the enabling variety, will speed up globalization. On the other hand, globalization likely will increase the rate of diffusion of technology.

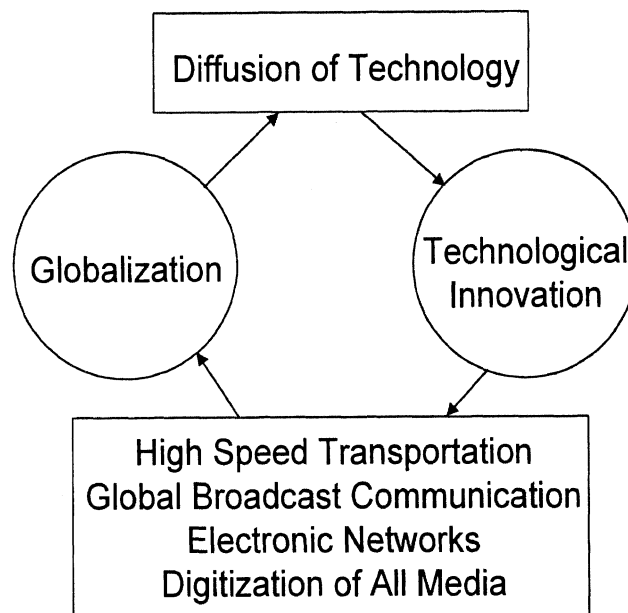


Figure C-1. Interaction of Globalization and Technology

General Technological Issues

It is beyond the scope of this paper to catalogue the myriad technological changes taking place and likely to take place in the next fifteen years. Nonetheless, an examination of likely changes reveals some common themes or issues, eight of which are identified and discussed in the following paragraphs.

1. Enabling electronic technologies will continue to develop very rapidly.
2. Technological changes will occur in engineering and manufacturing systems, processes, and equipment.

3. Ways of developing and implementing technology will change.
4. There will be major technological changes in automotive products.
5. Technological change will affect all parts of the value chain.
6. New technologies must contribute to a sustainable environment.
7. New technology will have a major impact on human resources.
8. Technology leadership and competitive advantage will be at risk.

Enabling electronic technologies will continue to develop very rapidly.

Increase in the speed of technological change is being enabled by the remarkable confluence of several underlying technologies. One of these is the rapid evolution of computing power: from bulky, stand-alone mainframe computers based on millions of semiconductors, to powerful, compact personal computers (with enormous memory capacity and speed) based on microprocessors (figure C-2). Another is the evolution of modern, high-speed telecommunications, not only by wire but by broad-band transmission over fiber optic cable and by satellite links to create an "information super highway." And a third is the development of the capability to digitize every sort of analog signal—linking data, text, sound, audio, image, and video—to enable simultaneous multimedia communications.⁷ Other enabling technologies, lasers and sensors, are complementary to these three and are just beginning to see wide application.

Chip	Public Debut	Initial MIPS*
Pentium	1993	100
Pentium Pro	1995	300
786	1997	500
886	2000	1,000
1286	2011	1,000,000

*Millions of instructions per second

Source: Intel Corp., Dataquest, Inc. in *Business Week*, (December 9, 1996): 15.

Figure C-2. Progression of the Microprocessor

The three technologies began to converge during the last fifteen years, with remarkable results. We see these results all about us: in multimedia personal computers, the Internet and World Wide Web, sophisticated electronic data interchange among suppliers, manufacturers, and transportation providers, and in increasing use of electronics in vehicles. As they continue to converge into reliable very-high-speed client/server networks, and as the ability to sense and communicate environmental variables, such as temperature, pressure, and acceleration is added, we can expect to see revolutionary changes in the way we design and manufacture products, procure

⁷ Don Tapscott. *The Digital Economy: Promise and Peril in the Age of Networked Intelligence*. New York: McGraw-Hill, 1996: 96-97.

parts, deliver products, and interact with customers, as well as in the products themselves. Advances in interactive design capability are linking U.S., European, and Japanese engineering sites today. These links will multiply rapidly in the next fifteen years throughout the value-added chain.

Within our society, the confluence of these electronic technologies will have great impact on lifestyles, which in turn will impact the shape of automotive demand.

Technological changes will occur in engineering and manufacturing systems, processes, and equipment.

Increasingly rapid application of math-based engineering, using the computational and manipulative power of computers, will take substantial engineering manpower, cost, and time out of the product development cycle. This will be accomplished primarily by reducing the need for prototype fabrication and testing, and at the same time, providing more optimal designs that can be manufactured more quickly at lower cost.

Equipment for manufacturing will be increasingly flexible, adaptable, and better integrated into factory-wide systems. Using flexible equipment, numerous product variations will be made almost as efficiently as manufacturing a large volume of standardized products.⁸

Ways of developing and implementing technology will change.

Manufacturing likely will become less separate from product conception, design, delivery, and disposal, as team approaches replace the old hierarchical approaches and discipline boundaries vanish. Increasingly, development engineering and manufacturing engineering will be done simultaneously, instead of serially, and manufacturing, distribution, merchandising, and service experts will have much greater input much earlier, as full partners in the product development cycle. Technology will drive knowledge sharing, facilitating globalization of product development and manufacturing, and knowledge sharing will further drive technology (figure C-3).

Process technology changes will reflect systems thinking and include a focus on flexibility, innovative distribution systems, and electronic communication among suppliers, manufacturers, dealers, and consumers. Emphasis on working to perfect entire systems will yield better products and lower costs. Suppliers, serving as systems integrators, will expand their support activities, such as R&D, component engineering, and purchasing. Systems integrators will assume responsibilities for executing technical tasks and coordination of technical and operational performance.⁹

⁸ Schroeder, Dean M., et al. "Linking Competitive Strategy and Manufacturing Process Technology." *Journal of Management Studies*, (March 1995): 164.

⁹ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 13-14.

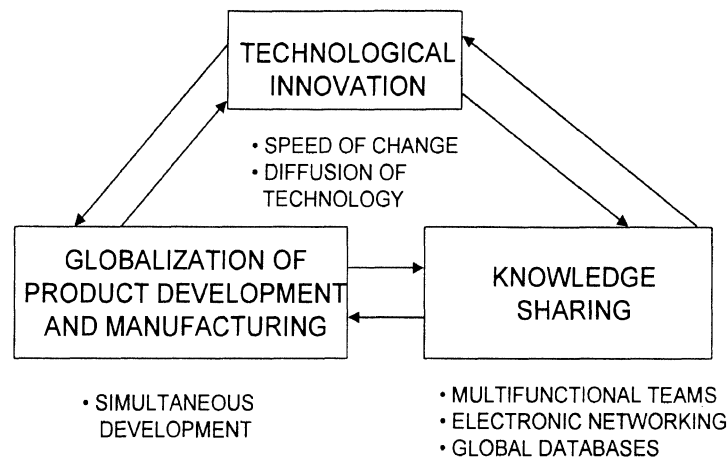


Figure C-3. Integration of Product Development and Manufacturing

At times, technological change proceeds in many small increments that appear to be continuous improvement or gradual change. At other times, as the result of major invention or process reengineering, radical change occurs in discontinuous breakthroughs. Some companies have focused on continuous improvement, and some have relied on major breakthroughs. Attention must be paid to both modes of change because they are complementary. Engineering and process changes that are both incremental and radical are essential to technological leadership. It will be critical in the future to manage both continuous improvement and re-engineering together.

There will be major technological changes in automotive products.

Product technology changes will include intelligent transportation systems that will impact vehicles, the highway, and the way they are used. Some industry observers believe a hybrid Stirling/electric vehicle is economically attractive and may be nearing technical feasibility. Alternative fuels and powertrain innovations to use those fuels are being developed. The joint industry/government-sponsored Partnership for a New Generation of Vehicles (PNGV) will be a major stimulus to innovative technology in fuels and materials over the next few years. Material substitutions that satisfy cost/weight tradeoff criteria are likely, with recyclability being an important factor in material choices. There may well be more electronics and fewer mechanical parts, with important cost, packaging, and weight advantages. Some predict that electronic componentry will grow to 20 percent of the total vehicle.¹⁰ High performance materials will be developed using

¹⁰ David E. Cole et al. *Delphi VIII Forecast and Analysis of the North American Automotive Industry: Technology*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 187.

computer-based design and manufacturing at the molecular level. (See Appendix, “Technological Innovation and Development,” for more detailed discussion of product changes.)

Better systems integration—that is, more seamless integration of electrical, electronics, and mechanical systems—will be a key challenge.

Technological change will affect all parts of the value chain.

Suppliers, assemblers, dealers, after-market service providers, and consumers will all be affected by technological advances (figure C-4). The consumer of the future may be very comfortable buying a vehicle or service parts on the World Wide Web. Suppliers and assemblers will use new networked communications capabilities to participate fully in product development teams. As work styles change, telecommuting may lessen consumer demand for cars.

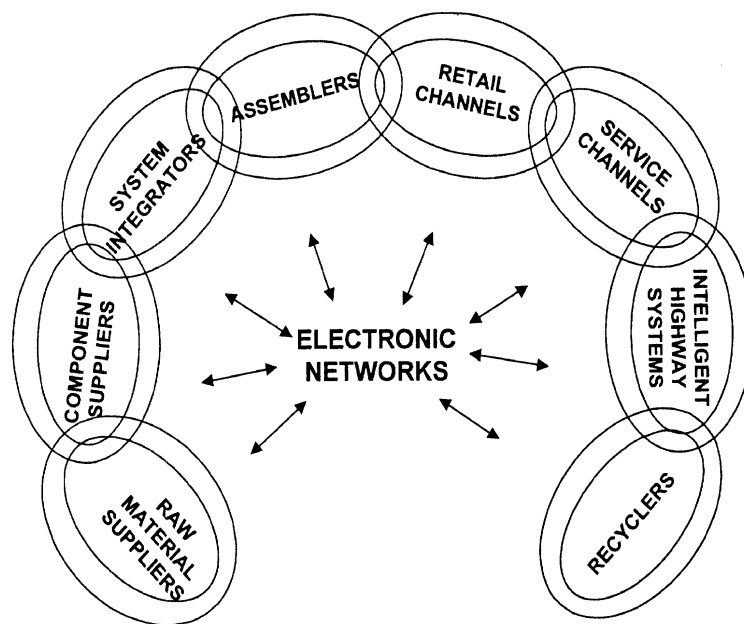


Figure C-4. Technologically Integrated Value Chain

New technologies must contribute to a sustainable environment.

It will be necessary to develop and implement technologies that contribute to a sustainable environment. Technology will be driven by changing demographics and the need for personal mobility in developing markets—all of which will put increasing strain on the environment, absent technological change. Driven by government and intergovernmental regulation as well as cost pressures, new technology will be needed to diminish wasteful use of natural resources and degradation of the environment.

Firms will need the ability to envision sustainable technologies and products that do not yet exist and to develop them ahead of competition.

Environmental concerns about both fuel consumption and pollution will become an even greater factor in technological development, because future levels of global economic activity will probably not be ecologically sustainable with existing technologies and production methods. The requirements to meet these challenges are subject to great uncertainty and substantial risk; for example, the uncertainties of global warming present new challenges and risks. Firms that adopt sustainable development strategies will likely be leaders in developing new technologies that minimize impact on the environment.¹¹

New technology will have a major impact on human resources, demanding new skills and education levels.

To participate in the networked, team-oriented work of the future, computer and communications skills will be entry tickets. The next generation of North American workers will face strong competition from ambitious, technically qualified and globally knowledgeable people all over the world. That implies not just developing North American engineers, managers, and executives through overseas assignments but also developing foreign nationals through assignments in North America.¹² Further, the increased pace of technological change will emphasize the importance of the "learning organization" and stimulate the development of life-long learning programs and skills, especially critical skills in digital communication, technical problem solving, and teamwork.¹³

Technology leadership and competitive advantage will be at risk.

Technology may be a basis of competition if it adds to customer value. Customers care little about technology per se, but they care about the product and value it may provide. They also care about the price, and that is where process technology impacts the customer. Technology change is therefore a critical arena for balancing the cost constraints of the industry. Some technological advances are clearly customer-based; others must be undertaken without initial customer support, with the recognition that product performance superiority will lead to eventual customer acceptance. An example is antilock brakes. It is not always clear what customers desire or how they value some of the new technologies.

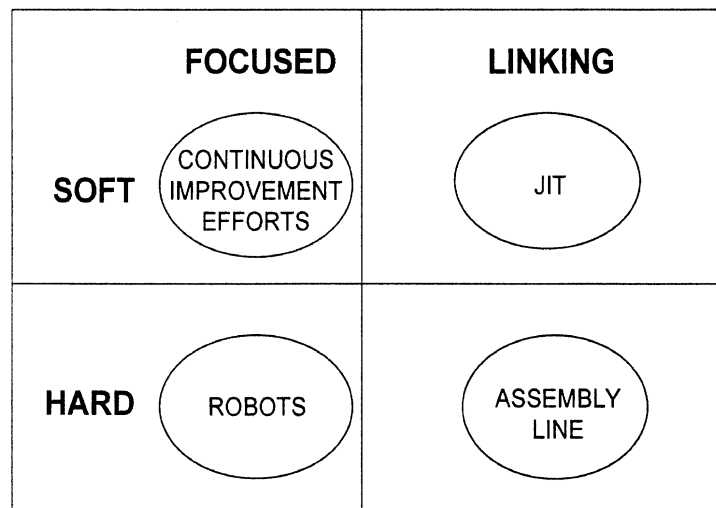
In process technology, leadership will be dependent on differences in rates of learning and application, as well as on invention and innovation. This in turn depends on

¹¹ Stuart L. Hart. "A Natural-Resource-Based View of the Firm." *Academy of Management Review* 209, no. 4 (October 1995): 986.

¹² Marjorie Sorge. "The Changing Automotive Workforce: The Next Generation Is Taking Over the U.S. Auto Industry." *Ward's Auto World* 30, no. 8 (August 1994): 25.

¹³ Sean P. McAlinden et al. *Driving America's Renaissance: Human Resource Issues in Michigan's Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1995: 47.

understanding the differences between hard and soft technologies and between focused and linking technologies. Process technology is hard if it is imbedded in a machine; it is soft if it is vested in humans. Hard technologies abound in automotive production and include robots, stamping presses, and lathes. Soft automotive technologies include many engineering routines, work analysis and improvement activities, and just-in-time processes. On a second dimension, technology may be focused, targeting narrow elements in a process, while linking technologies target the coordination or connection of sets of focused elements. In the past, technological development emphasized the intersection of hard and focused applications: Much of today's automation is the result. Increasingly, attention is turning toward the intersection of soft and linking technologies where advances of the future are likely to occur (figure C-5). Difficulty in learning increases as companies move toward the soft and linking technologies. At the same time, the potential gains to be realized are much greater.¹⁴



Source: Michael S. Flynn, and David E. Cole. The U.S. Automotive Industry: Technology and Competitiveness, in *Is New Technology Enough?: Making and Remaking U.S. Basic Industries*. Edited by Donald A. Hicks. Washington: The American Enterprise Institute, 1988: 86-161.

Figure C-5. Examples of Types of Automotive Process Technology

In some cases, economic growth forces will drive technology change. In other cases, the expense and investment involved may inhibit growth in technology innovation. Some highly cost-competitive industries operate on low margins that discourage investment in research and innovation. Because of the competitive environment, some industries are too cost conscious and too concerned with quality, product liability, and product timing discipline to experiment readily with or adopt untested new technology. Risk-averse companies avoid risky innovation. The real risk however, is that

¹⁴ Michael S. Flynn and David J. Andrea. "Corporate Learning from Japan: Partnering, People, and Process Technology." Proceedings of IPC'94 Conference & Exposition, The Engineering Society of Detroit, April 1994: 27-28.

entrepreneurs outside their industry will apply new technology and effectively put them out of business.¹⁵

Perhaps the greatest challenge to technological leadership and competitive advantage will be the wisdom and skill to manage technology and technological knowledge intelligently. This likely will require each firm to pay close attention to identifying, strengthening, and protecting its core technological competencies. Competitive advantage will derive, in part, from exploiting technology to create and maintain a learning organization. Significant investment will be required—not only to develop or acquire the latest new technology but also to build the skills to master it. This investment will compete with other investments in which management is historically more comfortable: plant, equipment, and people.

Governmental policy, in the form of regulation, may have an impact on the development speed of new technology. It has been argued that there would be less innovation without the push of regulations. Governmental policies may increase the speed (and also the cost) of new technological developments. On the other hand, government regulation increases exposure to product litigation, and product liability concerns may slow the introduction of new technology. Additional problems regarding regulations occur when there is a conflict between the method of achieving the goals of one set of regulations (like decreasing weight to increase fuel economy) and the goals of another (increasing crash worthiness which is correlated with greater weight).

Examples of Likely Technological Changes and New Products for the Automobile Industry

There are as many views of what the most important technological changes will be in the next decade as there are technology experts. For example, Battelle Memorial Institute identifies five technologies of particular interest to the automotive industry that will be among the top ten technologies for competitiveness in 2005: super materials, new energy sources, electronic miniaturization, cost-effective smart systems, and hybrid powertrain vehicles.¹⁶ These all fall within the categories of enabling, product, and process technologies.

High-performance engineering materials will be developed using computer-based design and manufacturing at the molecular level, for use in vehicles, electronic controls, on-board computers, energy conversion, and communications. New energy sources, including fuel cells and batteries, will be compact, longer lasting and highly portable. Electronic miniaturization will make possible hand-held, interactive, wireless data centers with built-in fax machines, telephones, and hard drives capable of storing voluminous multimedia data and easily adaptable to many mobile uses. Cost-effective

¹⁵ Michael S. Flynn and Bruce M. Belzowski. *Barriers to Adopting Structural Composites at the Traditional U.S. Automotive Manufacturers*. Report 94-36. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, December 1994: 32.

¹⁶ *Battelle 1995 Annual Report*. Columbus, OH: Battelle Memorial Institute, 1996: 14-15.

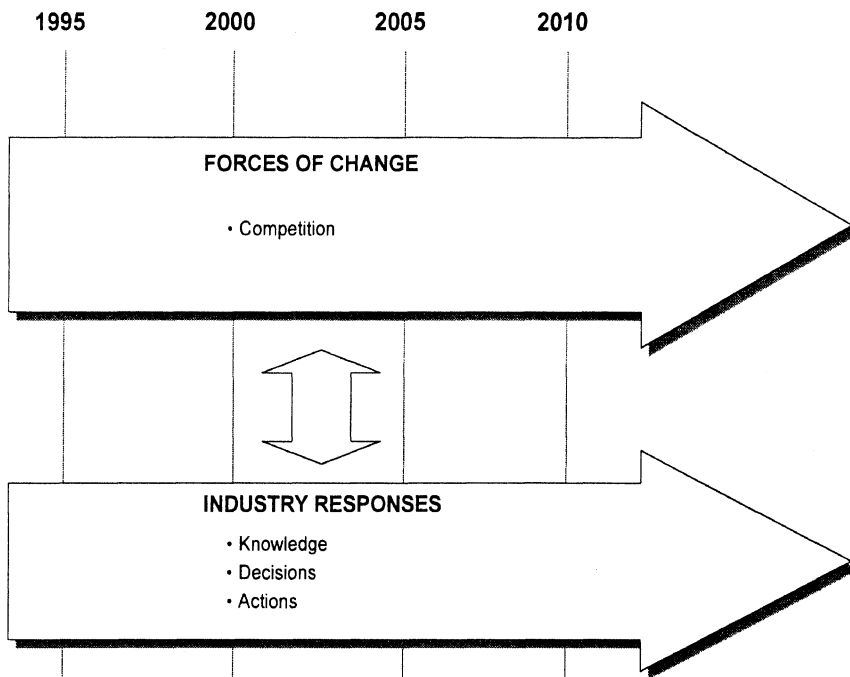
smart systems, which integrate power, sensors, and controls will eventually control the manufacturing process from beginning to end and control the vehicle as well. Hybrid-fuel vehicle technology will develop in conjunction with multiple new powertrains—including direct injection gasoline engines, hybrid-electric, and fuel cells, to permit use of more than one fuel in a vehicle for optimizing performance under a variety of operating conditions while minimizing emissions.

Prominent products resulting from these technologies will include personalized in-vehicle computers, multifueled automobiles, smart maps and tracking devices, and smart materials—all of key importance to the automotive industry. Powerful, mobile, personalized computers, responding to voice commands, will revolutionize personal activities and travel by ordering groceries, providing routine traffic updates, and reporting the latest news. Smart vehicles, equipped with versatile powertrains that will operate on a variety of fuels and refined electronic systems, will analyze driving conditions microsecond to microsecond to pick the optimal fuel and operating mode for maximum fuel efficiency and performance. A smart map in a vehicle, with the help of global positioning systems, will track a vehicle's exact location and give directions, by voice, to the destination. New smart materials, with electronic sensors built into the molecular structure of the material to warn of excessive stress, will have many uses in automobiles, bridges, and roads.

Implications

In the last fifteen years, remarkable technological advances have provided sustainable competitive advantage to many firms (e.g., microprocessor miniaturization for Intel, and lean production for Toyota). The pace of technological change will continue to accelerate in the next fifteen years.

In the future, *sustainable* may take on new meaning. It will be difficult to achieve competitive advantage with product and process technology over a long period, given that new technology likely will provide only temporary leadership. The first key to sustainable advantage in the future is to have the intelligence, speed, and agility to bring new, customer-valued technology continuously to bear on products and processes ahead of competitors. The second key is to be willing to make the investments in technology which enable continuous innovation by creating a true "learning organization." This kind of investment is very difficult to justify by common accounting practices, and, historically, has been a difficult decision for executives to make.



D. Competition

Introduction

Competition is the active pursuit of limited goods or rewards by two or more entities; success for one often comes at the expense of another. In industry, those rewards are usually customers and profits. Competition in the auto industry occurs on many levels and is probably as intense in North America now as at any time in the past. Competition primarily occurs among manufacturers and among suppliers who sell to them. Sources of competitive success include such factors as productivity and quality. Whatever the competitive strategy, it nearly always requires a near-term sacrifice of profits to be recouped through a higher level of future sales.¹⁷

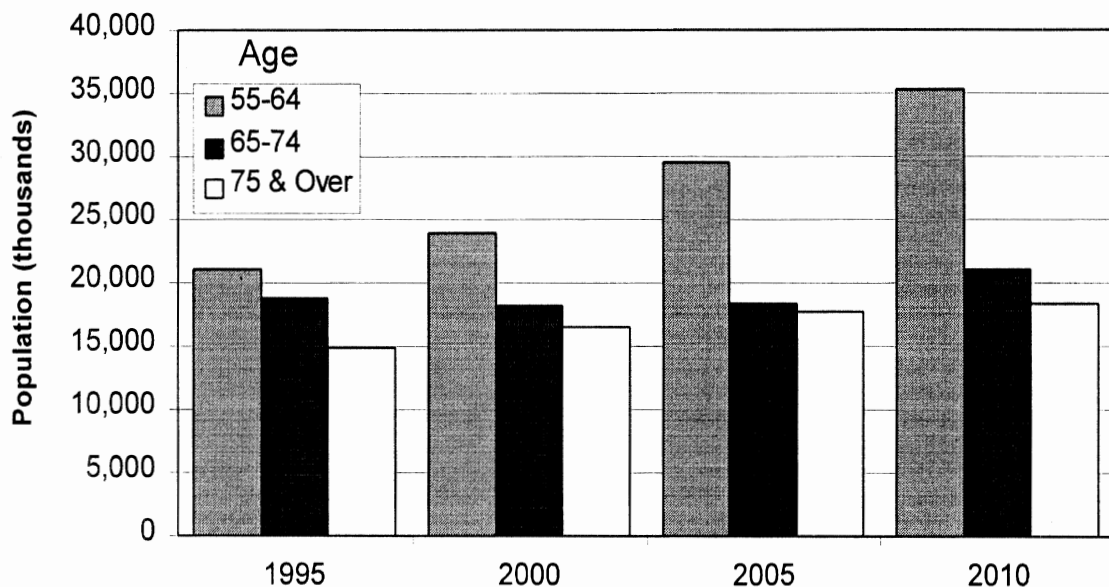
Part of the reason for increased auto industry competition is that the U.S. market (overwhelmingly North America's largest) is mature, with limited expectations for future growth. Modest population growth and negligible increases in income have converged to slow sales growth rates. Further, vehicles last longer and consumers consider used vehicles an acceptable alternative to increasingly expensive new ones. The result, at

¹⁷ Thomas Karier. "Competitiveness and American Enterprise." *Challenge*, (January-February 1994): 40-44.

best, is modest growth in sales. (One analyst estimates a future growth rate in sales in the U.S. of only 0.5 percent annually.)¹⁸

Trends Affecting Vehicle Competition

Competition is affected by a range of changes and trends. The population is changing, as the postwar surge in population known as the baby boom ages into seniority (see figure D-1). This segment of society may define their transportation wants and needs differently as they age, and that will likely have an impact on the kinds of products they require. Manufacturers will be competing with each other more intensely for the baby boomers who are reaching peak income-earning years. However, this generation is also approaching retirement age, which requires ample savings to offset reduced future income. Some of them may find themselves saving money during the ends of their careers to ensure adequate funds during retirement. Consequently, some baby boomers may buy fewer or less expensive vehicles in spite of relatively higher earnings.



Source: U.S. Department of Commerce, *Statistical Abstract of the United States*. Washington: D.C. U.S. Bureau of the Census, 116th Edition, 1996: 16.

Figure D-1. United States Resident Population Projections

¹⁸ Alex Taylor, III. "It's the Slow Lane for Automakers." *Fortune*, (April 1, 1996): 59-64.

Internationalization of American society may also have an impact on competition. Immigrants, for example, may bring different tastes for products, to which they have grown accustomed. Manufacturers interested in capturing these people as customers may need to give special consideration to their wants and needs. In fact, as car makers globalize their operations and presumably send personnel around the world, these employees may contribute a more international taste to the development of new products.

There are potentially enormous competitive implications for car makers driven by expanding manufacturing capacity. Many manufacturers are planning capacity increases which collectively outpace the level of expected demand. With such excess capacity, and with each manufacturer trying to achieve economies of scale in plant operation, there is potential for massive price competition. Manufacturers like South Korea's Daewoo, for example, have ambitious plans to become global players. Daewoo plans to spend \$11 billion between 1995 and 2000 "to become one of the world's biggest auto makers."¹⁹ Surplus manufacturing capacity in total around the world may be in excess of several million units—a situation made even more complicated by the intentions of Daewoo and other aspiring manufacturers. Other manufacturers are already in North America, and plan to increase the amount of manufacturing (and possibly selling) they do here. Japanese manufacturers have been strong competitors. The yen has retreated from its 1995 high versus the dollar, and Japanese manufacturers have used "lean design" and shortened product development time to squeeze cost out of vehicles.²⁰ Toyota is increasing its plant capacity in the United States. In 1996, it exported 80,000 U.S.-built vehicles.

In addition, there is the possibility of European players in the North American market. Fiat, Peugeot and Renault, which have a significant worldwide presence, are absent from the United States. Should they attempt to return, they could potentially increase the competition in a market for which sales growth rates are negligible.

While there is competition among manufacturers for sales, as noted above, the industry as a whole also must compete with nonautomotive goods for sales. Consumers' purchasing priorities have changed; many rank the purchase of computers and vacations, for example, ahead of the purchase of a new car, as discussed in Section B of this report. One reason is that cars are getting more expensive, another is that cars last longer and perform more reliably during their useful life. Therefore, a new car purchase has become more discretionary than in the past; a used vehicle may be a more viable alternative. In fact, autos could even compete with other transportation modes, such as small, electric-powered vehicles designed for neighborhood use. The industry, then, may have to look at alternatives for encouraging new car sales. These might include lower prices, more frequent styling changes, more features and safety equipment, and new technologies.

¹⁹ Bruce Bernard. "Europe's Car Makers Rev Up." *Europe*, (December-January 1995-96): 18-21.

²⁰ Edith Updike. "Japan Turns a Corner." *Business Week*, (February 26, 1996): 108-112.

Competition Among Manufacturers

Technological advances are an inherent part of competitive advantage. Product development and testing are moving to a computer-based world where engineers and designers use computer simulations and virtual images instead of clay models and bodies-in-white. The advantage of such virtual prototypes is a reduction in the time and money it takes to develop and test new models. That reduces the time to bring these models to market and consequently assures that the latest trends and tastes are more likely to be incorporated into the design.²¹ Technology is enhancing the gathering of customer data, too, as customer feedback becomes more commonplace via Internet home pages and information kiosks. In both these situations, optimal use of time is a competitive advantage. Vehicle technology is another variable in the technology equation but only when such technology carries "immediate and perceived customer value."²² The Internet provides a significantly new way to market vehicles. It can be used as a source of information, and most manufacturers have a home page where shoppers can go for information. This may be only the beginning, as shoppers potentially could order vehicles from the factory, reducing the role of the dealer.

Another aspect of the competitive environment is that many competitive advantages have a time element to them. Most advantages are advantages for only a limited time, until other competitors adopt them. At one point, for instance, the image of quality was largely the province of Japanese manufacturers. Today, quality is much more uniform among manufacturers and may not be the competitive edge it once was. High quality is expected by consumers; tomorrow's manufacturer may be penalized more for poor quality than rewarded for high quality. Manufacturers who can identify and exploit *sustainable* competitive advantages will fare better than those whose advantages are temporary.

One ironic facet of the nature of competition in the auto industry may be that market shares of particular companies will remain relatively stable, with few big gainers or losers. The focus of competition becomes maintaining one's place in the market rather than devising strategies for stealing from the competition. That competitive dimension could lead to different corporate strategies, more defensive than offensive, centered around retaining existing customers. Alternatively, manufacturers may end up expending vast resources for minor increases in market share.

Competitive manufacturers in the future will need to develop their own organizations to observe changes in the marketplace and monitor consumers wants. Toward that end, various industry experts have recommended actions for maintaining a competitive edge, many of which are based on an examination of how the North American manufacturers have reacted to and coped with increased foreign competition—a major competitive phenomenon of the last twenty years. Some of these prescriptions for maintaining a competitive edge are:

²¹ Tim Keenan. "Visualizing the Future." *Ward's Auto World*, (June 1995): 38-39.

²² Michael S. Flynn et al. *Competitive Survival: Private Initiatives, Public Policy, and the North American Automotive Industry*. Report #92-3. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1992: 73.

- *Focus on the company's core competencies.* The 1980s saw a rash of acquisitions by the domestic car manufacturers in an attempt to diversify into industries whose business cycles moved counter to the auto industry. Instead of providing a cushioning offset to the auto industry's highs and lows, these acquisitions sometimes drained scarce financial resources and often distracted management from running the core business (automotive design, manufacture and marketing). Today's strategic thinking suggests that channeling one's resources into doing a superior job running one particular business is more likely to ensure long-term profitability and viability than trying to piece together a group of diverse ones. Some industry thinkers would go even further and suggest that competitive survival requires that companies regularly review what their core competencies are and how to best perform them. Nevertheless, business management goals sometimes move in cycles, and eventually a diversification strategy could again seem appropriate.
- *Promote the development and functioning of teams.* Companies can no longer permit employees to operate in a manner that benefits one particular functional group at the expense of another, or worse, places personal career goals ahead of corporate well-being. Teams can enhance a company's total productivity.
- *Empower employees.* American business once mimicked the kind of management control favored by the military: Subordinates carried out assignments defined by management with little input or control. Today, realizing that these subordinates are often in a better position to attend to the needs of everyday operations, management has begun to confer authority and responsibility on lower level employees.
- *Become a learning organization.* Because change is never ending, companies that master learning to cope with changing circumstances will be ahead of the competition.

These are prescriptions for success, so they are also the areas for the competition of the future. How well companies implement these prescriptions is likely to determine how successful those companies are.

In addition, the auto industry needs to be concerned about tomorrow's leaders. Where will these leaders come from and what will they need to know to manage tomorrow's industry? Historically, the auto industry has probably provided other industries with more managerial talent than it has gleaned from them. Regardless of where they come from, the corporate leaders of tomorrow are likely to require leadership qualities and skill sets that differ from those needed today.

Competition Among Suppliers

Suppliers will play an increasing role in the competitive battlefield because manufacturers want to shift a significant share of the responsibility for automotive value

to them. Manufacturers are asking their suppliers to shoulder a greater burden in developing new technologies, in reducing costs, and in providing parts to global factories. It is conceivable that some suppliers will supply parts and components that are so unique in concept, function, or some other attribute appealing to consumers that they are even mentioned in vehicle advertising. "Car makers are becoming more like design studios and marketers," explains one industry observer, "and less like factories—outsourcing more and more of their part needs."²³ This same observer notes that there are three trends affecting suppliers: "the world car concept, continuing quality improvement, and the search for new materials." Smaller, lower-tier suppliers may feel the brunt of quality improvements at this point. Chrysler claims that most quality problems can be traced to second and third tier suppliers, not first tier ones.²⁴

Part of the competition among suppliers relates to pricing for their automotive customers. Car makers are expecting suppliers not only to hold the line on prices but in fact to reduce them, perhaps by as much as 5 percent to 6 percent per year.²⁵ The approach to pricing has changed dramatically from prior practices. Now, car makers specify a target price for a part or component and ask suppliers to identify ways to reach that price, using improved processes, simplified design, and other means.²⁶ Manufacturers insist that they are not out to attack the profit margins of suppliers, but rather want to see supplier costs and system complexity reduced. The Big Three have actively tried to limit the number of suppliers they use in order to build fewer, stronger relationships. However, GM, for one, has insisted it will not jeopardize its access to the latest vehicle technology or best prices through rigid associations with current suppliers.²⁷

While the assemblers shift responsibility to suppliers and reduce the number of supplier relationships, they may also alter the balance of power. In fact, both the supply chain and the distribution channel are experiencing major changes that may mean vehicle manufacturers have less control than in the past. The supply network is replete with mergers, joint ventures and other forms of integration to better meet the demands of auto assemblers. Bigger suppliers, with more responsibility and control, may have more power to choose their customers. However, size will not be the only determinant of supplier power. Suppliers who serve as systems integrators (that is, suppliers who provide entire systems and components) and who have high levels of other competencies, will be powerful by virtue of their roles and expertise.²⁸ In addition, because of industry rationalization, manufacturers may have fewer suppliers to choose from; these remaining suppliers are therefore likely to be less vulnerable to competition.

²³ Kathryn C. VanGilder. "Auto Industry Trends Opening Doors for IEs." *IIE Solutions*, (November 1995): 22-25.

²⁴ Ibid.

²⁵ Jerry Flint. "The TRW Way." *Forbes*, (July 31, 1995): 45-46.

²⁶ James Carbone. "Lessons from Detroit: Get Suppliers Involved Early." *Purchasing*, (October 19 1995): 38-42.

²⁷ Tim Keenan. "Visualizing the Future." *Ward's Auto World*, (June 1995): 38-39.

²⁸ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 23.

The organizational structure of the industry is changing also. Suppliers are combining resources with each other in uncommon ways, based on product or process capability. Such partnering arrangements are formed according to the resource requirements of a particular project or program. As such, these relationships are terminable and flexible. Consequently, the tiered structure is giving way to something perhaps more accurately portrayed as a network. The previous model, with its assumption of linear relationships in a hierarchy of tiers, is being replaced with a fluid network of virtual associations in which any particular company may serve many roles.

Competition in the Automotive Retail Value Chain

In the past, the competitive edge involved the product itself: the latest styling, the most horsepower, and most standard features. However, many manufacturers have already turned their attention to less obvious concerns, such as sales and service performance, to tap into other ways to differentiate their products and offer the customer more value. This transition is likely to continue into the future, as car manufacturers continue to examine the automotive value chain and the possibility of adding value that customers can perceive and appreciate.

In an effort to help distinguish themselves, manufacturers and dealers will attempt to improve the service they provide with the vehicles they design and sell. Vehicles today have a high level of quality and reduced service requirements, which mean potentially fewer trips to the dealer. When they do need service, however, customers can expect a higher level of service than in the past. This new level of service might include extended hours, home delivery of a newly serviced vehicle, or greater access to a substitute vehicle while the owner's vehicle is being serviced.

Most manufacturers are taking a hard look at how their products are sold. The retailing system is probably the least changed part of the industry, compared to developments in manufacturing or product design. As vehicles become more similar, car companies are realizing that sales and service may be just as important a competitive factor as product. Luxury makes, like Infiniti and Lexus, have emphasized impeccable service in addition to fine products. GM's Saturn division, while selling a much less expensive vehicle, has probably received the most attention for its friendly buying process as well as excellent service after the sale. In a recent customer satisfaction index poll from J.D. Power and Associates (one component of which is customer handling), Infiniti, Lexus, and Saturn, plus Acura and Mercedes-Benz, garnered top honors.²⁹ The way these manufacturers handle customers reflects a growing industry standard as well as a marketing approach that encompasses far more than just product.

²⁹ *Satisfaction Decline Signals Industry Performance Plateau*. Angora Hills, CA: The Power Report, J.D. Power & Associates, July 1996.

Consumers will see more auto malls or even showrooms that, like other retail establishments, offer competitors' products side-by-side.³⁰ The number of new car dealerships is thought to diminish, as well as the amount of inventory available at new car dealerships. Both these predictions suggest a consolidation in the industry based on potentially more efficient ways of doing business. Figure D-2 lists changes in vehicle retailers expected by participants in the Delphi forecast of the North American automotive industry. Current franchise agreements tend to limit the degree to which competing makes and models share floorspace, but car dealers carry multiple makes in order to build a financially viable outlet. These large dealers, whose relatively vast array of products from different manufacturers make them resemble automotive supermarkets, may not be very appealing to car companies that are in the midst of developing stronger brand images and in some cases exclusivity images.³¹ Builders of luxury vehicles may not want the proximity that invites easy comparisons and encourages the perception of vehicles as commodities.

Implications

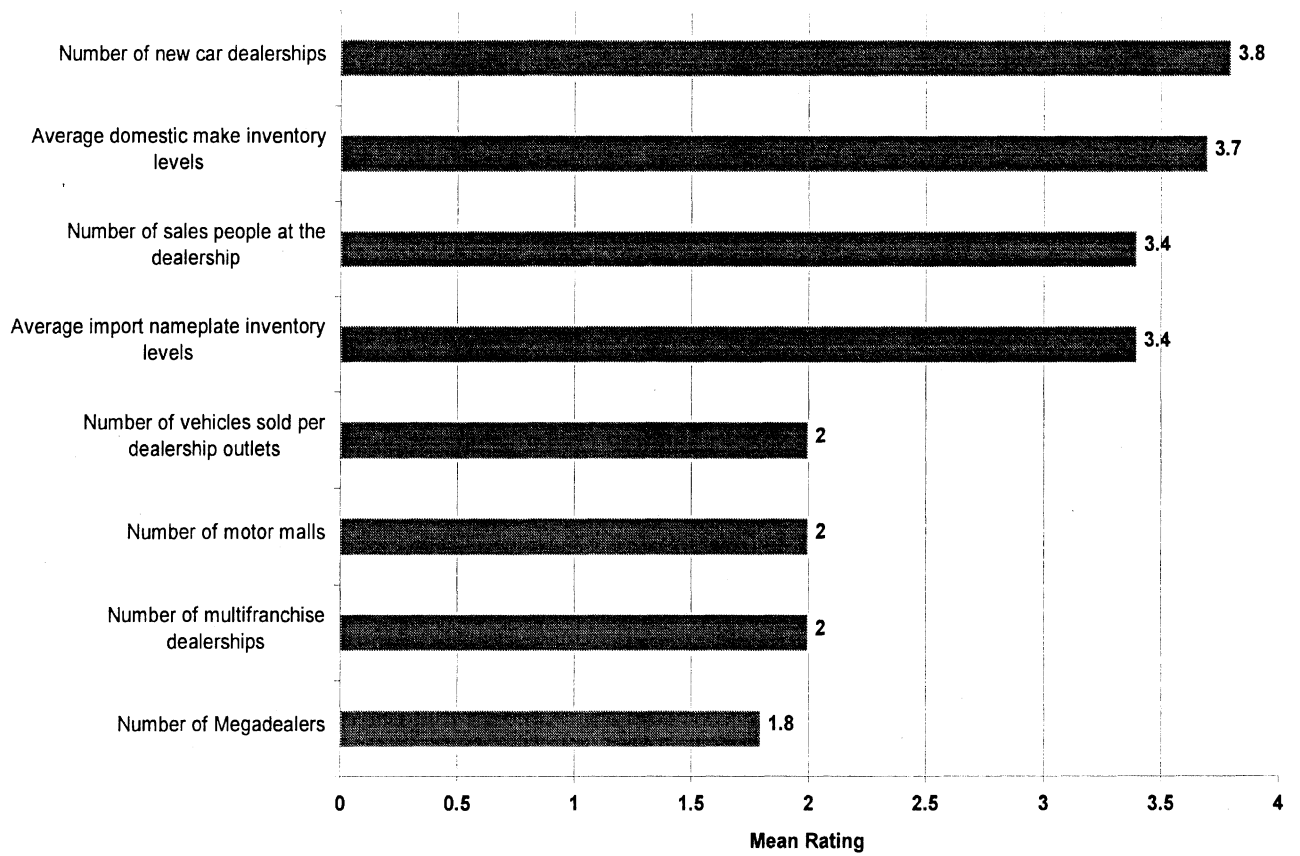
The bases for competition in the auto industry in North America are changing swiftly and profoundly. Negligible growth in vehicle sales and buyers' incomes means that vehicle manufacturers will be in a tug-of-war in a mature market for sales and profits. Consequently, manufacturers are examining all stages of vehicle life, from earliest design to final disposition, for opportunities to capture shares of the revenue stream. Prodded largely by manufacturer demands, suppliers are regrouping and jockeying for position in a procurement system whose final structure is still uncertain. Some of these suppliers will emerge with unprecedented systems and components responsibility. Although vehicle manufacturers are trying to refine and improve an outdated retail system, forces beyond the manufacturers are working to alter the system's structure, and an adjustment in the power relationship is likely. Technology remains a core part of industry competition, with its ability to revolutionize vehicle design and sales. The company that harnesses technology effectively gains a competitive advantage. Finally, decisions being made outside of North America will have significant competitive impact here.

Special mention must be made of the importance of human resources in obtaining and maintaining a competitive advantage. As vital as technological products and processes are, they can generally be copied by competitors, making their advantage fleeting. Employees with skills and flexibility, however, provide an enduring foundation for competitive advantage, in that such employees can learn new ways of doing their jobs as competitive circumstances change and thus sustain a stream of advantages. This human aspect will likely emerge as one of the most critical competitive differentiations as the industry transformation goes forward.

³⁰ Herb Shuldiner. "Head-to-Head in the Showroom." *Ward's Auto World*, (November 1994): 51-52.

³¹ *Ibid.*

1995-2005 Dealer Trend



Scale: 1 = sharply increase, 5 – sharply decrease

Source: David E. Cole et al. *Delphi VIII: Forecast and Analysis of the North American Automotive Industry: Technology*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 54.

Figure D-2. U.S. Dealership Network Characteristics

III. Summary and Conclusions

Summary

Nine factors have been identified as the major forces of change external to the North American automotive industry: globalization, customer desires and needs, technology, competition, economic factors, government policy, human resources, societal issues, and environmental factors. Of these, the first four were considered to be the most encompassing and most likely to have the greatest impact on the automotive industry over the next fifteen years.

Key characteristics of the forces of change are:

Globalization

- Growth potential for North American automotive manufacturers is outside the saturated North American market.
- Integrated and parallel strategies are two ways to implement corporate global structure. Both may be necessary.
- Global strategy will have a significant impact on product development decisions.
- Facilitators of globalization include international standards and protocols, homogenization of tastes, indifference to nation of vehicle origin, political and cultural issues, regulation, technological change, and vanishing boundaries.
- Factors confounding globalization include international monetary policy, trade blocs, and isolationist industrial policies.

Customer Desires and Needs

- Focusing on customer needs and desires is relatively new in the North American automotive industry.
- Consumers have an ever increasing number of choices:
 - what to buy (i.e., product variation)
 - whether to buy new or used
 - how to buy
- Consumers will continue to desire affordable vehicles.
- Consumers will buy vehicles from new forms of distribution channels, for example, the Internet.
- Both evolutionary and revolutionary changes will occur in the present distribution system, including an increased emphasis on service, quicker delivery time, and improved responsiveness to customers.
- Meeting customers' needs will be pivotal for suppliers, assemblers, and dealers.

Technology

- Competition is driving the ever-increasing speed of technological change.
- Three types of technology innovation will occur simultaneously:
 - enabling (electronic networks)
 - product (materials, electronics, imbedded sensors, fuels)
 - process (how work gets done)
- Computers, communication, and data digitization will converge as major electronic enablers of technological change
- The most important technology change will be in the soft and linking technologies—involving systems thinking, systems integration, and human interaction with technology.
- In technology, both continuous improvement and radical breakthroughs are essential to leadership.
- Product changes will be focused on new materials, computers, electronics and communication technology, and engine and fuel system improvements.
- Technological developments will speed up globalization, and globalization will make technology spread faster.

Competition

- New vehicle purchases will be of lower consumer priority than other discretionary expenditures for many people.
- As suppliers' responsibility and capability expand, they will choose their customers and suppliers and their power will likely grow.
- Consolidation will likely place more power in the retail channel.
- Competitive differentiation will depend upon technology exploitation and the achievement of customer satisfaction.
- Competitive differentiation will be enhanced by employee skills in engineering, technology, computer use, communication, and interpersonal skills.

Conclusions

In response to these changes, the industry will have to acquire knowledge, make decisions, and take action. These actions generally fall in the areas of financial, human resources, and product/process management, or company, market, and industry structure. Some of these necessary responses to changes are outlined in the following tables:

Knowledge to Acquire and Understand

INTERNATIONAL

- Standards and regulations and their harmonization
- Political issues
- Cultural issues
- Trade regions including trade blocs, intellectual property law, and barriers to entry
- Investment efficiencies including scale, risk, strategy, and adaptability
- Infrastructure

WORLDWIDE SOCIETAL AND ECONOMIC TRENDS

- Population
- Age distribution
- Decentralization of urban centers
- Household size
- Education levels
- Income levels
- Increasing environmental concerns

CUSTOMER CHARACTERISTICS AND NEEDS

- Global homogenization of tastes
- Specific personal circumstances (income, age, gender, immigrant status, transportation or mobility needs, evolving style and function preferences)
- Facility and comfort with electronic commerce

TECHNOLOGICAL INNOVATION

- Developments in networked multimedia computers, data acquisition and management, and communication capabilities for use in all aspects of product development, manufacturing, marketing, distribution, and selling
- Developments in new materials, electronics, and fuels
- Continued developments in hard and focused technologies; new emphasis on developments in soft and linking technologies involving entire systems; and coordination of human interfaces with technology
- Developments of new technologies adaptable to automotive industry products and processes
- Rewards and risks associated with technology investment and leadership
- Management of core technologies for continuous innovation

ORGANIZATIONAL ISSUES

- Changes in the power structure within the motor vehicle industry with regard to suppliers, assemblers, and distributors
- Function of organization and how it needs to change
- Innovative methods for improving organizational performance

Decisions to be Made

SUPPLIERS

- Maintain steady market share or grow
- Remain competitive only at home or go global
- If global, integrated or parallel structure across markets
- When to go global
- Design and develop vehicles and equipment for few or many markets
- Educate workers or rely on external educational services
- Whether to develop associations within the industry—vertically or horizontally
- Focus on core competencies or diversify

ASSEMBLERS

- Maintain steady market share or grow
- Consolidate around major markets or maintain rural presence
- Be single-line, dual, or multi-line
- Remain competitive only at home or go global
- If global, integrated or parallel structure in each market
- When to go global
- Design and develop vehicles and equipment for few or many markets
- Be manufacturers of vehicles or servers of transportation needs
- Be responsible regarding customer retention and acquisition or defer to existing and evolving retail channels
- Lease or sell vehicles, or both
- Educate workers or rely on external educational services
- Whether to develop associations within the industry—vertically or horizontally
- Focus on core competencies or diversify

RETAIL CHANNEL

- Maintain steady market share or grow
- Consolidate around major markets or maintain rural presence
- Be single-line, dual, or multi-line
- Lease or sell vehicles, or both
- Educate workers or rely on external educational services
- Whether to develop associations within the industry—vertically or horizontally
- Provide vehicles or provide transportation
- Focus on core competencies or diversify

Action Items

MANAGEMENT OF FINANCES

- Build a financial resource base to be able to function effectively in the worldwide economy
- Develop sources of capital to fund technology investment required of a learning organization
- Accumulate financial resources to weather global cyclical downturns while maintaining resources for product and process investments
- Ensure compatibility between financial systems and latest developments in global telecommunications

MANAGEMENT OF HUMAN RESOURCES

- Foster enhancement of hard and soft skills through explicit training, internal and external
- Allocate human resources between global opportunities and the domestic market
- Invest in the latest technology and build the human resources and skills to master it
- Institutionalize mechanisms and encourage attitudes to enhance sharing of knowledge
- Identify future human resource needs
- Identify future human resource availability
- Participate in and influence K-12 education systems—locally, nationally and internationally
- Be able to function in a matrix organization

MANAGEMENT OF PRODUCT AND PROCESS

- Decrease time and cost by harnessing multimedia network technology to simultaneously design, build, and distribute vehicles and parts worldwide
- Build and develop products and processes to be compatible with a sustainable environment
- Define and also cultivate customers' wants and needs by including the use of new technology
- Design a system that 1) empowers all employees to continually seek knowledge of customer wants and needs, and 2) incorporates this knowledge into appropriate company processes
- Seek strategic opportunities in the entire life cycle of the vehicle
- Develop a foundation of international know-how in anticipation of global participation
- Develop sales and service excellence to differentiate product

- Participate in joint efforts on component commonization (e.g. SAE, ISO, AIAG) because the basis of competition will change in the direction of process (quality, speed, timeliness, service, price) execution
- Determine role of technology in sharing knowledge and in building a learning organization
- Seek opportunities to create and exploit sustainable competitive advantages
- Ensure integration of technology is done within the context of an entire systems plan

STRUCTURE OF THE COMPANY

- Structure the company to function optimally in a global environment
- Outsource noncore competencies
- Implement a learning organization

STRUCTURE OF THE MARKET

- Structure advertising to facilitate the efficiency of the market
- Structure distribution and retail channels

STRUCTURE OF THE INDUSTRY

- Be prepared to participate in networks of companies at all levels of the transportation value chain globally
- Make sure viewpoint is well understood in government agencies

IV. Directions for Future Research

There are three primary directions for future research on the transformation of the North American automotive industry.

- The first is to gain a more complete understanding of the ways that external and internal forces will be changing in the future. This involves an understanding of what those forces of change will be, developing characterizations of each of them, and obtaining quantitative estimates, to the extent possible.
- A second direction for future research is to describe the relationship between the forces of change and the responses required on the part of the industry.
- The third direction for future research is to develop methods of changing. Explicitly, how is the required knowledge obtained? Once acquired, how is the knowledge most effectively used in the corporate decision process? And finally, what are the best methods to implement the actions required?

APPENDIX

This appendix is a compilation of descriptions of the nine forces of change, each written by one or more members of the staff of the Office for the Study of Automotive Transportation. Each description is intended to be capable of being a stand-alone document as well as part of this report. Accordingly, there is some information that appears in the main text of the report as well as in the appendix.

Government Policy

Authors: Francisco Tarin and Bruce M. Belzowski

INTRODUCTION

Despite successful attempts to reduce both its size and role in society, the federal government of the United States will continue to play an influential role in the activities of both corporations and citizens. Congress will still make laws and regulations that influence and monitor commerce, energy, labor, taxation, the environment and other areas. Legislation in any one of these areas could have a significant impact on the auto industry over the next ten to twenty years, and together their impact could be profound. While the policy areas may not change, specific issues surely will. In addition, the context of legislative decision making is already changing: an increasingly competitive global environment, changing demographics, and, possibly, a spirit of cooperation between industry and government will color future policy making.

GOVERNMENT REGULATIONS

One of the biggest issues concerning the federal government and the automotive industry has been the lessons that have been learned by both parties from the past and how a spirit of cooperation has risen out of what used to be a highly confrontational relationship. The battles that took place in the '60s, '70s, and '80s over the issues of clean air, safety, and corporate fuel-economy averages have led the manufacturers and the federal government to consider the effects of regulations on both parties before they are proposed, much less enacted. The government has also allowed the manufacturers to work together on cooperative, precompetitive issues that have affected the future of the industry and the citizenry (e.g., the advanced battery consortia in United States Council for Automotive Research [USCAR]).

But by 2010, the government may be much leaner and streamlined. Several major agencies and departments may be eliminated by then, and others may be forced to downsize and operate with decreased budgets while being expected to do more. This transformation could have a profound effect (negative or positive) on the relationship between the industry and the federal government. The challenge will be to transfer the lessons learned from the former agencies to the new agencies.

This streamlining of the government may result in fewer regulations as agencies begin to measure the effects of regulations using economic and social cost-benefit analysis methods.¹ In much the same way that lifecycle management of materials takes into account all the energy and recycling issues of materials from "cradle to grave", economic and social cost-benefit analysis will take into account as many ramifications of old and new laws and regulations as possible. This analysis will then assign an overall value to society—now and in the future—that lawmakers can use to help make a final decision about the effects of a law or regulation. But it would be naive to think that this

¹ K.J. Arrow et al. "Is There a Role for Benefit-Cost Analysis in Environmental, Health, and Safety Regulation?" *Science* 272, (1996): 221-222.

method of accounting will be the only decision-making tool regulators will employ. They will continue to make decisions that reflect political expediency rather than long-term visions of what will be good for the country, but cost-benefit analysis may help all parties more clearly and rationally understand the issues involved in any decision.

Another factor that may affect the future of automotive regulation is the decentralization of regulation and enforcement. Due to federal government downsizing, and the passage of the states' unfunded mandate legislation in 1995, states may be in a stronger position to shape and implement their own regulatory policies. This transfer of power to the states may have serious consistency implications. The possibility of fragmentation in the types of individual state regulations poses serious problems for the automobile industry. An example of this was the difference between the California electric vehicle mandate and the Northeastern states initiative to clean the air. While the final resolution may have forced the Northeastern states to adopt California rules, this series of events highlights the potential for these types of problems.

One of the major effects of regulations by either state or federal governments has been a significant technology push forcing manufacturers to produce products for the market that have untested market value for the consumer. Some of the features mandated by regulation have added significant costs to vehicles due to research and development costs incurred by manufacturers, which in turn are passed on to the consumer. This trend will probably continue in the future.

Manufacturers have become more proactive in anticipating trends in regulations by working with legislatures in a nonconfrontational mode: advising the legislators about what is technologically available currently, laying out a timetable for what may be achievable in the near (and distant) future, and showing the costs manufacturers will incur because of the proposed regulations. This type of negotiation between government and industry bodes well for the future as it moves toward a balance between the interests of the consumer and the manufacturer.

Government regulators and consumers appear to agree on safety issues. In this case, consumer demand for safety features may exceed regulatory requirements. Current trends in consumer vehicle options for safety features are making these options "marketable features."² If consumers are demanding safety options in cars and if manufacturers are offering these options, the government's role in regulating safety may not be as pronounced. Instead of having safety regulations that force auto manufacturers to install certain kinds of equipment in their vehicles, many of the safety features may already be in the cars of people who will be driving. One of the biggest challenges to manufacturers and legislators in the future will be in the area of tort reform. In an extreme example, a lawsuit can be brought against a manufacturer because a government-mandated safety device failed to protect, even though that device was incorrectly used, or the vehicle was operated improperly.

By 2010, U.S. policymakers may institute recyclability regulations for automobiles, following the lead of European policymakers. Although pressure on the auto industry may not be as intense in the recycling area (vehicles today are already about 75 percent

² David Zoia. "These Days It's Safety First." *Ward's Auto World* 31, no. 10, (1995): 68-69.

recyclable) research advances on recycling plastics in programs like the Partnership for a New Generation of Vehicles (PNGV) will yield impressive results. The auto manufacturers are leading the way in this area by beginning to use plastics that are not blended with other plastics (making recycling of a particular part too costly) labeling all plastic parts to make identification by recyclers easier, and designing the vehicle for easy disassembly by recyclers. These initiatives are beginning to take hold within the manufacturers' product development and design center; and in 20 years, we may see a virtually completely recyclable vehicle.

Finally, regulation is only nascent in the area of Intelligent Transportation Systems (ITS). Cooperation between government and industry will be key to any successful ITS implementation. In ten to twenty years, one may expect to see vehicles and highway infrastructure incorporating regulated transponders. This could allow a vehicle and the surrounding infrastructure to communicate to reduce traffic congestion, to automatically pay for tolls, to warn speeding vehicles, to direct tourists, or to even control a vehicle so that the driver may only steer or ultimately drive hands free. An important issue in the future of ITS is whether the driver will have the option of using the ITS system. It is possible that all or certain parts of the system will be mandated, thereby taking some of the freedom of the driving experience away from the driver. Alternatively, not all users of transportation will be able to afford ITS technology. This raises issues on the role of the government in assuring access for all users irrespective of the cost.

ENERGY POLICY

Energy policy in the near future will still be shaped by the availability and supply of oil, but industry may have more say in what that policy will be than it has in the past. In response to the OPEC-instigated oil shortages of the '70s, the U.S. government-imposed fuel conservation measures, including corporate average fuel economy (CAFE) standards for automakers. Having designed vehicles with low gas prices in mind, most domestic manufacturers were initially not capable of meeting the new fuel economy regulations. They shifted their resources to the development of downsized vehicles, smaller-displacement gasoline engines, diesels, and other solutions to enhance fuel economy. In the meantime, more fuel-efficient imported vehicles, designed where gas prices were already higher, enjoyed a significant boost in sales while domestic manufacturers retooled. In this case, the government fashioned a policy that temporarily hobbled the domestic manufacturers as they scrambled to meet regulations importers met easily.

More recently the government and the manufacturers have joined together in programs like the PNGV to develop more fuel efficient vehicles, as well as to support research and promotion of alternative fuels. In the future, the Department of Energy may implement alternative transportation fuel programs into fleets and help develop the infrastructure to support alternative fuels.³ In particular, natural gas is plentiful in the United States and is one of several alternatives to gasoline. The automotive industry, for its part, will continue to feel pressure from the federal government to develop alternative fuel

³ W.F. Squadron. *Alternative Transportation Fuels: Financing Issues. Options for Financing Alternative Fuel Vehicle Fleets and Infrastructure*. Report No. DOECE32750412. Washington, D.C.: Department of Energy, 1992.

vehicles, but it may likely encounter a government more mindful of technical and market barriers.

The other way the government may seek to promote both alternative fuels and alternative forms of transportation is through heavier taxation on gasoline. Even automobile manufacturers see higher gas taxes as a viable means of reducing national fuel consumption.⁴ However, that taxation would be politically unpopular, and it would certainly be surprising to see the United States match European gasoline taxation levels. It may be that a combination of moderately increased gasoline taxes, ready availability of alternative fuels, and comparably performing alternative-fueled vehicles will spark consumer acceptance.

TAX POLICY

Anticipating tax policies that affect the future of the auto industry is virtually impossible. There are countless possibilities. Taking into consideration arguments to reduce income tax levels through a flat tax or reduction in capital gains taxes, consumers may have more discretionary income. What they do with this additional income is unclear. Consumers may buy more new autos or they may simply buy more expensive autos. They may not spend it on transportation at all, preferring to buy other goods. The impact of such tax reduction is hard to predict.

A tax policy that would more directly influence the auto industry is the increase of the gasoline tax. Raising the gasoline tax would decrease new car sales, since they tend to slow down when fuel prices jump. In the past when fuel had gotten expensive, Japanese car sales climbed at the expense of bigger American cars.⁵ Under this type of scenario, automakers would have to produce more fuel efficient cars that consumers would want to buy in order to compete with the increased foreign competition. If they fail to do so, the impact of a gasoline tax would be especially hard on the U.S. automobile industry.⁶ But a gradual increase in fuel prices over a period of years would allow U.S. manufacturers to adjust their mix of vehicles and compete on relatively equal footing with manufacturers who already have fleets with high fuel economy.

TRADE POLICY

With the passage of GATT and NAFTA, and the creation of trading blocs like ASEAN and European Community, regional trade has begun to come out of its protectionist phase. The formation of and the power given to the World Trade Organization (WTO) is unprecedented, but free trade remains more of an agreed-upon idea than a reality. The future will test the limits of what the participating countries call free trade. Trading blocs may be used to build walls around the trading partners, or they will be the building blocks to freer trade. How the WTO deals with violations of GATT over the next 20 years will determine the success of free trade. Information technology may play an important part. As more information becomes available to the consumers of the world, they may demand more and pressure members of trading blocs to be more open.

⁴ Jerry Flint. "The Devil You Know." *Forbes*. 156, no. 11 (1995): 108-110.

⁵ *Ibid*, 108.

⁶ *Ibid*.

Trade policy in North America may follow two distinct trends. On the one hand, the United States will seek to broaden its trade within the North American Free Trade area. It is also likely that the United States will expand NAFTA to include several South American countries (i.e., Peru, Chile, Argentina, Brazil, and Ecuador). As growing economies, these new markets will offer many new opportunities for automobile-related investments.

Maintaining balanced trade will continue to be high on the list of priorities for each country. There are, however, possible threats to maintaining balanced trade in the future. More than likely, Japan will be joined by booming East Asian economies in exporting to the United States and the rest of the world. The automobile industry, in particular, may feel the effects of these exports. Because of a growing trade deficit or a perceived threat to a domestic industry, policymakers may resort to protectionist trade policies. Renegotiation of trade agreements, increased tariffs, as well as local content requirements may typify the kinds of trade tactics practiced in the future.

One of the major initiatives for the United States is harmonization of international standards. For the automotive industry, this includes the coordination of environmental regulations, safety standards, and trade and competition policies such as antitrust laws and subsidies. While the private sector often supports the harmonization of standards, conflicting standards and politics have held up the process. The challenge revolves around trying to satisfy legal restrictions on all sides of international borders and the fact that many countries often institute many of their own standards as a means of trade protectionism.

Progress toward harmonization will be gradual. In talks between the United States and the European Community, governments have been particularly apprehensive about adopting foreign environmental and safety standards.⁷ The issue is that international standards may fail to address local needs. Instead, nations have been working hard at having their own regulations and standards adopted as international standards. Negotiations for further harmonization will continue slowly well into the next century, especially as the number of nations involved in the process of harmonization also continues to increase.⁸

LABOR

History suggests that as a country's manufacturing ability matures, its industrial wages rise. Therefore, building plants in low-wage countries can be only a short-term strategy for cost containment. Locating in a country where one can develop a market and export freely might be a better approach.

Labor regulations in the United States may need to address a labor force that is older and more ethnically and racially diverse, and that contains more women. Labor policies may be concerned with equal opportunity hiring and gender equity in pay, as well as

⁷ James T. McKenna. "Harmonizing Creeps Along, Frustrating Anxious Industry." *Aviation Week and Space Technology*, (July 17, 1995): 53.

⁸ Ibid.

health care and pension benefits for a growing pool of part-time workers. Job insecurity resulting from continued downsizing of companies will also challenge labor regulators.

The future influence of labor unions is difficult to predict. While the labor movement's influence has declined in the last 30 to 40 years, recent mergers between labor unions in North America may foreshadow a resurgence in union power. In the last year, the United Steelworkers of America merged with the International Association of Machinists and the United Rubber Workers. The UAW has made similar strategic moves to reunite with the Canadian autoworkers union.⁹ If this is the case, unions may exert pressure not only on the companies that employ their members, but also on federal and state governments to address many of the aforementioned labor-related issues. The Big Three labor force will differ from the nonunion labor force in that in 15 to 20 years it will be younger. Within the United States, the Big Three will replace over 200,000 retiring workers over the next 10 years. This large turnover in the workforce will challenge educators to develop individuals who will have the needed technical skills and be able to work in a team-oriented environment, and it will challenge employers to choose the best individuals to work in an increasingly technical environment.

POLITICAL ISSUES

In considering who will be shaping government policy as it pertains to the automotive industry in the next ten to fifteen years, there are many important political factors. The U.S. automotive industry, both the Big Three and New Entrants, will continue to invest significant resources in monitoring and lobbying the federal and state governments on issues concerning trade.

Economic growth and competition for jobs and will be motivating factors at the state and local levels. With more foreign manufacturers coming to the U.S. mainland, state and local governments will be attracting foreign companies to their areas, offering them tax incentives and other benefits to entice them to establish operations in their states and communities.

Finally, public policy will continue to be influenced by the courts. Court interpretations and rulings related to liability cases—auto safety, environment, workplace safety—could shape policies that influence the auto industry.

⁹ Frank Washington. "UAW's Yokich Faces Big Tests in '96." *Ward's Auto World* 31, no. 12 (1995): 57.

Societal Issues

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INTRODUCTION

Societal and private well being, as they relate to the automotive industry, are contingent on a myriad of forces including technology, economic trends, environment, demography, government policy, and attitudes/ethics (see figure 1). This discussion focuses on the demographic trends and societal attitudes and ethics over the next 20 years. The impact of these two forces on societal well being can be assessed by considering the ability of individuals to participate in society, which can be understood by measuring the overall health of the population, the level of employment within the society, how secure individuals feel, housing availability and affordability, disposable income, and the quality of the environment. Because this discussion revolves around the future of the automotive industry, societal well being will be measured by both personal mobility which refers to the ability of individuals to reach their desired destinations (through private or public means) and by the degree of economic stability that may exist in 2010.

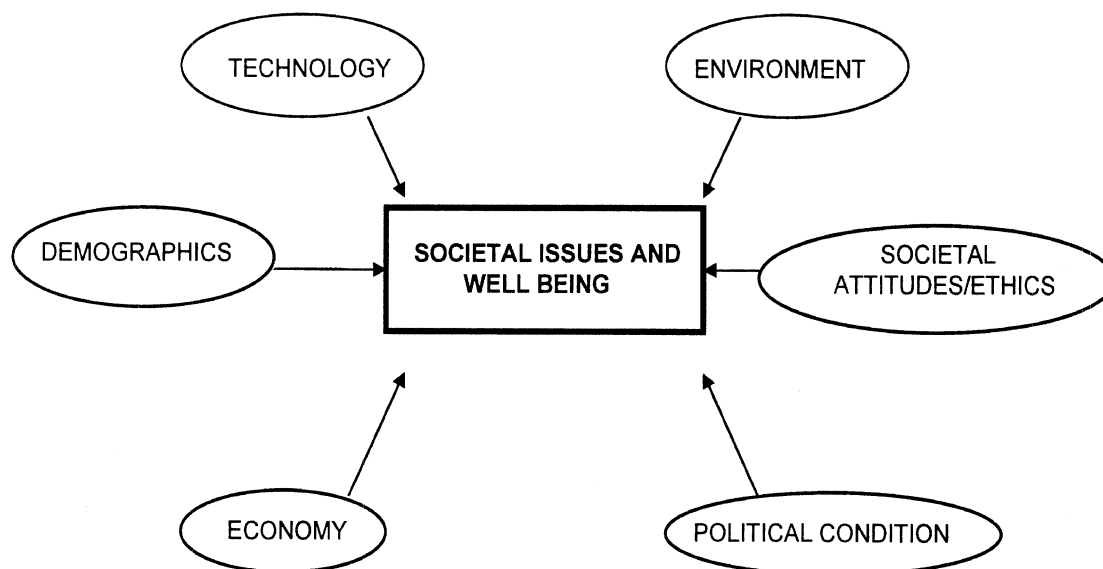


Figure 1. Societal Issues and Well Being

DEMOGRAPHICS

Of all the forces that will be changing the world over the next generation, demography may have the greatest impact. Population shifts have an inexorable effect on the world's living standards, its politics, its environment, and on how people behave towards each other—within their own societies, as well as in others. Internationally, there are five trends that are of particular interest:

Population Growth and Age Distribution

Changes in population growth, location and age will be many in the future.¹⁰ Globally, population growth shows two distinct trends. First, growth in the industrial world will either be relatively insignificant or negative. Second, world population growth will be concentrated in the developing areas, such as Africa and Asia. While one-third of the population lived in the industrial world in 1950, by 2020 it will only be one-fifth. This future pattern of population growth will depend largely on how powerful a force the apparent link between development and the fertility rate turns out to be. The transformation of China will be an interesting example of a nation that historically has been a poor country with a high fertility rate. Demographers remain unsure as to whether its present and expected economic growth will also weaken the government's influence on population control, thus triggering a rise in birth rates. Nonetheless population forecasts for Asia anticipate that it will retain roughly the same proportion of humankind as it did in 1990. Africa's share of population is expected to increase from 12 percent in 1990 to about 15 percent in 2010.

Populations in developing countries will be younger with high fertility rates, but in general, industrial societies will become older and continue with lower fertility rates. Two contrasting industrial countries are Britain and Japan. Britain, which has had one of the oldest populations of the industrial nations in Europe, will have one of the youngest with a decrease in the proportion of 65-year-olds relative to the whole population. Japan will go from the youngest to being the oldest of the main industrialized nations.

In North America, the U.S. median age will have increased from 31.4 in 1985 to 39.3 in 2020.¹¹ According to U.S. census predictions for 2015, the number of males aged 64 and over is expected to increase from 13.7 million to 20.5 million.¹² The number of females will increase from 20.0 million to 26.3 million.¹³ In Canada, the population of those over 65 will make up about 18 percent of the populace, making it older than that of the U.S. In Mexico, the high national birth rate will keep its overall population much younger than that of the U.S.

Women in the Workforce

The proportion of women in the workforce has risen in every OECD country over the last thirty years.¹⁴ In many countries, further rises in female participation will be the principal source of new labor. In the U.S., participation of women in the workforce has been increasing since the 1950s. Between 1950 and 1990, the percentage of the workforce

¹⁰ Hamish McRae. *The World in 2020: Power, Culture, and Prosperity*. Boston: Harvard Business School Press, 1994.

¹¹ John D. Kasarda. *Population and Employment Change in the United States: Past, Present, and Future*. Washington, D.C.: National Research Council, Transportation Research Board, 1989.

¹² U.S. Department of Commerce, *Statistical Abstract of the United States*. Washington D.C.: U.S. Bureau of the Census, 114th Edition, 1994.

¹³ Ibid.

¹⁴ McRae, *The World in 2020: Power, Culture, and Prosperity*.

that is female increased from 35 percent to 42 percent.¹⁵ The percentage of married women employed doubled between 1960 and 1990, from 30 percent to 60 percent. Similarly, the number of working mothers has increased with these trends. Between 1980 and 1990, the number of mothers in the U.S. labor force increased from 17.8 million to 22.2 million.¹⁶ The percentage of married women with children under the age of 6 who worked outside the home increased from 18 percent in 1960 to 60 percent in 1994.¹⁷ Further rises in female workforce participation will not only be one of the principal sources of new labor, but a potential source of new vehicle sales in the future as it has been in the past 20 years.

Immigration

It is worth noting that different continents will experience different levels of immigration. Immigration in Europe in the first part of the next century will be limited even more than it has been in the 1990s.¹⁸ Pressure to increase immigration will be resisted. In Asia, migration within countries will be more significant than migration between them. For example, within China there will be movement of people to the economic zones which are also becoming semi-autonomous states within the country.¹⁹

In contrast, immigration into the United States is expected to continue. Presently, the changing racial and ethnic mix in the United States is being fueled by the growing numbers of Hispanics and Asians and a decline in the birth rate of non-Hispanic whites. Immigrants from Mexico and the Caribbean into the United States increased from 1.65 million between 1971 and 1980, to 3.13 million from 1981 to 1990.²⁰ In the same time periods, Asian immigration increased from 1.63 to 2.82 million people.²¹ Immigration from South America and Africa increased also, but not nearly at the magnitude of the first two groups. This immigration will change the future composition of the U.S. population. Between 1990 and 2015, the U.S. population is projected to grow by 86.9 million people. Of this increase, 55 percent (47.8 million) will be the result of increases in the number of Hispanic, African, and Asian residents.²²

¹⁵ Sandra Rosenbloom. *A Vision of Emerging Transportation Requirements Twenty Years in the Future* (Final Draft). Tuscon: University of Arizona, Drachman Institute for Travel and Regional Development Studies, 1995.

¹⁶ Margaret Dykens. "The Stats are Enlightening." *Perspective on Social Issues*. (April 25, 1995): 3.

¹⁷ Rosenbloom, *A Vision of Emerging Transportation Requirements Twenty Years in the Future* (Final Draft), 37-40.

¹⁸ Hamish McRae. *The World in 2020: Power, Culture, and Prosperity*. Boston: Harvard Business School Press, 1994: 116-117.

¹⁹ McRae, *The World in 2020: Power, Culture, and Prosperity*, 117-118.

²⁰ U.S. Department of Commerce, *Statistical Abstract of the United States*. Washington D.C.: U.S. Bureau of the Census, 114th Edition, 1994.

²¹ Ibid.

²² Jennifer Cheeseman Day. *Age, Population Projections of the U.S. by Sex, Race and Hispanic Origin: 1993-2050, Current Population Reports*. Washington, D.C.: Bureau of the Census, 1994: 25-104.

Declining Household Size and Increasing Households

Another demographic change existing in the United States is the declining household size, concurrent with increases in the number of households. Average household size has steadily dropped from 3.14 people in 1970 to 2.66 in 1987, and is expected to decrease to 2.5 by the turn of the century.²³ Falling fertility rates have been accompanied by an expansion in the number of elderly single-person households, single-parent households, postwar Baby Boom married couples without children or with one child, and households composed of unrelated adults. The number of households is projected to increase from 88 million in 1986 to 106 million in 2000.²⁴

Decentralization of Urban Centers

The flight of people from urban centers will continue well into the next century. Trends indicate that economic growth patterns in the U.S. suburbs will continue. Kasarda notes that central city job increases were greatly surpassed by employment growth in the suburban rings.²⁵ In addition, preference surveys consistently document that the suburbs are, by a wide margin, the modal residential choice of the American population.²⁶ However, in contrast, in some cities a reurbanization has started. Both of these movements may create opportunities for automotive manufacturers to sell more vehicles, but the combination of suburbanization and reurbanization may also lead to freeway congestion. High levels of congestion may lead frustrated drivers to opt for public transportation if it is available, or in the long term, vote for funding to develop future public transportation modes.

ATTITUDES AND ETHICS

Attitudes

The rising average age of the population will probably be the most important force determining future trends in social attitudes. Because people under eighteen cannot vote, it is highly likely that retired people, plus those close to retirement, will become the dominant political force in western democracies (they will be close to having a majority of the votes). Consequently, this older generation may be an integral component that shapes the social and political climate, that is, increasingly conservative political debates, little tolerance for crime, disorder, and antisocial behavior, and greater acceptance of authority in controlling such behavior.²⁷ Already, the aging Baby Boomer generation has become more conservative on various issues than they were 20 years ago, but their attitudes also indicate they maintain some of the values they helped change in the past. They are less likely to believe in a traditional division of labor

²³ John D. Kasarda. *Population and Employment Change in the United States: Past, Present, and Future*. Washington, D.C.: National Research Council, Transportation Research Board, 1989: 121.

²⁴ Ibid.

²⁵ Ibid, 127.

²⁶ Ibid, 119.

²⁷ Hamish McRae. *The World in 2020: Power, Culture, and Prosperity*. Boston: Harvard Business School Press, 1994: 109.

between men and women.²⁸ They are politically more conservative, but their stated commitment to civil rights is stronger than ever.²⁹

Media

The media will continue to affect social attitudes. Conservatism stemming from an older more conservative generation of Baby Boomers will influence this industry as well. Current efforts to regulate the media industry—television, motion pictures, music—may pressure it to adopt some programming standards, such as voluntary family-friendly programming, by the major networks. These steps may pave the direction this industry will take. Although First Amendment rights will be an issue, the pressure to alter the standards of entertainment might be further reinforced by conservative industry stockholders. In this area the public may take a more proactive position in forcing industries, like the music industry, to limit the marketing of music with obscene, offensive, violent lyrics.

Business Ethics

Higher standards for corporate social responsibility and ethical business policies may be an integral part of successful businesses. A successful company as measured by economic efficiency and competitive effectiveness may also be successful as measured by social betterment. Corporate managers may need to be “good global citizens”—paying attention to the welfare of their constituent groups. Otherwise, they may be unable to gain the trust, commitment, and enthusiastic effort of those constituent groups.³⁰ Further, without the trust, commitment, and enthusiastic effort on the part of all the constituent groups—those within the company, those within the industry, and those within the society—modern business firms will be less able to be successful over time in a highly global economy. Already in the automotive industry, there is an increasing urgency in developing ethical rules and standards across the changing domains of assembler-supplier relationships.³¹ Ethical concerns have become more important as the industry attempts to establish more effective “partner-like” relationships.³²

Another area of research has shown that, in the future, an ever-growing number of conscientious investors will pressure corporations to act responsibly on social, environmental, and ethical issues. An increasing number of religious institutional investors, along with state and city pension funds, socially responsible money managers, and individual investors that hold collective investments worth \$45 billion will continue to link social and environmental responsibility and business ethics with

²⁸ Susan Mitchell. “Are Baby Boomers Their Parents?” *American Demographics*. 18, no. 6, (1996): 40-45.

²⁹ *Ibid.*, 42.

³⁰ LaRue Tone Hosmer. *Moral Leadership in Business*. Burr Ridge, IL: Irwin, 1994: 233.

³¹ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 30-31.

³² *Ibid.*

corporate financial performance.³³ From the CEOs and managers to the stockholders, corporate social responsibility and environmental responsibility will be the foundation for business ethics in the new millennium.

PERSONAL MOBILITY AND TRANSPORTATION

Demographic changes will be one of the principal factors influencing personal mobility and transportation policies in the near future. The aging American population will determine the kinds of technology and the types of traffic laws that will be implemented. This changing demographic will mean that more than one out of every five drivers in the year 2020 will likely be over 65 years of age. The increasing average annual miles per driver for men and women age 65 and older complicates travel and transportation needs.³⁴ This aging populace may force transportation policymakers and auto manufacturers to reconsider policies, regulations, and vehicle designs. Questions regarding licensing standards may arise, as well as the need for larger directional signs, brighter street lighting and roadway signs, more legible instrument panel displays, fully automated seat belts, and laws for minimum speeds on freeways.³⁵

Increasing numbers of women in the workforce will mean a greater demand for personal mobility. Studies have shown that working women have different travel patterns and needs than working men. Women more often depend on the car than men do because their multiple obligations require them to combine work trips with shopping, chauffeuring children, and responding to home emergencies.³⁶ In most cases, the automobile offers and will continue to offer the most flexibility in balancing work responsibilities, childcare, and domestic responsibilities. Transportation policymakers will have to take into consideration these differences as they implement their policies.

The immigration implications for personal mobility will vary. Given that the immigrants come from varied backgrounds their needs may be quite different. Many of these immigrants may have little experience with cars and may not be able to afford their own vehicles. In either case, immigrants and the inner-city poor will have a greater reliance on public transportation systems. Since there will be language differences, as well as physical differences, in the immigrant populations (some of these peoples may be smaller in stature), transportation systems and vehicles will have to address the different ergonomic, experiential, and language backgrounds of the new immigrant populations.³⁷

³³ Harry J. Van Buren, III. "Business Ethics for the New Millenium." *Business and Society Review* 94, (Winter 1995).

³⁴ U.S. Department of Transportation, *Entering into the 21st Century--Painting the Most-Likely Future*. Washington, D.C.: Federal Highway Administration, 1995.

³⁵ John D. Kasarda. *Population and Employment Change in the United States: Past, Present, and Future*. Washington, D.C.: National Research Council, Transportation Research Board, 1989: 121.

³⁶ Sandra Rosenbloom. *A Vision of Emerging Transportation Requirements Twenty Years in the Future* (Final Draft). Tuscon: University of Arizona, Drachman Institute for Travel and Regional Development Studies, 1995: 4-8.

³⁷ Barbara C. Richardson. "Symposia on Critical Issues in Traffic Safety." Southfield, Michigan: American Iron and Steel Institute, 1993.

Declining household size, the increasing number of households, and the trend toward suburbanization will also increase the need for personal mobility. These changes may increase the travel demand per household, resulting in more personal car use, or more trips. With the numbers and sizes of suburbs increasing, this may also increase the need for transportation for the elderly living in these suburbs. Likewise, it may be accompanied by more suburb-to-suburb and suburb-to-city commutes, decreasing the reliance on transit and increasing the use of personal vehicles.³⁸

Increasing reliance on telecommunications is likely to strengthen the position of cities that exploit the growing demand for information-based activities in a transforming global economy.³⁹ While in certain instances telecommuting will contribute to suburbanization, it will add some relief to traffic congestion, giving more flexibility to employees. Depending on the popularity and proliferation of computers and online services that offer electronic shopping, home-online degree education programs, and simple video conferencing, the need to actually drive to destinations will decrease accordingly. However, there is no clear consensus on what the status of telecommuting will be in ten to twenty years.

ECONOMIC STATUS

As mentioned earlier, economic status is an indicator of societal well-being. The fact the U.S. economy will continue its transformation from a manufacturing to service economy will add to the growing economic insecurity among working and middle-class Americans. Consequently, many of today's trends—stagnating wages, corporate layoffs, growing income disparities, escalating college and medical costs—may continue for the next twenty years. From a business perspective, companies will shift toward attaining more efficiency and will have people working only the hours needed. Thus, part-time shifts may continue to increase.⁴⁰ Also, employers will have to rethink the way they employ both women and older people.

In this environment, higher levels of education will become more essential in gaining economic mobility. Younger workers will need to be prepared for retraining several times in a career. They will need to adapt to a rapidly changing job market that is influenced, not only by trends toward cost-cutting efficiency, but by rapidly changing technology. Likewise, unless government policy sets a goal of better supporting university students, they will be expected to work part-time to pay a greater share of their education costs. Given this scenario, there will be more pressure on students to learn marketable skills.

³⁸ Barbara C. Richardson. "The Future of Transportation in Society: Forces of Change." Proceedings of Transportation Beyond 2000: Technologies Needed for Engineering Design for the Future, National Aeronautics and Space Administration, Hampton, Virginia, February 1996: 113-139.

³⁹ John D. Kasarda. *Population and Employment Change in the United States: Past, Present, and Future*. Washington, D.C.: National Research Council, Transportation Research Board, 1989: 130.

⁴⁰ Hamish McRae. *The World in 2020: Power, Culture, and Prosperity*. Boston: Harvard Business School Press, 1994: 103.

As women and immigrants become more of an integral part of the labor force, their economic mobility may increase. The economic mobility of immigrants will depend on both educational attainment and the availability of dependable transportation, that is, ownership of an automobile or access to public transportation, that allows commuting to and from work.⁴¹ Further, for immigrants, they will also face problems that traditionally have accompanied assimilation into the U.S. mainstream.

The economic status of older Americans may continue to be unstable in the next twenty years. The normal retirement age is expected to rise to 67 or 70 by 2020, increasing slightly the number of income-earning years. That could translate into somewhat greater retirement assets for seniors.⁴² However, in the longer term, the dependence on savings and fixed-income pensions may limit their economic security. Further, the threats of an insolvent security system, increasing medical costs, and inflation may significantly threaten the economic security of older Americans.

DEMOGRAPHIC AND PSYCHOGRAPHIC MARKETING

Automotive manufacturers have used demographics as a way of targeting messages to particular consumers in their attempts to market their vehicles for almost as long as vehicles have been produced. In the past 10 years they have begun using psychographics as a way of differentiating customers, using lifestyle choices and attitudes to aim marketing messages directly at specific types of potential customers. With the current move by manufacturers toward brand management, they try to combine demographic and psychographic characteristics of customers, trying to form clusters or groups of customers that respond predictably to a marketing message. Being able to predict the response of future messages on large groups of customers will allow manufacturers to design vehicles and marketing campaigns that attract the type of customer the brand is designed to attract. The future challenge for all marketers is to extend coverage and maintain accurate information for every customer and potential customer in the United States, a daunting task in light of the general movement of the population, immigration of potential new buyers, and changing lifestyle and attitudes based on the changing ages, composition, and incomes of households.

⁴¹ John D. Kasarda. *Population and Employment Change in the United States: Past, Present, and Future*. Washington, D.C.: National Research Council, Transportation Research Board, 1989: 130.

⁴² Hamish McRae. *The World in 2020: Power, Culture, and Prosperity*. Boston: Harvard Business School Press, 1994: 103.

Competition

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THE NATURE OF COMPETITION

In industry, the rewards for success in competition are usually customers and profits. Competition in the auto industry occurs on many levels and is probably as intense in North America now as at any time in the past. Competition occurs among manufacturers and among suppliers. Sources of competitive success include such things as productivity and quality.⁴³ Whatever the competitive strategy, it nearly always requires a near-term sacrifice in profits to be recouped through a higher level of future sales.⁴⁴

WHY COMPETITION IN NORTH AMERICA IS BECOMING MORE INTENSE

Part of the reason for increased auto industry competition is that the U.S. market, overwhelmingly North America's biggest, is saturated. In addition, more companies market and manufacture vehicles in this market, and more suppliers provide them with parts. Modest population growth combined with negligible increases in income has conspired to slow growth rates. Further, vehicles last longer, and consumers consider used vehicles an acceptable alternative to increasingly expensive new ones. The result is low or no growth in sales.⁴⁵ One figure published suggests a future growth rate in sales in the U.S. to be only 0.5 percent annually.⁴⁶ That means that one company's gain is another's loss. This situation is intensified if manufacturers who currently do not market in the U.S. attempt to do so.

Limited growth in the industry may mean limited access to capital. By many financial measures, returns in the auto industry are modest compared to those in other growing industries. That could mean a scarcity of capital in an industry that typically spends huge amounts of money to develop new vehicles and to build or upgrade manufacturing plants.

VEHICLES VS OTHER PURCHASES

While there is competition among manufacturers for sales, the industry as a whole competes with nonautomotive goods for sales, too. Consumers' purchasing priorities have changed, and some rank things like the purchase of computers and vacations ahead of the purchase of a new car. Part of the reason is that cars are getting more expensive while another is that cars last longer and perform more reliably during their useful life. Therefore, a new car purchase has become more optional than in the past, and a used vehicle is a very viable alternative. In fact, autos could even compete with

⁴³ "Suppliers Beware! The Gap is Widening." *Manufacturing Engineering*, (December 1994): 14-19.

⁴⁴ Thomas Karier. "Competitiveness and American Enterprise." *Challenge*, (January-February 1994): 40-44.

⁴⁵ Alex Taylor, III, "It's the Slow Lane for Automakers." *Fortune*, (April 1, 1996): 59-64.

⁴⁶ Ibid.

other transportation devices, such as small, electric-powered vehicles designed for neighborhood use. The industry, then, may have to look at alternatives for encouraging new car sales. These might include such things as more frequent styling changes or more optional content and safety equipment.

COMPETITION IN THE DISTRIBUTION SYSTEM

Most manufacturers are taking a hard look at how their products are sold. Compared to development in manufacturing or product design, the retailing system has probably changed the least. As vehicles become less distinguishable, car companies are realizing that sales and service may be just as important a competitive factor as product. Luxury makes, e.g. Infiniti and Lexus, have emphasized impeccable service in addition to fine products. GM's Saturn division, while selling a much less expensive vehicle, has probably received the most attention for its friendly buying process as well as excellent service after the sale. In a recent Customer Satisfaction Index poll from J.D. Power and Associates (one component of which is customer handling) Saturn, plus Acura and Mercedes-Benz, garnered top honors.⁴⁷ The way the manufacturers of these vehicles handle customers reflects a growing industry standard, as well as a marketing approach that encompasses far more than just product.

The selling side of the business is also likely to change. Consumers will see more auto malls or even showrooms that, like other retail establishments, offer competitors' products side-by-side.⁴⁸ Current franchise agreements tend to limit the degree to which competing makes and models share floor space but in many small communities, car dealers carry multiple makes in order to build a financially viable outlet. The so-called "supermarket theory" may not be very appealing to car companies in the midst of developing stronger brand images—and in some cases exclusivity images.⁴⁹ Builders of luxury vehicles may not want the proximity that invites easy comparisons and encourages the perception of vehicles as commodities.

While these changes in the purchasing and ownership experience are likely to entice new customers, they are aimed as much at helping manufacturers retain existing customers. Manufacturers have broadened the definition of what it is they provide to customers: not just a product, but an experience. Consequently, purchase and ownership experience must be included in any definition of customer satisfaction. Tightening competition is responsible for manufacturers looking at many nonproduct aspects of competition: it is no longer a "seller's market but a buyer's market based upon replacement of existing vehicles."⁵⁰

INDUSTRY COMPETITION

Competition in the future will involve more than just products. Competitive manufacturers in the future will need to set up their own organizations in such a fashion

⁴⁷ *Satisfaction Decline Signals Industry Performance Plateau*. Angora Hills, CA: The Power Report, J.D. Power & Associates, July 1996: 1-5.

⁴⁸ Herb Shuldiner. "Head-to-Head in the Showroom." *Ward's Auto World*, November (1994): 51-52.

⁴⁹ *Ibid.*

⁵⁰ Vincent Alonzo. "Shedding Their Skin." *Incentive*, (August 1995): 37-39.

as to be able to harness changes in the marketplace, monitor consumers wants, etc. Towards that end, numerous industry experts have recommended prescriptions for maintaining a competitive edge, many of which are based on an examination of how the North American manufacturers have reacted to and coped with increased foreign competition, a major competitive phenomenon of the last twenty years.⁵¹ Some of these include:

- Focus on the company's core competencies. The 1980s saw a rash of acquisitions by the domestic car manufacturers, in an attempt to diversify into industries whose business cycles moved counter to auto's. Instead of providing a cushioning offset to the auto industry's highs and lows, these acquisitions sometimes drained scarce financial resources and often distracted management from running the core business (automotive design, manufacture and marketing). Today's strategic thinking suggests that channeling one's resources into doing a superior job running one particular business is more likely to maintain long-term profitability and viability than trying to piece together a group of diverse ones. Some industry thinkers would go even further and suggest that competitive survival requires that companies regularly review what their core competencies are and how best to focus on them. Business management goals move in cycles so it is possible that a diversification strategy could again become popular.

- Promote the development and functioning of teams. No longer can companies permit employees to operate in a manner that benefits one particular functional group at the expense of another—or worse, places personal career goals ahead of corporate well-being.

- Empower employees. American business once mimicked the kind of management control favored by the military: subordinates carried out assignments defined by management with little input or control. Today, realizing that these subordinates are often in a better position to attend to the needs of everyday operations, management has conferred authority and responsibility to lower level employees.

- Become a learning organization. Because change is never-ending, companies that master learning to cope with changing circumstances will be ahead of the competition.

In addition, the auto industry needs to be concerned about tomorrow's leaders. Where will they come from and what will they need to know to manage tomorrow's industry? Historically, the auto industry has probably provided other industries with more managerial talent than it has accepted from them. Regardless of where they come from, the corporate leaders of tomorrow are likely to require leadership qualities and skill sets that differ from those needed today.

These are prescriptions for success, so they are also the areas for the competition of the future. How well companies do these things is likely to determine how successful those companies are.

⁵¹ Anita Lienert. "From Rust to Riches." *American Management Association*, (November 1994): 10-14.

Technological advances are an inherent part of competitive advantage. For instance, product development and testing are moving to a computer-based world where engineers and designers use computer simulations and holographic images instead of clay models and bodies-in-white. The advantage of such virtual prototypes is a reduction in the time it takes to develop and test new models. That reduces the time it takes to bring these models to market and consequently assures that the latest trends and tastes are incorporated into the design.⁵² Technology, too, is enhancing the gathering of customer data, as customer feedback becomes more commonplace via Internet home pages and information kiosks. In both these situations, optimal use of time is a competitive advantage. Vehicle technology is another variable in the technology equation, but only when such technology carries "immediate and perceived customer value."⁵³

One ironic aspect of the nature of competition in the auto industry may be that market shares of particular companies will remain relatively stable, with few big gainers or losers in the coming years. The focus of competition becomes maintaining one's place in the market rather than devising strategies for conquering sales from a competitor. That competitive dimension could lead to new kinds of corporate strategies centered around retaining existing customers instead of trying to attract new ones. Alternatively, manufacturers may end up expending vast resources for minor increases in market share.

Another consideration of the competitive environment is that many competitive advantages have a time element. That is, most advantages are advantages for only a limited time, since other competitors can eventually adopt them. At one point, for instance, the image of quality was largely the province of Japanese manufacturers. Today, quality is much more uniform among manufacturers and may not be the competitive edge it once was. High quality is expected by consumers, and today's manufacturer may be more penalized for poor quality than for high quality. Manufacturers who can identify and exploit *sustainable* competitive advantages will fare better than those whose advantages are temporary.

COMPETITION IN THE SUPPLIER COMMUNITY

Suppliers will play an increasing role in the competitive battlefield because manufacturers want to shift a significant share of the responsibility for automotive value to them. For instance, some manufacturers will ask their suppliers to shoulder a greater burden in developing new technologies, in reducing costs, in providing parts to global factories. It is conceivable that some suppliers will supply parts and components that are unique in concept, function or some other attribute appealing to consumers achieving mention in vehicle advertising. "Car makers are becoming more like design studios and marketers," explains one industry observer, "and less like

⁵² Tim Keenan. "Visualizing the Future." *Ward's Auto World*, (June 1995): 38-39.

⁵³ Michael S. Flynn et al. "The Competitiveness of the North American Auto Industry." Ann Arbor: University of Michigan, *UMTRI Research Review*, 23, no. 3, (1992): 73.

factories—outsourcing more and more of their part needs.”⁵⁴ This same observer notes that there are three trends affecting suppliers: “the world car concept, continuing quality improvement, and the search for new materials.”⁵⁵ Smaller, lower-tier suppliers may feel the brunt of quality improvements at this point. Chrysler claims that most quality problems can be traced to second and third tier suppliers, rather than first tier.⁵⁶

Part of the competition among suppliers relates to pricing for their automotive customers. Car makers are expecting suppliers not only to hold the line on prices but in fact to reduce them, perhaps by as much as 5-6 percent per year.⁵⁷ The approach to pricing has changed dramatically from prior practices. Now, car makers identify a target price for a part or component and ask suppliers to identify ways to reach that cost, using improved processes, simplified design and other means.⁵⁸ Manufacturers insist that they are not out to attack the profit margins of suppliers, but rather want to see supplier costs and system complexity reduced.⁵⁹ The Big Three have actively tried to reduce the number of suppliers they use in order to build stronger but fewer relationships. However, GM, for one, has insisted it will not jeopardize its access to the latest vehicle technology through rigid associations with current suppliers.⁶⁰

SHIFTING POWER AND REORGANIZATION

While the assemblers shift responsibility to suppliers and reduce the number of suppliers they deal with, they may also alter the balance of power. In fact, both the supply chain and the distribution channel are experiencing major changes that may mean vehicle manufacturers have less control than in the past. The supply network is beset with mergers, joint ventures and other forms of integration to better meet the demands of auto assemblers. Bigger suppliers, with more responsibility and control, may have more power to choose their customers. However, size will not be the only determinant of supplier power. Suppliers who serve as systems integrators will be powerful by virtue of their roles and expertise.⁶¹ In addition, because of industry rationalization, manufacturers may have fewer suppliers to choose from, and these remaining suppliers are therefore likely to be less vulnerable to competition.

Similarly, there may be a consolidation in the distribution chain resulting in fewer, but larger dealerships—many of which will handle several brands. The used vehicle market has seen the development of national chains; at least one of which has an agreement

⁵⁴ Kathryn C. VanGilder. “Auto Industry Trends Opening Doors for IEs.” *IIE Solutions*, (November 1995): 22-25.

⁵⁵ *Ibid.*

⁵⁶ James Carbone. “Lessons from Detroit: Get Suppliers Involved Early.” *Purchasing*, (October 19, 1995): 38-42.

⁵⁷ Jerry Flint. “The TRW Way.” *Forbes*, (July 31, 1995): 45-46.

⁵⁸ Carbone, “Lessons from Detroit: Get Suppliers Involved Early.”, 38-42.

⁵⁹ Tim Keenan. “Waste Warriors.” *Ward's Auto World*, (December 1995): 59-61.

⁶⁰ *Ibid.*

⁶¹ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 23.

with a manufacturer to sell new vehicles. Such large retailers may exercise significant clout with the OEMs. Some OEMs will feel squeezed between increasingly powerful suppliers and distributors.

The organizational structure of the industry is also changing. Suppliers are combining resources with each other in uncommon ways, based on product or process capability. Such "partnering" arrangements are formed according to resource requirements of a particular project or program. As such, these relationships are terminable and flexible. Consequently, the "tiered" structure is giving way to something perhaps more accurately portrayed as a network. The previous model, with its assumption of linear relationships in a hierarchy of tiers, is being replaced with a fluid network of virtual associations in which any particular company may serve multiples roles.

COMPETITION FROM OVERSEAS

Manufacturers are entering new or existing markets around the globe. Manufacturers like South Korea's Daewoo have ambitious plans to become global players. Daewoo plans to spend \$11 billion between 1995 and 2000 "to become one of the world's biggest auto makers."⁶² The intentions of Daewoo and other smaller manufacturers make even more complicated the fact that there is excess manufacturing capacity in total around the world, probably in excess of several million units.⁶³ Other manufacturers are already in North America, and plan to increase the amount of manufacturing (and possibly selling) they do here. Japanese manufacturers have been stronger competitors, generally, than European ones. That may continue in the future. The yen has retreated from its 1995 high versus the dollar and Japanese manufacturers have used "lean design" and shortened product development cycles to squeeze cost out of vehicles.⁶⁴ Toyota is attempting to increase its plant capacity in the U.S.⁶⁵ and expected to export 80,000 U.S.-built vehicles by 1996.⁶⁶

CONCLUSION

The bases for competition in the auto industry in North America are changing swiftly and profoundly. Negligible growth in vehicle sales and buyers' incomes means that vehicle manufacturers will be in a tug-of-war in a mature market for sales and profits. Consequently, manufacturers are examining all stages of vehicle life, from earliest design to final disposition, for opportunities to participate in revenue generation. Prodded largely by manufacturer demands, suppliers are regrouping and jockeying for position in a procurement system whose final structure is still uncertain. Some of these suppliers will emerge with unprecedented systems and components responsibility. Although vehicle manufacturers are trying to refine and improve an outdated retail system, forces beyond the manufacturers are trying to alter the system's structure. Technology remains a core part of industry competition, with its ability to revolutionize vehicle design and sales. The company which harnesses technology effectively gains a

⁶² Bruce Barnard. "Europe's Car Makers Rev Up." *Europe*, (December/January, 1995-96): 18-21.

⁶³ Ibid.

⁶⁴ Edith Updike. "Japan Turns a Corner." *Business Week*, (February 26, 1996): 108-112.

⁶⁵ "Mid-Term Global Business Plan Announced." *Japan*, (June 21, 1994): 81-84.

⁶⁶ Ibid.

competitive advantage. Finally, decisions being made outside of North America could have significant competitive impact here.

Customer Desires and Needs

Author: Jeffrey M. Davis

INTRODUCTION

The purchase of a new car or truck represents emotional and practical considerations unlike those of any other product. There are a great many consumer transportation needs and wants, reflected by the availability of a vast array of models. The most important issues for the auto industry to consider are determining what the wants and needs of customers are, and determining how best to meet those wants and needs.

Consumer choices are affected by practical considerations, like income, age, and family size. They are also affected by subjective considerations, like vehicle styling, status and reputation. If the industry is to continue to provide appealing cars and trucks, it will need to monitor the changing circumstances and desires of its customers.

AFFORDABILITY

Prices continue to be an important consideration for both buyers and sellers of cars and trucks. To the extent that personal mobility is a necessity and not a luxury, consumers will have to acquire vehicles (or other means of transportation), so merely predicting sales levels of vehicles alone is not entirely useful. What is likely to happen in some economic segments as prices increase is reduced spending on vehicles—possibly a migration from more expensive vehicles to less costly, probably smaller, ones or to used vehicles. Alternatively, consumers may postpone the purchase of a vehicle due to high cost, or due to the purchase of some other expensive product. On the other hand, the monthly payment is the primary financial consideration for many buyers, not total vehicle price. Consequently, personal leasing has become increasingly popular as a remedy for high prices, since lease payments typically are substantially lower than monthly loan payments. It is not yet clear whether leasing serves only as a prescription for escalating vehicle prices, or if leasing permits consumers to buy more expensive cars and trucks. Probably it does both.

This raises a question about vehicle content and its effect on prices. Unquestionably, cars and trucks today feature a rich array of comfort and convenience items, safety features and performance features available in many vehicle segments. These features add cost. In an increasingly price-sensitive market, some consumers may be willing to forego these features for a lower price. Therefore, there exists the possibility of de-contenting vehicles in the future, reversing a long-standing trend towards increased vehicle content.

The used vehicle market has received a great deal of attention in light of new vehicle affordability concerns. The “nearly-new” vehicle market is considered a growth market, as short-term leases make used vehicles still under warranty widely available. As new vehicle prices rise, particularly if prices increase more rapidly than income, used vehicles become an attractive alternative for many people. High levels of reliability and durability also make used vehicles appealing.

There is an additional consideration with regard to rising vehicle prices—the fragmentation of the market into segments and niches. Manufacturers have designed many vehicles with appeal to only a limited number of buyers. There are more nameplates, selling in lower volumes, than in the past. With lower volumes, there are fewer economies of scale, and therefore higher prices.

TASTES AND COMPETITION WITH OTHER GOODS AND SERVICES

Over the next ten years or so, manufacturers are likely to produce even more low-volume nameplates according to panelists in a University of Michigan Delphi study.⁶⁷ That suggests a continued preference for specialized vehicles on the part of consumers. In fact, there is talk in the industry of mass customization: customers ordering vehicles directly from the factory using showroom kiosks, and factory deliveries taking days, not the current weeks (or even months). Efficiencies that result from this redefined ordering system could make cars less expensive. That could be offset by the increasing complexity and attendant cost of the deviations that come with “unique” products: the manufacturing variation that accompanies customization carries a cost penalty. While consumers may decry the rising prices of light vehicles, they may contribute greatly to those rising prices by wanting more features and a vehicle more specific to their tastes. The last decade or so has seen a significant loss in manufacturing economies of scale as the proliferation of new model choices has pushed down the sales volume of any particular model.

The growing environmental movement is not likely to affect consumer tastes, according to Delphi panelists.⁶⁸ Consumers are likely to pay only a small amount for vehicles that produce no emissions or are completely recyclable. High fuel economy vehicles, which can be construed as environmentally friendly, are desirable because higher initial costs are offset by lower operating costs.

There is a new development in the industry that could have serious implications for vehicle sales. Some manufacturers will try to take advantage of their vehicles' longevity by participating in the value chain that exists after the vehicle is sold. Currently, most manufacturers have little involvement in the aftermarket, defined as the time after a vehicle is sold as new and the time it is scrapped. Two phenomena exist that, when combined, make the aftermarket a logical place for increased manufacturer participation. First, vehicles today are increasingly reliable and durable. Second, some vehicle technology changes faster than these new cars wear out. While some customers will buy new cars to have the latest technology, others may not, for affordability or other reasons. These latter customers are those for whom manufacturers could provide vehicle upgrades, particularly in electronics, emissions and safety. We have already seen manufacturers sponsoring recertification programs for used vehicles. A logical next step is to provide systems upgrades to keep a used vehicle “current.”

⁶⁷ David E. Cole et al. *Delphi VIII Forecast and Analysis of the North American Automobile Industry: Marketing*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 124-125.

⁶⁸ Ibid.

SPECIAL NEEDS OF AGING CONSUMERS AND OTHER GROUPS

The U.S. Bureau of the Census estimates that there will be nearly 40 percent more persons over the age of 64 by 2015 than in 1995. While most persons enjoy robust health and unimpaired mobility during advanced age, many older Americans will have special transportation needs. Perhaps more than in any other country, the transportation system in the U.S. relies on the personal car. In fact, our transportation system and land use patterns evolved in the way they did due to widespread use of the personally-owned car. The interstate highway system and extensive development of local paved roads encouraged the use of cars, while simultaneously discouraging the construction of mass transit systems. In turn, pervasive use of cars permitted the development of extensive suburbs and segregation of living, working, and shopping spaces. The separation of these "districts" is so widespread that personal transportation almost becomes mandatory for personal mobility. Consequently, society bears some responsibility for the transportation needs of those who are unable to operate individually operated vehicles. Some important transportation issues for society to consider include providing: after-school transportation for children whose parents work, highly personalized mobility for older citizens no longer capable of operating a vehicle themselves, and low-cost transportation for low-income citizens. Other issues include safety, privacy, and enhanced social interaction.⁶⁹

Handicapped drivers may pose the greatest challenge for auto manufacturers, because the handicapped may require a variety of vehicle design alterations to accommodate their limitations.

DISTRIBUTION SYSTEMS

There is potentially a major upheaval in the way cars reach consumers from the factory. Traditional franchise agreements between manufacturer and retailers will prevent any overnight changes. Still, changes in technology and heightened expectations from consumers may be altering the buying and service process. For one, increased information flows, via computer and other published sources, have rendered the salesperson on the showroom floor less of an exclusive information source about a vehicle. In addition, the potential to bypass the traditional dealer and order a vehicle directly from the factory may be increasingly possible.

Fairly or unfairly, the dealer has a negative reputation from a transactional point of view. As a high ticket purchase, consumers are especially sensitive to prices and want to come away feeling that they have not paid an excessive amount for the vehicle they chose. Discounting of the manufacturer's suggested retail price (MSRP), a practice started years ago, meant that prices were negotiable, a concept that many consumers enthusiastically accept. The MSRP has become merely a beginning negotiating point, except for highly desirable models for which the dealer may be able to charge sticker price or more. Unfortunately, it set the standard practice for buying a car, establishing a potentially hostile buying environment. Because of this environment, many consumers might like to bypass the salesperson and buy a car through buying services or even

⁶⁹ Barbara C. Richardson. "The Future of Transportation in Society: Forces of Change." Proceedings of Transportation Beyond 2000: Technologies Needed for Engineering Design for the Future, National Aeronautics and Space Administration, Hampton, Virginia, February 1996.

over the computer. The technology is certainly available today to allow that. So, reasons for change in the distribution system are based on consumers wanting to pay less (bypass the middleman) and avoid a hostile buying environment.

The traditional retail system is not going to give up without a fight. Today's retailers, over 22,000 of them, have a legal right to inventory from the manufacturers.⁷⁰ The best salespeople at the dealership still offer information about the various choices buyers have available. Also, the dealer is the point of pick up for the vehicle (even computer-ordered vehicles eventually must be picked up somewhere) and has after-the-sale service (maintenance and repair). We have already seen a diminished influence on the part of the manufacturer, as many dealers have become multifranchise operations. When several makes share showroom floor space, the manufacturer has less control over how vehicles are sold.

Delphi Forecast panelists identified several ways in which the retailer of the future will change to meet customer needs and expectations. The selling process is likely to integrate more computer technology. For example, computer simulations may substitute for actual vehicle test drives, and dealers may keep a great deal more information on customers in a computerized database; even 24-hour shopping is possible through ATM-like machines. Sales people will likely be more product-knowledgeable in keeping with a role evolving into consultative selling rather than hard selling. Finally, the general services of the dealers may offer other auto-related, but nonproduct services, for example, insurance. Many dealerships are likely to be upgraded, in keeping with a trend to try to maintain a relationship with buyers. Some dealers offer more personalized service, such as pickup and delivery of serviced vehicles. As far as the kinds of dealerships, Delphi panelists predict an increase in "megadealers," or multifranchise dealers, with a corresponding decrease in the number of dealerships and salespersons.

BRANDING/PRODUCT DIFFERENTIATION

Brand management is a marketing approach to maximize the value of a product to the customer. Brand management uses strategic and tactical marketing tools (such as pricing and product positioning) to maximize brand equity, and therefore enhance desirability to consumers and ultimately owner loyalty. The movement toward brand management in the auto industry suggests even greater manufacturer involvement in the marketing process than before. OSAT's Delphi VIII Forecast considers numerous consumer-related issues that have potential implications for branding. Panelists predict that styling offers the most opportunity for product differentiation in the next ten years. Pricing and interior design also offer significant opportunity, as do added features and improved refinement. Nonproduct attributes play a large part in brand management. In addition to product features, Delphi panelists were asked to consider what sales and service attributes are required to enhance brand loyalty. They responded that safe, reliable, well designed vehicles sold by more competent salespeople and serviced correctly and conveniently are the key ingredients for owner loyalty in the future.

⁷⁰ *Motor Vehicle Facts and Figures*. Detroit: American Automobile Manufacturers Association, 1996: 74.

Brand management offers advantages to both consumers and manufacturers. Brand management is expected to help manufacturers more precisely develop their products, incorporate features and attributes, and devise appropriate marketing campaigns. Multidivisional companies, in particular, stand to gain by more precise positioning of both makes and models: current overlap at some companies leads to cannibalism between vehicle lines. Consumers can benefit from brand management because their wants and needs are more likely to be considered in customer research with a brand manager serving as a vehicle "champion." In addition, as manufacturers better define the intended customers, those customers will be better able to determine which vehicles meet their purchasing criteria.

CONCLUSION

Cars and trucks remain purchases that appeal to a combination of a customer's needs and wants. Neither a completely rational nor emotional choice, personal transportation selections reflect a myriad of criteria for any particular consumer. The auto industry struggles to find ways to identify what it is that customers want and need. It has largely been successful at this, which is why there are so many cars and trucks to choose from. It has been less successful in providing a satisfying purchase experience for customers. With a growing aged population and modest income gains, tomorrow's buyers may find their choices limited by age and income. Further, competition with other goods, such as computers or vacations, longer vehicle life, and diminished status appeal conspire to make the purchase of a new vehicle a more discretionary purchase. For vehicle manufacturers to continue to succeed, they must be prepared to refine or redefine any aspect of the purchase and ownership experience.

Economic Factors

Author: David Graham

INTRODUCTION

The world economy is on the cusp of a ten-year period of moderate, but geographically uneven, growth. Governmental monetary policies in the major industrialized nations, designed to curb inflation and lengthen cyclical economic upturns, may continue to inhibit rapid growth while promoting economic stability in Europe, North America, and Japan. The developing industrial countries (primarily Asian) are expected to experience more robust expansion through the turn of the century.

GLOBAL ECONOMIC OUTLOOK

The deceleration of inflation in the industrial nations in the 1990s from 5.0 percent in 1990 to 2.4 percent in 1994 has largely been the result of restrictive governmental monetary policy.⁷¹ Bruised by two decades of inflation and budget deficits, the European G7 countries (Great Britain, Germany, France, Italy) and the United States have started to reign in government spending and raise interest rates. In Europe, this effort has its own particular urgency. In order to create a common currency, the EC nations must have manageable debt/income and deficit/income ratios. As a result, several European central banks have affiliated themselves ideologically with the conservative but influential Bundesbank of Germany in order to achieve relative debt parity⁷². In general, the Western European nations are expected to attain a GDP growth rate averaging 2.5-3.0 percent over the next ten years while maintaining a relatively low rate of inflation—forecasted to be approximately 3 percent annually.⁷³

The United States and Japan are expected to post similarly slow but steady growth rates over the next several years. The U.S. Federal Reserve Bank's strategy of gradual interest rate hikes to stem the growth of the inflation rate is expected to continue through the middle of the next decade; and GDP growth is predicted to average 2.5 percent annually during the same period. Additionally, the U.S. budget deficit is expected to continue to fall as a percentage of GDP—from 3.1 percent in 1994 to less than 1.0 percent in 2005. Japan is pursuing more aggressive and expansionary fiscal and monetary policies in the short term as it begins its emergence from its worst economic downturn since the end of World War II. Japanese GDP growth rates are expected to rise from 0.5 percent annually in 1992 to 1994 to approximately 3.0 percent annually through 2005.⁷⁴

As the industrialized nations seek macroeconomic stability, there will most likely be some adjustments forthcoming in the international money markets, particularly involving

⁷¹ Evangelos Simos and John Triantis. "International Business Outlook." *The Journal of Business Forecasting*, (Fall 1995): 30.

⁷² John Wilke. "Global Austerity: War on Inflation Curbs World-Wide Growth." *The Wall Street Journal*; (April 10, 1996): 1.

⁷³ Simos, "International Business Outlook," 32.

⁷⁴ *Ibid.*

the U.S. dollar. Many feel that the dollar has been overvalued against the Japanese yen and the German mark in recent years. In the long-term forecast, the dollar is expected to depreciate against these two currencies. Depending on the degree of change, currency fluctuations can have significant effects on national economies by changing industry cost/price structures and influencing trade balance levels. If a particular country's currency depreciates against the world money markets, the relative price of its imports will rise while its exports become less expensive, generally resulting in an improved foreign trade balance. While the converse may be true for an appreciating currency, a strong exchange rate has its own advantages. Strong purchasing power can facilitate industrial expansion. Japan is a prime example of this. A strong yen has enabled the Japanese to make huge capital investments and enter numerous global industries.

Over the next ten years, the most dramatic growth story will likely be the continued development of the Asian economies. Economic growth in Asia will continue to outpace the rest of the world, at least through the turn of the century. GDP growth rates (excluding Japan) will reach nearly 7.5 percent annually during the next decade. Inflation will probably decline from the current 9.0 percent to between 6 percent and 7 percent annually in 2005 as increased consumption rates in the developing countries are likely to result in rising interest rates.⁷⁵

Economic growth in developing Asia is paralleled by its current population boom which, given the probable rise in personal disposable income, certainly enhances the region's appeal as an emerging market. Consider that the ASEAN population is currently larger than that of the NAFTA countries. Consider also that, according to current projections, 60 percent of the world's population will live in the Asia Pacific region. While Asian population growth is by no means a recent trend, it is important to note that much of the current growth is concentrated in urban areas. It is estimated that by 2020, Asia will be predominantly urban.⁷⁶ This suggests an emergent, industrially oriented populace with an increased need for consumer goods that is more conveniently accessible as a market than in years past. Given that, it is important to recognize that growth in consumer spending—particularly automotive purchases—depends on the equitable distribution of new wealth, not merely raw economic growth.

Given these global economic forecasts, it is reasonable to expect that the global automobile industry will reflect these trends during the next ten years. Therefore, one could probably expect moderately slow market growth in Europe, North America, and Japan. The domestic brands in the United States, depending on the prevailing trade policy, could potentially gain some market share from selected imports, given a weakening dollar. The large gains in terms of market growth and production capability will be particularly strong in the emerging Asian countries. A recent OSAT survey indicates that the automotive community tends to share some of these outlooks. They predict a slight increase in the U.S. interest and inflation rates through 2005 as well as a small annual domestic market increase of 0.5 to 1.0 percent. They also identified China, perhaps the epitome of the burgeoning Asian market, as both a very attractive

⁷⁵ Mark Towery. "Is This the Pacific Rim or Global Century?" *Atlanta International Magazine*, (June 1996).

⁷⁶ *Ibid.*

opportunity for sales and production but also, like South Korea, an emerging competitive threat. Nevertheless, the fact remains that three of the four most frequently mentioned countries were Asian.⁷⁷

A CLOSER LOOK

The American automobile market appears to be headed toward a sustained period of flattening sales trends that will last for at least the next several years. Indeed, the most common estimate of sales trend growth through the year 2005 is a relatively meager 0.5 percent to 1.0 percent annually. Following is a more detailed review of some of the economic factors that have contributed to these predictions of slower growth and the effects they are likely to precipitate upon the industry as a whole.

Product Affordability

Perhaps the most striking development in the industry from a consumer standpoint is the continuing trend of new car price increases outstripping wage growth. In 1973, the average new vehicle price was \$4,000, while the median annual income for a family of four was approximately \$12,000. In contrast, the average household income in 1995 was \$36,000 a year, but the price of a new vehicle averaged roughly \$20,000. This represents a significant jump in the price of a new vehicle as a percentage of a family's annual income—from 33 percent in 1973 to 56 percent today.⁷⁸ However, consumers may be keeping cars longer, since the average age of a vehicle on the road in 1996 is 8.4 years, compared to 7.0 years in 1980. The increase in annual "rent," then (the annual purchase or lease cost), may not be so great as the above measure suggests.

Rising vehicle prices may be partly a function of the Big Three's efforts to improve the overall quality of their vehicles as well as an increase in vehicle content. While American cars and trucks are now comparable to competitors' products in terms of quantifiable quality standards such as defects per vehicle, this progress has added cost to the vehicle. In addition, adding more features such as antilock brakes and airbags has fattened the prices of even entry-level vehicles, pushing them out of the comfortable affordability range of many potential buyers. For example, the cheapest Ford Contour has a suggested retail price of \$14,285. Two years ago, it replaced the Tempo, whose cheapest version listed for only \$9,615, according to Edmund's New Cars Guide. Mechanically superior and more amply equipped, the Contour is nonetheless out of reach for the entry-level buyers who were so well served by the Tempo.

Demographics

An analysis of the country's demographic shifts during the next decade could point toward a continuation of flattening sales and increasing prices. Research by Chrysler Corporation indicates that the United States is in the middle of a 25-year decline in the growth rate of the number of households, that will continue well into the next century. Households are traditionally the main car-buying unit in this country. Furthermore,

⁷⁷ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996.

⁷⁸ Brian S. Moskal. "Affordability Crisis?" *Industry Week*, (November 2, 1995): 12.

Chrysler researchers see most of the decline occurring in the households headed by 35 to 44 year-olds, the prime car-buying age group.⁷⁹

A shift of a different nature will occur as the massive Baby Boomer population passes through middle-age and into the over-50 demographic bracket. This bulge no doubt intrigues the carmakers, who traditionally have viewed the 50-plus segment as extremely profitable, since they tend to have the most discretionary income and are therefore less price-sensitive and more willing to buy expensive luxury cars and sport utility vehicles. It is unlikely, then, that the automakers will move to de-content their products in any meaningful way in order to cut prices. On the other hand, despite high incomes, a 1995 study by Merrill Lynch showed that the average middle-aged American had only about \$2,600 in net liquid financial assets. It also calculated that a baby-boomer earning \$100,000 a year will need \$653,000 in today's dollars to be able to retire in comfort, yet typically will save only 31 percent of the amount necessary to achieve this goal.⁸⁰ It is possible that, as this huge demographic segment begins to see retirement looming larger over the horizon without having adequately prepared, their group spending habits will become more conservative and, as a whole, less attracted to the luxury purchase.

Federal Reserve Impact

In 1994, the Federal Reserve Board, sensing the economy was heating up faster than planned, took preemptive steps to avoid an increase in the inflation rate. Between February 1994 and February 1995, the Fed instituted a series of small increases in the short-term interest rate. While this strategy did keep inflation under control (a plus for the industry), it had the adverse affect of dampening new car sales in the short-term. The rate increases discouraged potential buyers due to the resulting escalation of monthly car payments. The rate hikes also affected mortgage and credit card rates, resulting in a diminution of consumers' discretionary income.⁸¹

The effect of interest rate increases has also served as an impetus for increased vehicle leasing. The sticker shock of new car prices, coupled with high finance rates, has made leasing a car an increasingly attractive alternative to buying. J.D. Power & Associates forecasts that leasing will continue to grow, from 24 percent of the current car market to 45 percent during the next cyclical downturn in the industry. One reason for this is that monthly lease payments tend to be less than those of conventionally financed vehicles because, with leasing, the consumer is not financing the entire vehicle, but rather the difference between the original sales price and the vehicle's residual value at the end of the lease term.⁸² Car makers are probably more likely to promote this option when faced with a sales slump. Used car sales are also benefiting from the current market, as more consumers are beginning to consider a late-model pre-owned vehicle an acceptable substitute for a new one. The consequences of this trend can be seen in the recent emergence of the used car "superstore."

⁷⁹ Alex Taylor, III. "It's the Slow Lane for Automakers." *Fortune*, (April 1, 1996): 63.

⁸⁰ Bernard Wysocki. "Binge Buyers: Many Baby Boomers Save Little, May Run Into Trouble Later On." *The Wall Street Journal*, (June 5, 1995): 1.

⁸¹ Raymond Serafin. "Interest Rates Pave Way for Buyer's Market." *Advertising Age*, (April 17, 1995): 42.

⁸² *Ibid.*

While it is difficult to accurately predict the fluctuation of interest rates and their effect on the automobile industry, it does appear that the government has by and large validated the Federal Reserve's strategy of using rate increases to curb inflation. Fed Chairman Alan Greenspan was recently appointed to a third term—to run through the year 2000.

Implications

The changes in the monetary environment have had both short- and long-term implications for the auto industry. The auto manufacturers geared 1995 production rates toward a strong sales year, based on 1994 results. A softening economy and the sales slowdown forced U.S. automakers to cut back production. Despite doing so, they were still faced with a substantial inventory pile-up at the year's end. *Ward's Automotive Reports* estimated inventories on dealer lots in November 1995 at 3,440,000 units, up 14 percent from the previous year.⁸³ The Big Three offered a series of rebates and other incentives to eliminate the backlog. During this period, companies had to use advertising money that otherwise would have gone towards establishing brand identity or introducing new product lines and earmarked it instead for the rebate ads. In 1996, the adjustment difficulties continued, as some in the industry encountered the opposite problem of not having enough inventory.

The Big Three have not viewed 1995 as an aberration, but rather as a trend toward flattening sales for the next few years at least. Accordingly, Chrysler, Ford, and GM have had to adjust their own internal models of the U.S. economy to reflect a smaller automobile industry. Chrysler adjusted its model, assuming that in a trend year, Americans will buy approximately 14.5 million cars and light trucks. This represents a 3.3 percent reduction from the previous model, and differs markedly from its 1995 market estimate of just over 16 million vehicles. Chrysler's new model also predicts slower domestic sales growth—0.5 percent a year as opposed to 1.0 percent annually in the old model.⁸⁴

Assuming the other U.S. automakers share Chrysler's vision of the future (this includes New Entrants, as evidenced by Nissan's 10 percent cut in production for the first quarter of 1996), reverberations of the shift will be felt in the long term. Consider that the 3.3 percent reduction in the U.S. market posited by Chrysler represents a decrease of 500,000 vehicles, roughly the annual output of two assembly plants.⁸⁵

CONCLUSION

Over the next decade, it is reasonable to assume that the economic factors previously discussed will continue to have an effect. As sales trends flatten, car companies will be driven to become leaner and more cost efficient. Thus, trends already apparent in the industry, such as squeezing as much value as possible from the supply chain through system integration and outsourcing will probably be spurred on by such economic

⁸³ Rebecca Blumenstein. "Big Three Auto Firms View New Year With More Pessimism than in Late '94." *The Wall Street Journal*, (December 27, 1995): 2.

⁸⁴ Robert Simison. "Detroit is Retooling Its Economic Models; Less than Great Expectations Hold Implications for U.S." *The Wall Street Journal*, (August 7, 1995): 2.

⁸⁵ *Ibid.*

conditions. Consider also Chrysler's current strategy of maintaining several billion dollars of cash in reserve. Although this move no doubt has its origins in the two near-disasters the company endured in the past 15 years, it also reflects a certain amount of pragmatism regarding the future in the recognition that, even during an economic downturn or a period of lackluster sales, it is desirable to spend money to develop new products. To what extent this full-reserve strategy will or can be adopted industry-wide remains to be seen.

To summarize, the industry is changing to reflect a slower-growing domestic market brought about by a shift in economic conditions, product attributes and consumer attitudes. While some of these changes may be gradual, they also appear to be inexorable. And in an industry that contributes \$250 billion to the gross domestic product, accounts for 4.5 percent of total output, and employs 1.6 million people, they are certain to have widespread effects.⁸⁶

⁸⁶ Ibid.

Environment and Natural Resources

Author: Jeffrey M. Davis

INTRODUCTION

Although the auto industry has addressed many of the concerns about environmental degradation associated with the manufacture and use of its products, it will still be expected to deal with the issue in the future. Despite a significant reduction in new pollution, pollutants already in the environment take a long time to neutralize, and they remain tangible evidence of past environmental practices.

One of the most salient aspects of environmental concerns and its relation to the auto industry is the highly politicized nature of the debate. Although most people agree in principle on the need for some kind of ecological vigilance, there is a great divergence of opinion on how to protect the environment. Because of its political roots, government enthusiasm and direction vary over time; even the government agencies that monitor compliance are threatened by funding cutbacks. Regulation is likely to ebb and flow based in large part on shifting political winds and funding expediencies. The political influences and the accompanying shifts in policy (depending on the political persuasions of the President and Congress) mean that the auto industry will probably endure frequent policy shifts and reversals, and, with many states assuming a role in setting standards, potentially conflicting requirements.

POLLUTION

Air pollution from cars and trucks is still a high-profile environmental issue. Although great strides have been made in this area, there is still significant concern, possibly more at some state governments than at the national government level. California, whose lawmakers have consistently been stricter than national legislators, may be joined by policy- and law-makers in other states in taking a greater role in controlling pollution from cars and trucks.

Because the catalytic converter so effectively reduces the primary sources of fouled air, the newest vehicles (while not completely clean) produce a small fraction of the pollution of their predecessors. In fact, it is the older cars still on the road, themselves a small fraction of the vehicle population, that contribute the lion's share of mobile-source pollutants. (One source says, "50 percent of motor vehicle emissions are from these 10 percent of vehicles"⁸⁷; another source says 80 percent.⁸⁸) Eventually, these vehicles will wear out and be scrapped. In the meantime, while some people advocate offering incentives to owners of older vehicles to replace them with less-polluting new ones, most recent government programs have been aimed at reducing emissions on new cars—already much cleaner. In Mexico, the government has restricted use of older vehicles by limiting their operation to four days per week.

⁸⁷ "Auto Emissions Decline in Major U.S. Cities." *Oil & Gas Journal*, (January 16, 1995): 30.

⁸⁸ William Beaver. "Clinton's Dream Machine." *B&E Review*, (October-December, 1994): 12-16.

Another aspect of the pollution problem is that additional improvements in vehicle pollution reduction cost significantly more than previous gains. At some point, it may become unreasonably expensive to achieve even negligible improvements in emissions. Many persons close to the industry believe that point has been reached. Technological means of achieving lower emissions may have been completely exploited, at least within the confines of the internal combustion engine. Large increases in vehicle prices due to pollution abatement equipment may not be politically viable, particularly considering that the government recently suspended a national gasoline tax to relieve consumers of increasing gas prices. With ever-increasing vehicle prices, the cost of additional pollution abatement equipment may be met with consumer resistance.

Still another aspect of the problem is that motor vehicle sources of pollution have diminished greatly. Recently, pollution from nonhighway sources has increased, and possibly offset gains by decreased pollution from highway vehicles.⁸⁹ Lawn mowers and boats, for example, have been cited as being particularly "dirty." Nevertheless, the automobile is still identified in the mind of the public (and much of the government) as being the culprit. Many feel the auto industry is being held responsible for solving a problem that it no longer causes.

The fact that some states have or are developing their own standards for pollution levels and for appropriate means to accomplish those levels complicates the problem that the auto industry has with government regulation. California has long developed its own standards, and some states in the northeast may be joining it. This could be troublesome news for auto manufacturers who may end up facing a slew of new requirements. At best, car companies would build to the strictest standards, thereby satisfying all states, but incurring numerous additional costs. At worst, manufacturers may have to build variations in their vehicles to meet differing standards, a production complication that could raise prices.

RECYCLING ISSUES

The use of automotive materials has not captured the attention of the government or public to the same extent in North America that pollution-related issues have. This is probably because the automobile, with its high degree of recycled steel, is a recycling leader, whose prime concerns are reducing landfill use and reusing source materials. One 1994 estimate says about "75 percent of the typical car can be recycled now"⁹⁰ making the automobile one of the most recycled consumer durables. However, that 75 percent is mostly steel,⁹¹ and very little of it is plastic. Plastics use is on the rise as manufacturers struggle to attain fuel economy goals, specifically CAFE requirements in the U.S. The increasing use of plastics is raising some concern, since plastics are usually in smaller components, are nonmagnetic, and vary in chemical composition, making separation and processing difficult. Economic considerations have driven salvage yards to extract as much steel from scrapped vehicles as possible for reuse, an example of environmental concerns being alleviated by market forces. Landfill capacity

⁸⁹ "Auto Emissions Decline in Major U.S. Cities." *Oil & Gas Journal*, (January 16, 1995): 30.

⁹⁰ Marjorie Sorge. "Recycling an Old Idea." *Ward's Auto World*, (September 1994): 67-69.

⁹¹ Peter Mapleston. "Auto Sector's Recycling Goals Keep Plastics on Hot Seat." *Modern Plastics*, (May 1995): 48-58.

is shrinking in the United States, and costs to dispose of materials is increasing.⁹² This situation may promote the development of an efficient infrastructure for plastics recycling.

In Europe, vehicle recycling efforts are more advanced than in the United States. Conditions and costs in Europe make recycling more of an immediate concern than in America. Less room for people and garbage makes recycling efforts more urgent and intense. Efforts to recycle seem to be occurring at both the government and corporate levels. Several European governments, for instance, are considering legislation affecting the disposal of end of life vehicles (ELVs).⁹³ In Italy, where 1.5 million cars are scrapped annually, Fiat has offered to permit car owners to leave their scrap vehicles at a Fiat dealership "without charge or obligation to buy a Fiat."⁹⁴ In Europe, industry groups want to reduce the percentage of a car that reaches a landfill reduce to 15 percent by 2002, and to 5 percent by 2015.⁹⁵ In Japan, the Ministry for International Trade and Industry (MITI) will require vehicles to be 85 percent recyclable by 2002, and 90 percent recyclable by 2015.⁹⁶ Technology and economics currently limit achievement of these goals.

The implication for North American manufacturers who export to Europe, of course, is that their vehicles will have to conform to whatever systems emerge for recycling parts. It is important to note, however, that environmental concerns vary from country to country in Europe, as around the world. In addition, industrialized countries may face different environmental concerns than developing countries. It will be difficult to fashion global environmental rules since some regulatory standards, such as those governing environmental contamination, may be too severe in developing countries—where the bulk of industrialization and its attendant pollution lie ahead.

Many manufacturers in North America are already planning to recycle parts of their cars and trucks (whether for export or not). Some are marking plastic parts, in particular, with numbers or colors that identify a specific kind of plastic, facilitating the recycling process. They may ask their suppliers to become more responsible for recycling the parts and components they supply. Some companies are using Life Cycle Assessment (LCA) to determine the environmental impact of the materials they use in their products.⁹⁷ The intention of LCA is to "assess the impact of a product on the environment by categorizing emissions and resource consumption into environmental

⁹² Flynn, Michael S., and Belzowski, Bruce M. "Recycling Automotive Plastics." Ann Arbor: University of Michigan, *UMTRI Research Review*, (July-August 1994): 9.

⁹³ Robert Eller. "Regulatory Concerns and New Technology...The View From Europe." *Ward's Auto World*, (January 1996): 19.

⁹⁴ *Ibid.*

⁹⁵ Peter Mapleston. "Auto Sector's Recycling Goals Keep Plastics on Hot Seat." *Modern Plastics*, (May 1995): 48-58.

⁹⁶ "MITI Sets Recycling Targets for Cars of 85% by 2002, 90% by 2015." *The Japan Digest*, (October 4, 1996): 3-4.

⁹⁷ Don. F. Bari. "Life Cycle Assessment as an Environmental Tool." *Ward's Auto World*, (November 1995): 17.

burden categories (e.g., global warming, bioaccumulators, ozone depleters, scarce-resource utilization, etc).⁹⁸

One important issue is that the parts of the automobile that can be recycled will probably not be recycled "as is" but rather will need to be broken down into elemental components or returned to a basic material state that can be fashioned into something else. Knowing this, materials that can be easily returned to their original state or can be broken down are going to become the materials of choice for manufacturers. That which is not or cannot be recycled, called auto shredder residue (ASR), amounts to about 3-million tons annually. That is a great deal of waste, but represents only about 2 percent of total annual additions to municipal landfills.⁹⁹ Environmentally friendly incineration processes are available to burn some of this waste. In fact, the energy produced from incineration can be used to burn other waste products.

Resource depletion tends to receive less attention than other environmental concerns. Any attention given to the matter is generally aimed at resources employed by users, that is, gasoline. For example, occasionally someone predicts a shortage of oil, or even a date for when the world's oil supplies will run out. This prediction usually serves as a warning to vehicle users. In reality, the auto industry will have to consider resource shortages from both manufacturing and using vehicles. Motor vehicles employ many nonrenewable resources in both their design and manufacture. Copper, for example, is used in many vehicle components, along with many other minerals for which there is a limited supply. As these materials become scarcer, it usually becomes more costly and more environmentally damaging to extract each additional unit of ore.¹⁰⁰

CONSUMER ISSUES AND EXPECTATIONS

According to a recent poll of industry executives, consumers would probably not pay much extra for products that are environmentally friendly unless they receive some sort of "return on investment."¹⁰¹ For example, half of these executives predict that a buyer of a mid-size car would pay between \$212 and \$1,000 extra for a car that gets 40 miles per gallon. That premium is offset by a savings in fuel costs. Other "green" attributes, which don't provide such readily discernible benefits, are valued less by consumers, according to these industry experts. Consumers may be willing to pay more up front for features that save them money in operating costs, such as improved fuel economy. They may not be willing to pay as much more for features that help the environment but not their pocketbooks.

A different poll taken in the fall of 1994 suggested that neither auto manufacturers nor suppliers believe that consumers will choose vehicles because of a higher level of

⁹⁸ Ibid.

⁹⁹ Marjorie Sorge. "Recycling an Old Idea." *Ward's Auto World*, (September 1994): 67-69.

¹⁰⁰ Gregory Keoleian et al. *Industrial Ecology of the Automobile: A Life Cycle Perspective*. SAE book manuscript, August, 1996: 40, 68.

¹⁰¹ David E. Cole et al. *Delphi VIII Forecast and Analysis of the North American Automobile Industry: Marketing*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 124-125.

recyclable components.¹⁰² The same poll indicated that respondents could recall few instances where steel was used because of its recyclable properties. Ford Motor Company, however, has a procurement policy of avoiding materials that would reduce the recyclability of a vehicle. In Europe, though, the outlook is different. "[The 'green' car] has caught on in Europe and is gaining strength by the hour," says Phillip Phillips of the ChemQuest Group.¹⁰³

INTERNATIONAL COMPETITION AND REGULATIONS

U.S. companies are likely to be affected by international regulations in the near future, as well as by the potentially conflicting demands of national and state governments. Global warming is being addressed by no fewer than 25 organizations.¹⁰⁴ The result could be legally binding requirements on U.S. corporations to comply with global standards.¹⁰⁵ American industry has typically deferred to or been shielded by the government in matters involving extraterritorial concerns. In matters involving the use of energy and concern about energy by-products, U.S. companies may want to become more involved and vocal in determining the U.S. government's international negotiations. This is because the United States is the most energy intensive economy in the world and stands to bear the brunt of efforts to reduce environmentally damaging practices.¹⁰⁶

CONCLUSION

The use and manufacture of automobiles continues to have an impact on the environment, but not nearly to the extent it did 30 years ago. Prodded by government, the industry has made remarkable strides in rendering its products friendly to the environment, as well as safe to operate. Unfortunately, years of environmental neglect on the part of all industries, and sometimes careless use of vehicles by consumers, have resulted in polluted city air, threatened ecosystems, and endangered plants and animals. Many of these issues have been identified and addressed. In general, how much negative environmental impact will be permissible in the future is a political issue with vocal proponents at either extreme.

Because so much has already been done to alleviate the pollution associated with the manufacture and use of cars and trucks, additional improvements are likely to require enormous resources for research and for implementation. As vehicle prices rise, consumers may balk at paying for more pollution-abatement devices.

Recycling remains an open question. The issue has received little attention from the U.S. government so far and market forces have ensured recycling of steel-intense bodies and components. Light vehicles contribute surprisingly little to U.S. landfills.

¹⁰² Keenan, Tim. "Recycling to be Major Consumer Issue." *Ward's Auto World*, September (1994), pp. 62-65.

¹⁰³ Ray Pospisil. "Auto Industry Suppliers, Well Along on VOCs, Look Ahead to Recycling." *Chemical Week*, (March 9, 1994): 36.

¹⁰⁴ William H. Miller. "A Wake-Up Call to Industry." *Industry Week*, (January 3, 1994): 51-52.

¹⁰⁵ Ibid.

¹⁰⁶ Ibid.

Recycling is starting to get more attention because of the greater use of plastics, which are much more difficult to recycle than steel.

Overall, the impact of the auto on the environment will continue to be an issue monitored by government and of only moderate concern to consumers.

Globalization

Author: Jeffrey M. Davis

INTRODUCTION

In a recent poll of American executives by the American Management Association, half of the respondents identified globalization as the trend likely to have the "greatest repercussions" in the future.¹⁰⁷ What is globalization? No simple definition of globalization exists but probably any general definition might highlight the volume and regularity of transnational activities and the ease with which such activities take place. Those activities can be the trading of goods and services, the movement of people, the spread of technology or ideas. In a global world, there are fewer and fewer impediments to the movement of people and things. For the auto industry, globalization in the next ten to fifteen years means establishing a worldwide corporate presence that effectively identifies the wants and needs of consumers everywhere, and efficiently provides them with products that satisfy them. To date, auto companies seem to have chosen one of two strategies for this presence, parallel or integrated, both of which are discussed later.

The concept of global interaction is not new, particularly global trade. In fact, for many industrialized nations, the percent of the gross domestic product that represents global trade is actually smaller now than it was before World War I.¹⁰⁸ In the past, global interaction was controlled largely by governments, and ebbed and flowed according to political concerns and policies. Today, globalization is driven more by commerce and communication, activities for which national borders are often meaningless and which people everywhere tend to have in common, unlike the cultural, linguistic or religious differences that helped form and crystallize nations in the first place.

What is new is the sheer magnitude of international trade. Worldwide commerce is estimated to have been \$2 trillion in 1980, \$3 trillion in 1990, and is forecast to expand to \$8 trillion by 2000.¹⁰⁹ Another way to look at global trade volume is in relative terms. Early in the next century, economists predict, the United States, Europe, and East Asia will form relatively equal trade blocs, ending an era of U.S. economic domination.¹¹⁰ Importantly, global capital markets are highly efficient and investors very sophisticated, making money available for projects with suitable returns anywhere in the world.

¹⁰⁷ Eileen Davis. "Globe Trotting in the Information Age." *AMA Management Review*, (April 1995): 17.

¹⁰⁸ Vincent Cable. "The Diminished Nation-State: A Study in the Loss of Economic Power." *Daedalus*, (March 22, 1995): 23.

¹⁰⁹ Paul Collins. "Citicorp Sees Emerging Markets," speech before the Bank and Financial Analysts Association, Reuters News Agency, (March 19, 1996).

¹¹⁰ Vincent J. Schodolski. "As the World Shrinks, a Chasm Develops." *Chicago Tribune*, (March 31, 1996): 1.

Auto manufacturers have their own particular issues concerning globalization. These issues include what kind of global corporate structure to adopt, how (and if) they should adapt current products for global markets, and how best to insure a reliable and efficient network of suppliers. In addition, the industry faces the same concerns that face other kinds of multinational commerce: cultural and political (including trade) concerns, competitive issues and risks.

GLOBAL STRUCTURE

Global growth in the auto industry involves important considerations about corporate structure because the manufacturing and marketing requirements in other countries may vary greatly from those at home. Adopting one kind of corporate structure over another reflects, in part, a company's particular needs but also its commitment to global success. Companies who wish to merely sell their home products in markets willing to purchase them may need nothing more than an "export office." Companies interested in designing products for particular markets, and possibly even building them there, will require a substantially broader organization.

Two kinds of structures have emerged in the industry's current globalization: parallel and integrated. Parallel corporate structure generally means that a company establishes free-standing organizations in different countries or regions, each capable of a significant degree of independent decisionmaking and functional area expertise (design, manufacturing, etc.). General Motors operates its European and American operations with this organizational structure. Integrated structure, however, tends to assign specialized responsibilities to each region. Ford Motor Company, for instance, plans to develop small- and medium-sized vehicles for global markets in Europe, and large vehicles in the United States. The intent is to move from a parallel organization to an integrated one. In Asia, Toyota and Honda source specific components from different countries, causing specialization by country. Ultimately, how and where corporate decisionmaking is made reflects the degree to which a corporation is a global one.

Several implications for the future exist. First, companies who supply auto manufacturers may be under pressure to shape their own international operations to conform to those of their customers. Auto manufacturers building around the globe may insist that their suppliers follow them with neighboring production facilities. Such an arrangement helps maintain the "just-in-time" supply pipeline. However, this may become a source of frustration to suppliers, who risk losing economies of scale if parts production is moved from one large to many small plants. Second, governments of developing countries may show a preference for the manufacturer who uses a parallel-type organization, since that kind of structure promises the full range of development and assembly jobs and the job skills the developing economy wants to capture.

COMMONIZATION

Globalization is facilitated by the development of standards and protocols. In this respect, the auto industry is in the early stages of globalization. Differing standards for vehicle dimensions, crash worthiness, emission levels, fuel economy requirements (or more specifically, the means to achieve acceptable fuel economy), and others remain in place, complicating production and exporting. Currently, manufacturers build to "worst-

case” requirements or modify models for different markets. These divergent requirements are likely to diminish as nations unify their standards.

Standardization of regulations is also promoting the development of a global community. Agencies like the International Organization for Standards (ISO), which was established in 1946, examine all kinds of processes for manufacturing, quality and other activities in an effort to create a consistent standard for product look, feel, quality, etc. ISO’s goal is to have a world where products are ranked or rated in such a way that the ranking or rating is universally meaningful and equivalent: a Grade A egg is identical in the U.S., Peru, and Mozambique. While this consistency and uniformity may well be welcome to some countries, it may stifle the development of others. This is because some regulatory standards, such as those governing the environment and its contamination, may be too severe in developing countries where the bulk of industrialization and its attendant pollution lies ahead.

MARKETING AND PRODUCTION ISSUES

Most manufacturers start by exporting products designed for their home market. There are limitations to this strategy since consumer wants and needs can vary considerably from market to market, depending on income, operating conditions, and many other factors. Consequently, auto manufacturers face decisions about product development and design that determine the extent to which vehicles are designed to serve few or many markets. In North America, brand management seems to be taking hold as a strategy for targeting individuals. Does brand management have a role in targeting global markets? It may, in light of the possibly conflicting desires of consumers in different markets and manufacturers’ desire to minimize production variation. A strong brand may allow a manufacturer to get away with less tailoring to specific markets. It is this manufacturer who can come closest to offering a true, same-in-every-market, “world car.” Of course, between consumer tastes in developed countries and the sometimes crude roads in developing ones, the world car is likely to be a truck.

On the other hand, there may be a converging or homogenization of consumers’ tastes and preferences around the world, simplifying the pursuit of selling products and services globally.¹¹¹ In the distant future, some experts predict, consumers around the world will be purchasing more of the same products. Variations will remain, however, driven in part by cultural differences and expectations. Varying levels of income mean many consumers may have a taste for goods they may not be able to afford.

A recent industry study examined, in part, global aspects of North America’s changing manufacturer-supplier relationships. Among other things, participants in the study identified China as offering the most “attractive automotive opportunities”¹¹² outside North America. In fact, for production, China is thought to be as attractive as the United States. Further, China is considered even more attractive than the U.S. as a market.

¹¹¹ Gerald and Naomi Caiden. “Brothers’ Keepers.” *Society*, (September 1995): 16.

¹¹² Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 10-11.

Brazil, too, is thought to be appealing for both production and marketing.¹¹³ The study goes on to say that suppliers have ambitious plans for global expansion and that both suppliers and manufacturers believe the globalization of the auto industry is less than half way to where it will be in 10 years.¹¹⁴

China represents a paradigm of developing countries, both in terms of its circumstances and the developed world's perceptions. The world sees a high population/low vehicle density country with a rapidly growing economy. Unfortunately, the income required to buy and operate a vehicle is still not widely available, paved roads are often unavailable and government regulations change often.¹¹⁵

POLITICS AND CULTURE

Success in international commerce requires consideration of political and cultural concerns. Objective evaluation of a country's political stability, for example, is important before making large investments in plants. Trade issues, and the potential for trade friction, cannot be ignored either. Because of its high monetary value and great potential for exporting, trade in automobiles and auto parts can have a pronounced effect on trade balances and foreign currency reserves. Avoiding trade friction probably requires the combined efforts of both governments and manufacturers.

Another political concern involves the regionalization of trading organizations or blocs. Groups or trade agreements, like NAFTA, ASEAN or the European Common Market, facilitate trade between their members but sometimes hinder trade, especially imports, with nonmembers. At their best, trading blocs can help encourage economic development in less-developed countries; at their worst, they represent a "counter reformation" of sorts to the principles of free trade.

Globalization is largely driven by the private sector.¹¹⁶ Because the nation-state is not likely to disappear, the increasing ease of trading and communicating globally may create tensions between national interests and corporate ones. For instance, manufacturers are increasingly free to locate plants according to economic imperatives, such as lower cost labor. This could create insecurity in the labor forces of high-wage nations who could pressure their governments to make amends for jobs lost to overseas workers. Many governments, especially those not popularly elected, may feel threatened by the easy access their citizens have to information about the world. Still other governments may have legitimate concerns about their eroding cultural identity. One example of conflict involves the issue of intellectual property, where the proprietary work of a corporation is essentially left unprotected in some markets through lack of legislative and enforcement activity by foreign governments. A different example highlights the potential for conflict between corporations and government: in the early 1990s, the U.S. government negotiated to open Japan to the automotive products of U.S. manufacturers, but GM further increased its shipment of vehicles from Europe.

¹¹³ Ibid.

¹¹⁴ Ibid.

¹¹⁵ "The Long Drive into the Middle Kingdom." *The Economist*, (June 8, 1996): 63-64.

¹¹⁶ Vincent Cable. "The Diminished Nation-State: A Study in the Loss of Economic Power." *Daedalus*, (March 22, 1995): 23.

Some developing economies seem to have chosen the auto industry, with its well-paying jobs, as the engine driving economic development. However, these countries have the opportunity, in the early stages of development, to plan total transportation systems that more developed nations did not. They also have the chance to avoid the environmental concerns like air and water pollution that advanced economies have had to address. For instance, automobile use in the United States has promoted (or permitted) land and building use patterns that may not always be optimal. An example of this is "suburban sprawl," a derogatory term for housing and shopping development outside major urban centers. Although successfully addressed for the most part, pollution from the manufacture and use of cars and trucks was a significant concern. The question is, will developing economies choose to learn from the "mistakes" of the advanced economies as they adopt their successes? Will the desire to develop the economy eclipse land use or pollution concerns? As North American vehicle manufacturers begin to build and sell in emerging markets, what are their responsibilities in these areas? These are national-level political issues in which the global auto manufacturer might become involved.

COMPETITION

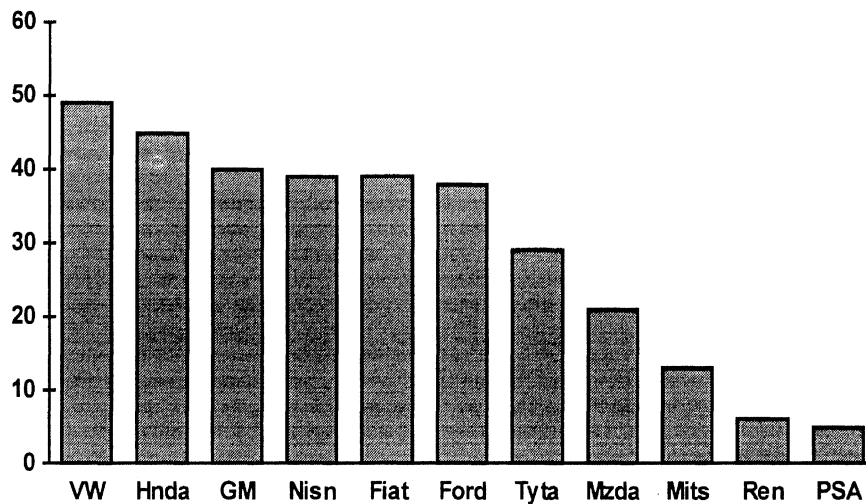
At a corporate level, competition across national boundaries is largely the same as competition within a country's borders. However there are some differences which bear discussion. First, emerging markets in developing countries represent a competitive threat as well as an opportunity. Many of these countries already have significant raw materials resources and having an indigenous auto industry is seen as a necessary step to building a strong, diversified economy. The more ambitious among them, such as South Korea, plan to acquire significant export capabilities. In fact, South Korea has been identified, after Japan, as being the strongest competitor to North America in 2005.¹¹⁷

Second, when a manufacturer builds a plant in a developing nation, it demonstrates to the locals it employs how to build its product. If that company also requires its suppliers to establish a local presence or even to build their own parts or components plants, it establishes a source of parts and components for that product. With or without a government policy regarding an automotive industry, having a local presence helps facilitate the transfer of technological and managerial know-how that was once a competitive advantage. In some ways, globalization sows the seeds for both commercial success and commercial competition.

Many auto manufacturers already build and sell around the world. The graph below shows the degree to which selected manufacturers produce globally.¹¹⁸

¹¹⁷ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 10-11.

¹¹⁸ *Motor Vehicle Facts and Figures*. Detroit: American Automobile Manufacturers Association, 1996: 6-7.



Source: 1996 *Ward's Automotive Yearbook*. Southfield, MI: Ward's Communications, n.d.

Percent of 1995 Vehicle Production Away from Home Base, by Maker

Another source of competition in the industry could come from outside: companies that started in other industries and moved into light vehicle production. For such companies, developing and producing a car or truck requires only incremental expertise or resources. Korean conglomerate Samsung, for example, has completed a vehicle assembly plant in Korea and opened a design studio in California.¹¹⁹

CONCLUSION

In general, globalization is facilitated by the common goals, attitudes, desires and circumstances of people who may live worlds apart. It is both a process and a mindset. For auto companies, it may be more of a process: designing, marketing and manufacturing vehicles in whatever location makes sense. For consumers, it may be more of a mindset: indifference to the national origins of a company or the location of its plants. The cachet of "imported" or "domestic" becomes meaningless. Overall, the process of globalization is likely to make it easier for manufacturers to sell around the world, but it also makes it easier for new manufacturers to enter the market fray. One respondent in the AMA poll cited earlier predicted that, "learning to function effectively in a true global economy will separate the highly successful from the also-rans."¹²⁰

¹¹⁹ Unsigned. *Samsung Hangs Plate in L.A.* *Automotive News*, (November 4, 1996): 41.

¹²⁰ Eileen Davis. "Globe Trotting in the Information Age." *AMA Management Review*, (April 1995): 17.

Human Resources

Author: Morgan H. Edwards

INTRODUCTION

The next fifteen years will be a period of substantial turnover in the human resources employed by the North American automotive industry. The two components of this turnover are retirements in the present workforce and growth (or contraction) in automotive production and required workforce levels. Aging of the present workforce assures the retirement component; the growth of automotive employment is more speculative. It is likely that international markets will grow faster in the years to come than United States and Canadian markets. If North American automotive employment is to grow, the growth will come from North American participation in production to meet global demand rather than from sales growth in the U.S. and Canada.¹²¹

DEMOGRAPHICS OF AUTOMOTIVE WORKFORCE

In 1993, the North American automotive industry employed about 1.9 million people, with about 1 million of these engaged in various aspects of the design and production of vehicles.¹²²

Over the last fifteen years, steady increases in productivity through restructuring and automation, together with a flat trend in North American vehicle sales, caused declining employment in the North American automotive industry. Employment in the North American automotive industry has fallen by about 200,000 jobs since 1978. A U.S. loss of over 240,000 jobs was somewhat offset by an increase of over 40,000 jobs in Canada, reflecting the shift in assembly activity from the United States to Canada during the 1980s. This employment decline occurred in spite of expanded direct investment by the Japanese automotive industry in North America. The number of jobs created by the New Entrants in North America did not offset the automotive jobs lost in the traditional industry—either in assembly or component manufacturing. As a result of extensive use of parts imported from Japan, cars made and sold in North America by the New Entrants supported many fewer jobs than did cars made by the traditional industry.¹²³ More recently, as the Japanese yen gained strength against the dollar, the proportion of North American produced parts has increased in vehicles assembled by the New Entrants.

In the traditional industry, the average age and seniority of employees changed sharply during this period. From 1979 to 1984, indefinite layoffs of production employees by

¹²¹ Sean P. McAlinden et al. *Driving America's Renaissance, Human Resource Issues in Michigan's Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1995: 3-4.

¹²² *Motor Vehicle Facts and Figures*. Detroit: American Automobile Manufacturers Association, 1991, 1992, 1993, 1994, 1995, 1996.

¹²³ Flynn, Michael S., et al. *Competitive Survival: Private Initiatives, Public Policy, and the North American Automotive Industry*. Report #92-3. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1992.

reverse seniority primarily affected employees with hire dates between 1973 and 1980, largely eliminating a generation of younger employees. The ratio of active employees to company retirees fell to unprecedented levels at all of the Big Three companies. Since 1985, the domestic labor forces of these companies have been largely composed of mid-seniority employees steadily moving toward near-term retirement.¹²⁴ In the New Entrants' plants, a much younger workforce was hired.

According to Bureau of Labor Statistics data, in 1995 the average age of hourly and salaried automotive employees was 45 years, compared with 38 years for all workers. Almost one-third of the workforce is over 50 years old. The aging of the workforce occurs across the board, including hourly skilled trades (average age 47 years), salaried engineers and technicians (41 years), and white collar (45 years).¹²⁵ In the larger supplier workforce, the average age is about 46.

Length of service is another factor in determining retirements. By the summer of 1995, more than half of Big Three employees had accumulated over twenty years of company service. As a result of "30-and-out" provisions in labor contracts, half of all present auto industry employees could be gone in the next 8-10 years.

Another large segment of the automotive workforce is found in the distribution system. It is estimated that total employment of the automotive sales and service sector was 3.3 million people in 1993 (the latest year for which totals are available). This figure, which represents all wholesale and retail activity, including gasoline service stations, auto repair shops, and wholesale and retail auto parts stores, was up from 3 million in 1992 but was about equal to the 1988 employment level. The number of employees in franchised new car dealerships dropped from about 930,000 in 1990 to about 875,000 in 1992 but increased to 993,000 in 1995.¹²⁶

EMPLOYEE TURNOVER

A 1995 study forecasted total Big Three employee attrition between 1995 and 2003 of about 250,000—including 200,000 hourly and 50,000 salaried employees.¹²⁷ In critical skill areas, about 40,000 skilled trades employees and 15,000 engineers and technicians will retire. Heavy attrition also is projected for white collar and management employees.

Based on reasonable assumptions about North American vehicle production, U.S. sourcing, vehicle content, best practices, and productivity growth, Big Three employment could decline as much as 30,000 over the next eight to ten years. With an increase in exports of North American production to meet global automotive demand, however, Big Three employment could increase instead by 10,000.

¹²⁴ Sean P. McAlinden et al. *Driving America's Renaissance, Human Resource Issues in Michigan's Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1995: 9.

¹²⁵ Ibid, 10, 14.

¹²⁶ *Motor Vehicle Facts and Figures*. Detroit: American Automobile Manufacturers Association, 1991, 1992, 1993, 1994, 1995, 1996

¹²⁷ McAlinden, *Driving America's Renaissance, Human Resource Issues in Michigan's Automotive Industry*, 19, 29.

The projected employment change, combined with projected attrition, yields hiring estimates for 1995-2003 ranging from 220,000 to 260,000 new employees—or about 25,000 to 30,000 new hires a year. Most of these would be base hourly employees but also would include about 35,000 skilled trades and 10,000 engineers and technicians. Extending these projections to 2010, further attrition of about 200,000 employees can be expected, requiring a continuation of the annual hiring rate of 25,000 throughout the period.

SUPPLY OF WORKERS

Whether the supply of potential workers will be adequate to fill the need, especially in the hourly ranks, is a key question. The number of high school graduates has declined by one-third annually since 1980, reflecting the fall in birth rates in the 1970s. The forecast that the Big Three will need to hire 25,000-30,000 hourly workers annually for the next fifteen years means that the automotive industry will seek to recruit a substantial portion of the available graduates. Recent high school graduates are not the only source of new hires, however. The potential pool of new hires will include large numbers of general educational development (GED) and community college graduates.¹²⁸

The ability of the automotive industry to attract large number of applicants is well documented. Relatively high levels of compensation earned by employees of the Big Three—roughly twice the total compensation of the average job—is a powerful stimulant to the supply of workers.¹²⁹ It should be noted, however, that the average automotive wage may be misleading, because it obscures the fact that the automotive skilled trades are underpaid relative to the same trades in nonautomotive jobs while unskilled automotive workers are overpaid. This phenomenon, if uncorrected, may accentuate future shortages of skilled trades.

Use of a two-tiered wage structure is likely to increase, both at assemblers and suppliers. A lower wage tier for relatively unskilled, starting workers will be balanced by a higher wage tier for experienced, trained workers and for the skilled trades. The lower wage tier will help traditional assemblers and suppliers compete with New Entrants who locate plants at greenfield sites in traditionally low-wage Southeastern states.

There are growing numbers of degreed people on the plant floor, and more college graduates may join the hourly ranks either because of job shortages or poor pay in other fields.¹³⁰ In some cases, hourly workers have acquired degrees while employed on the line. Drawn by the high pay, they have decided to stay until eligible for “30-and-out,” and then to leave for teaching jobs.

¹²⁸ Sean P. McAlinden et al. *Driving America's Renaissance, Human Resource Issues in Michigan's Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1995: 33-34.

¹²⁹ Marjorie Sorge. “The Changing Automotive Workforce: The Next Generation Is Taking Over the U.S. Auto Industry.” *Ward's Auto World* 30, no. 8 (1994): 24-30.

¹³⁰ *Ibid.*

Higher immigration is likely to be another source of additional production workers. Canada has had notable success in attracting immigrants with production skills and can be expected to continue to attract experienced workers from Eastern Europe.¹³¹ Motorola also has been successful in recruiting immigrant workers and has used its extensive training programs to equip them with the required skills. The present national tension over immigration levels and benefits for immigrants will likely subside over the next fifteen years as industrial demand for new workers grows.

There is a trend toward using contract workers, not only for white collar clerical functions but increasingly for production jobs. From 1983 to 1993, blue collar contract workers increased from 9 percent to 23 percent of total contract workers. Male contract workers increased from 25 percent of total contract workers to 38 percent. With increased emphasis on outsourcing, cost avoidance, and flexibility and concentration on core products and competencies, this trend is expected to continue and perhaps accelerate.¹³²

Another trend is that white males are diminishing as a percentage of the workforce, reflecting women entering the workforce from two-earner households, broader opportunities for women and minorities in supervisory and managerial jobs, and the increasing proportion of minorities in the population at large. These trends are likely to continue.

The automotive distribution system, which includes dealer sales and service functions, will likely continue to draw its workers from the economy at large. Increasing complexity of vehicle electronics may increase dealer service department demand for technically trained mechanics, although a trend to package complex mechanical and electronic components as *black boxes* and provide exchange banks for plug-in replacement modules may soften the demand somewhat. Technical training in the diagnosis of more complex mechanical and electronic systems will undoubtedly be required.

FUTURE NEEDS AND SKILLS AVAILABILITY

The North American automotive industry is increasingly recognizing that it must develop its human resources if it is to compete in the emerging international economy. Engineering and technical workers especially are a critical competitive resource. Improving the supply of such workers is a serious competitive challenge. Lessening international tensions and reduced U.S. spending for defense may free up a greater supply of technical and engineering personnel over the coming years.¹³³

In the next fifteen years, for both assemblers and suppliers, the most challenging hiring requirements will occur in the hourly skilled trades and in salaried engineers and

¹³¹ Michael S. Flynn et al. *Competitive Survival: Private Initiatives, Public Policy, and the North American Automotive Industry*. Report #92-3. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1992: 106.

¹³² Frank Washington. "The Underground Workforce: The Murky, Controversial World of Automotive 'Contract' Workers." *Ward's Auto World*, (August 1995): 20-24.

¹³³ Flynn, *Competitive Survival: Private Initiatives, Public Policy, and the North American Automotive Industry*, p. 106.

technicians, because of the emphasis on productivity, quality, and technological progress in design and production.

For hourly workers and skilled trades, standards for new hires are stricter than in the past and will continue to increase. The nature of automotive production work will change markedly in the future. Automakers increasingly will need people who can learn, solve problems, understand math and science, communicate in writing and speech, and accept and understand diversity. They also will want workers to be loyal and mobile and have traditional values and work ethics. However, the supply of workers in the next 15 years is likely to be less loyal, less mobile, come from more diverse backgrounds, and demand benefits such as flex time, elder care, and childcare.¹³⁴ Autoworkers will need to think and learn on the job and be self-motivated and able to self-manage their activities. They will need a wider range of technical skills, as use of programmable automation increases.¹³⁵

Recruiting will be sophisticated and often conducted by outside human resource management consultants.¹³⁶ Aptitude testing will be widely used to assess literacy, numeracy, manual dexterity, ability to communicate, and ability to work in team settings. The requirements of modern technology in the plants will make it necessary to test for facility in digital communications and the ability to work with computer screens and keyboards.¹³⁷

Technicians will need more than a high-school diploma to get a job. Attendance at high-school technical centers and degrees from two-year technical schools will be required for automotive industry jobs.¹³⁸ One source of new technical workers likely will be the retraining of non-core and excess nontechnical employees.

Some new skills probably will be required in the distribution chain. As mentioned previously, increasing complexity of vehicle electronics may increase requirements for technically trained mechanics, mainly for diagnosis. However, built-in electronic diagnosis (with data storage and read-out capability) is expected to increase sharply, reducing the scope and complexity of training required. Black-box packaging of complex mechanical and electronic systems, together with manufacturer-provided exchange banks for plug-in replacement modules is already in use for components/systems such as engines, engine control modules, automatic transmissions, radios, and cassettes/CD players. This mode of repair is likely to grow, diminishing the training task for dealerships.

¹³⁴ Marjorie Sorge. "The Changing Automotive Workforce: The Next Generation Is Taking Over the U.S. Auto Industry." *Ward's Auto World* 30, no. 8 (1994): 24.

¹³⁵ Sean P. McAlinden, et al. *Driving America's Renaissance, Human Resource Issues in Michigan's Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1995: 42-43.

¹³⁶ Sorge, "The Changing Automotive Workforce: The Next Generation Is Taking Over the U.S. Auto Industry," 25.

¹³⁷ McAlinden, *Driving America's Renaissance, Human Resource Issues in Michigan's Automotive Industry*, 43-44.

¹³⁸ Sorge, "The Changing Automotive Workforce: The Next Generation Is Taking Over the U.S. Auto Industry," 29.

A more significant change in skill requirements is likely in the dealership sales force. Automotive sales, together with insurance and real estate, traditionally required little educational background and attracted a relatively transient workforce, but in the last decade, insurance sales have become increasingly professional. The same trend is evident in real estate sales. With the assemblers' present focus on satisfying customers and managing the entire ownership experience, this trend has begun and is likely to grow in automotive sales and service. Training in use of sophisticated new sales tools, such as informational data bases, computerized graphic sales displays, new financing and leasing packages, will be required, as well as training in ethical standards and practices.

EDUCATION AND TRAINING

The general problems of the educational system are well documented, as are the international differences in training provided employees after they begin their work careers. A recent study suggests that Japanese automakers invest more than twice the hours of annual training in employees than do the traditional producers. The difference is even more extreme for new employees.¹³⁹

Educational policies play a significant role in the public policies of North America's competitors. By providing a sound education, a country can help its citizens compete in the global economy. While the U.S. has received significant praise for its higher educational system, it has been criticized for its stance on vocational training and is often viewed as providing inadequate general education at elementary and high-school levels. The German educational system provides excellent vocational training for its nonacademically-oriented youth. The Japanese system tends to train its workers at the factory. As the automobile industry becomes increasingly reliant on more sophisticated, often computerized components and manufacturing equipment, it will require a more highly educated and competent labor force. Retraining programs and technological innovations must be welcomed by management and labor alike if they are to compete.¹⁴⁰

In one study, focus groups expressed unhappiness with the current performance of the K-12 school systems. In the experience of focus groups members, a large number of applicants lacked basic skills (not only mathematics and reading and writing skills) but also "employability" skills that include work ethic, attentiveness, and the abilities to learn on the job and to deal with diversity in the workplace.

A child's performance in school has an impact on later ability to contribute to the workforce. While America's declining high school dropout rate is a hopeful sign, the United States falls short in other areas of grade school education. In core academic subjects, U.S. students spend less than half the instruction time of Japanese, French, and German students. Thirteen-year olds ranked last in math and science when compared with students in other industrialized nations. This occurs despite the fact that

¹³⁹ Michael S. Flynn et al. *Competitive Survival: Private Initiatives, Public Policy, and the North American Automotive Industry*. Report #92-3. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1992: 105.

¹⁴⁰ *Ibid*, 122.

the U.S. spends more on primary and secondary education than most other countries; revenues at these educational levels have increased almost five-fold since 1950.¹⁴¹

Another opinion expressed in focus groups is that schools do not educate future employees in problem-solving, team skills, or the ability to work with others. Manufacturing in general appears to be disparaged or ignored by school administrators and teachers, and the dignity of physical work—actually making things—is not valued. Focus group members suggested that deficiencies in K-12 result not from lack of financial support (funding levels in the U.S. exceed other developed nations) and not from lack of awareness of current demands of employers, but rather from lack of will or lack of simple competence on the part of teachers and school administrators.¹⁴² Observers are uncertain whether U.S. educational institutions will reconnect with U.S. manufacturing over the next decade.

In the previously cited study,¹⁴³ focus groups expressed growing and strong dissatisfaction with college-level engineering education. Present curricula for mechanical and electrical engineers is excellent for vehicle product engineering, but not a good match for manufacturing needs. Process or manufacturing engineering often involves working in the plants and often requires on-the-spot problem solving. Strengthening the manufacturing “literacy” of engineering schools is needed. In addition, engineering schools need to teach skills in team participation and communication and multilingual capabilities and the capacity to operate in an international environment.¹⁴⁴ The ability to read widely in the technical literature—sometimes in other languages—will be important to stay abreast of technical developments globally.

The next generation of U.S. workers will face strong competition from ambitious, technically qualified, and globally knowledgeable people all over the world. That implies not just developing U.S. engineers, managers, and executives through overseas assignments but also developing foreign nationals through assignments here in the United States. The continual upgrading of workforce knowledge and skills has become increasingly important to a country’s competitiveness.¹⁴⁵

U.S. performance lags behind other countries in on-the-job training as well. Overall, only 16 percent of U.S. workers receive formal job training from their employers. Skilled and professional employees receive far more training than do unskilled U.S. workers. The number of Japanese employees who receive formal training is three to five times than of the U.S.¹⁴⁶ The North American automotive assemblers and suppliers today are

¹⁴¹ Elizabeth Connor. “Will our Human Resources Measure Up?” *HR Focus*, (October 1995): 22-23.

¹⁴² Sean P. McAlinden, et al. *Driving America’s Renaissance, Human Resource Issues in Michigan’s Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1995: 47.

¹⁴³ *Ibid*, 41.

¹⁴⁴ *Ibid*.

¹⁴⁵ Marjorie Sorge. “The Changing Automotive Workforce: The Next Generation Is Taking Over the U.S. Auto Industry.” *Ward’s Auto World* 30, no. 8 (1994): 25.

¹⁴⁶ Elizabeth Connor. “Will our Human Resources Measure Up?” *HR Focus*, (October 1995): 23.

beginning to recognize that they no longer can rely on the external educational system to produce large quantities of ready-trained workers—ranging from hourly production workers to accountants to salesmen. Increasingly, they must assume responsibility for an internal educational system adding specific skills needed for their complex work places to the general skills that new employees bring to the workplace. Such internal educational systems will likely be structured for life-long learning—both for the individual and for the corporate entity. The Big Three automakers spend 750 million dollars annually in North America for employee training, and this is likely to increase in the next fifteen years.¹⁴⁷

One additional educational requirement that should be noted is the necessity for grooming future generations of automotive workers for leadership at all levels of the value chain. Many of the attributes desired for hourly workers are also requirements for executives and managers, manufacturers, suppliers, and dealers alike: working in teams, matrix responsibilities, communication skills, customer sensitivity, ethical behavior, and more. These attributes are widely needed in our society, in all industries, and should be recognized as educational requirements by our higher education system.

CONCLUSION

The requirements of the North American automotive industry for large numbers of relatively well educated workers at all levels—but especially engineering, technical, and skilled trades workers—will be a substantial challenge to our educational systems—primary, secondary, and college—as well as to the internal educational systems of the North American automotive companies.

¹⁴⁷ General Motors Corporation, Ford Motor Company, and Chrysler Corporation, correspondence with the author, April, 1997.

Technological Innovation and Development

Author: Morgan H. Edwards

INTRODUCTION

Technology forecasting is always difficult. We tend to overrate existing developing technologies and miss the fast-breaking, unforeseen new technologies. As we approach the next century, radical advances in technology are likely to change traditional business practices. Customized marketing is replacing mass marketing and mass communications, and technology is a major enabler of this change.

The base of technical knowledge doubles every few years, largely because of growth in computing power and the explosion of information and communications technology. Acceleration of the rate of technological change is likely to continue, increasing unpredictability over the next ten to twenty years.

Most technological changes are aimed at doing more, better, faster, and/or cheaper. Traditional motivators of change are more demanding customers who want more variety in products at lower prices, the drive for lower costs and higher quality, and shortages of capital and skilled human resources. A new stimulus is the need for shorter development-to-market time to respond to tough global competitors. George Fisher, the CEO of Eastman Kodak, believes that the need for new technologies, improved quality, and faster development-to-market cycle times will increase exponentially as we move to customized marketing.¹⁴⁸

MAJOR UNDERLYING TRENDS OF TECHNOLOGICAL CHANGE

Computing Power

The phenomenal increases of the last fifteen years in computing power, as measured in both speed of operation and size of memory capacity, are expected to continue through the next fifteen years. The changes feed on and stimulate each other. As increases in memory capacity allow program size and complexity to increase, faster processing speeds are required; and as speed increases, the range and complexity of applications grow, demanding yet another increment of speed and memory capacity. These forces are not likely to diminish.

Since the development of the personal computer and local area networks, the computer has moved from the domain of mainframe technical specialists to the everyday workplace of varied production and office workers. With that movement has come an explosion of applications and a linking of data, images, sound, and video. Concurrently, the same technological advances that permitted the low-cost PC expanded the

¹⁴⁸ "The Next 25: What Today's Leading CEOs, Management Gurus, and Futurists See Coming for Your Company, Your Job, and Your Life Between 1995 and 2020." *Industry Week* 244, no. 15, (1995): 43.

capabilities and use of mainframes and minicomputers into advanced applications in design and engineering and the translation of engineering data directly into manufacturing processes. Better use of currently available hardware and software, as well as technical advances, are expected to have substantial positive influence on product quality, reliability, and durability. These advances will occur throughout the processes of vehicle design, development, manufacture, distribution, and sales.¹⁴⁹

Information Explosion and Communications Technology

In the past 25 years, information and communications technology has transformed the way companies operate. Technology has allowed more information to be available now than in the past, so that having the right information when it is needed has become essential. Information is available much more quickly today, eroding barriers between markets and changing the scope of business from multinational to globally integrated. The new challenge is information overload, an increasing problem as organizational techniques for digesting and using information have lagged behind the capability for collecting and storing data. The computer is at the root of the information explosion. Bill Gates, CEO of Microsoft, has observed that the PC has been the tool of individuals performing their work, but it is evolving into a communications device—into a vehicle for sharing information. At the same time, the nature of information itself is changing, as we are able to access it in richer forms, including images, sound, and video.¹⁵⁰

Technical Literacy

Another underlying factor speeding up application of technology, especially in the marketplace, is increasing consumer familiarity with and facility in using electronic media. The generation that grew up with Nintendo and home computers is likely to be much more comfortable with all sorts of new technology. It may be hard for many of today's older consumers to envision buying a car from a Web page on the Internet, but the Nintendo generation may very well be willing and eager to do so. At the same time, widely noted failures to teach adequate math skills in urban schools may create an anomalous split between the computer-literate and the math-deficient.

PRODUCT TECHNOLOGY CHANGES

Alternative Fuels and Powertrain Technology

Over the next fifteen years, application of alternative propulsion systems for vehicles is likely to increase, under the pressure of automotive emission and fuel economy standards. Improvements are expected in fuel economy from engine efficiency, weight reduction (exclusive of downsizing), downsizing, transmission efficiency, aerodynamics,

¹⁴⁹ David E. Cole et al. *Delphi VIII Forecast and Analysis of the North American Automobile Industry: Technology*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 105.

¹⁵⁰ "The Next 25: What Today's Leading CEOs, Management Gurus, and Futurists See Coming for Your Company, Your Job, and Your Life Between 1995 and 2020." *Industry Week* 244, no. 15, (1995): 43.

reduced tire rolling resistance, more energy-efficient accessories, and superchargers/turbochargers (with engine downsizing), in that order.¹⁵¹

The easiest fuel substitution is diesel, but emissions (particulate and NOx) and low market acceptance for passenger cars are obstacles. Increased use on direct-injection diesel in large trucks and some light-duty trucks is likely.

Experimental use of pure electric vehicles is expected to be limited, because of storage battery technology limitations, even though electric drivetrain technology is well developed, simpler, and lower in cost than internal combustion drivetrain technology. A breakthrough in battery technology (size and weight), if achieved, could accelerate usage of electric vehicles, but significant use is unlikely before 2010. Charging station infrastructure will require substantial investment and lead-time.

More promising in meeting emissions standards, improving fuel economy, and reducing investment is a gasoline/electric hybrid approach, in which an electric drivetrain is supplemented by an efficient gasoline engine running at a constant high speed (for minimum emissions and high fuel economy) providing for electrical generation and emergency requirements for bursts of power. Some industry observers believe a Stirling/electric hybrid is economically attractive and may be nearing technical feasibility.

Natural gas and propane propulsion, which depends on the development of an extensive fuel-delivery infrastructure and safer on-vehicle storage capability, probably lies beyond the fifteen-year horizon. The weight of high-pressure storage systems make gaseous fuels impractical for passenger cars and more suitable for trucks, but delivery infrastructure is developing very slowly. Nevertheless, for fleet use, natural gas may be the most economical of all the alternative fuels systems and competitive with present fuels.

Fuel cell technology development appears to be even further in the future. Interest in alcohol (methanol and ethanol) fuels continues to wane.

Material Substitution

Cost and weight will continue to be the most critical material selection attributes in the coming decade. The industry has traditionally relied on high-weight, low-cost materials such as cast iron and steel, but as pressure to reduce weight increases, the industry is looking more closely at lower weight, higher cost materials. The cost/weight tradeoff will continue to be critical for at least the next decade. New applications and technologies are likely in plastics, aluminum, magnesium, titanium, ceramics, metal matrix composites, nylon, and powdered metals—most of which are intended to reduce weight and increase component life. There may be significant opportunity for suppliers, especially those with expertise in high-volume manufacturing of lightweight materials.¹⁵²

¹⁵¹ Cole, *Delphi VIII Forecast and Analysis of the North American Automotive Industry: Technology*, 16.

¹⁵² David E. Cole et al. *Delphi VIII Forecast and Analysis of the North American Automobile Industry: Materials*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, 1996: 26, 53-56.

Recyclability may be an inhibitor to use of some low-weight materials. For decades, the industry has been actively working to make environmentally friendlier products. Much of this work has been focused on the manufacturing and operational stages of the product's life cycle. In recent years, there has been an increased interest in the impact of the product at the retirement stage. Presently, 75 percent (by weight) of each vehicle is recycled. This is accomplished by the removal of resalable parts, fluids, and metals. The remaining 25 percent, composed mostly of plastics, goes to the landfill as automotive shredder residue (ASR). Decreasing the amount of ASR is currently the focus of the industry's recycling strategy. The most severe barriers to automotive plastics recycling are likely to be economic, not technical. Few, if any, plastics are not technically recyclable, but large-scale plastics recycling will continue to be inhibited by the lack of an economically viable recycling infrastructure and difficulty in separating waste into the various components. Ultimately, it is unlikely that any important automotive material will be eliminated by recycling concerns.¹⁵³

Electronics

Vehicle electronic content is expected to grow to 20 percent of total vehicle value by 2005. Multiplexed power systems and fiber optics are likely avenues of growth. Applications of electronic features, such as antitheft, CD players, electronic keyless entry, and on-board engine diagnostics using expert systems, are expected to increase significantly in the next decade. The number of electric motors in standard passenger cars is expected to double by 2005. Electronic noise cancellation technology is expected in limited application in the next decade.¹⁵⁴

Use of electronics can have important cost, packaging, and weight advantages. For example, it has been reported that Navistar will reduce the number of mechanical components controlling its fuel injection system by a factor of ten, and reduce the injector size by half, using electronic advancements.¹⁵⁵

Partnership for a New Generation of Vehicles

The joint industry/government-sponsored Partnership for a New Generation of Vehicles (PNGV) may be a major stimulus to innovative technology in both fuels and materials. The most likely technology to achieve PNGV's 87-mpg fuel economy goal is a combination of a composite-intensive body structure and a heat engine electric hybrid powertrain. The aggressive fuel economy goal in a family-sized vehicle will require technology breakthrough in every system of the vehicle. Obtaining fuel economy improvements without adding significant cost to the vehicle, while retaining vehicle utility and comfort, is perhaps the biggest challenge. Cost would appear to be the greatest barrier to commercialization. PNGV will probably utilize an electric drivetrain, an energy

¹⁵³ Ibid, 123.

¹⁵⁴ Ibid, 187-201.

¹⁵⁵ Richard F. Celeste. "Strategic Alliances for Innovation: Emerging Models of Technology-Based Twenty-First Century Economic Development." *Economic Development Review*, (Winter 1996).

storage system (battery, flywheel, or ultracapacitor), regenerative braking, engine-off idles and decelerations, and some type of turbine generator.¹⁵⁶

Intelligent Transportation Systems

Technology advances of the last few years in intelligent transportation systems are likely to receive increasing application during the next fifteen years. Satellites in geosynchronous orbit permit rudimentary location and navigation systems in luxury vehicles today, and these should spread to other vehicles as refinements are introduced and costs are reduced. Today's research into the highway of the future should yield advances in command and control of vehicles and highway usage patterns, as well as improvements in highway safety through sensing, warning, and braking system innovations.

PROCESS TECHNOLOGY CHANGES

Math-Based Engineering

The development of mathematically based techniques for engineering automotive components and systems, using the computational and manipulative power of computers, has potential to alter dramatically the time-honored engineering sequence of design, prototype, and development. A shift away from manpower-intensive prototype build and test methods has begun and likely will be completed during the next fifteen years. Advantages of the new technology, which includes digital scanning of surfaces, finite element structural analysis, and computer simulation, are more precise matching of performance to requirements, much shorter development time, less investment in prototypes and test facilities, and less engineering manpower. Indeed, Wolfgang Reitzle, head of product planning for BMW, predicts that, within six or seven years, automakers will design their vehicles entirely by computer, completely skipping the costly and time-consuming step of building and testing prototypes.¹⁵⁷

The trend toward the use of math and computing is also clear in design and styling, where hand-drawn sketches, carefully crafted clay models, and painstakingly constructed templates are giving way to computer 3-D imaging and sketching, computer rotation and manipulation of designs, rapid experimentation with a wide range of variations, determination of mathematical coordinates from completed designs and numerical-controlled diemaking directly from these coordinates.

Manufacturing Systems and Process Technology

The focus of responsibility for manufacturing and control of manufacturing technology is shifting. Increasingly, assemblers will relinquish various support activities such as R&D, component engineering, and purchasing to systems integrators. This will permit assemblers to focus their energies on their own core processes such as product planning, vehicle engineering, and marketing, as they relinquish less central activities to

¹⁵⁶ Cole, *Delphi VIII Forecast and Analysis of the North American Automotive Industry: Technology*, 23-31.

¹⁵⁷ Ralph Kisiel. "BMW Exec. Puts Prototypes on Extinction List." *Automotive News*, (October 28, 1996): 40A.

suppliers. Reducing the overhead expenditures associated with support activities should lower break-even production quantities and allow assemblers to serve smaller niche markets profitably. The key characteristic of the systems integrator will be the assumption of responsibility for the execution of most technical tasks in the product chain and the coordination of the chain's technical and operational performance.¹⁵⁸

The conventional definition of manufacturing processes as technical or purely physical activities is being expanded to include the human routines of production.¹⁵⁹ Manufacturing processes must be considered as integral parts of the systems they produce. Automotive systems may be formulated according to functional performance of the system, the geography of the parts in the vehicle, the material or technology involved, or the close relationship of the concepts involved.¹⁶⁰ For example, TRW advertises to the auto assemblers that it wants to be their safety systems supplier—a classification based largely on the functional performance of the systems.

The strategic role of manufacturing technology traditionally entails a tradeoff between the flexibility to produce wide product variety and cost efficiency. Initially, when competition centers around product innovation, flexible general purpose processes are necessary to accommodate a variety of products and frequent design changes. As standardized products and high volume shifts competition towards cost efficiency, production systems become more targeted, integrated, capital intensive, and complex. The arrival of computer-controlled smart manufacturing technologies has challenged former notions about trade-offs between priorities, especially flexibility versus efficiency. Because the latest technologies are more flexible, numerous product variations can be made almost as efficiently as manufacturing a large volume of standardized products.¹⁶¹

Rapid changeover and agile assembly are major issues in the assembly of automotive bodies. Current methods require hard assembly tooling, which is expensive, long-lead, and inflexible. Today's decision-making and implementation time for robot-based automation systems is an order of magnitude too slow to keep pace with increasingly shorter product innovation cycles. Robot-based production systems are being developed that can be put to work or reconfigured in a fraction of the time it typically takes now. Workcell simulation, flexible parts feeding, open-architecture controllers, system modularity and scalability, and data-driven software modules are some of the developing technologies for reducing implementation times.¹⁶²

¹⁵⁸ Michael S. Flynn et al. *The 21st Century Supply Chain: The Changing Roles, Responsibilities, and Relationships in the Automotive Industry*. Ann Arbor: University of Michigan Transportation Research Institute, Office for the Study of Automotive Transportation, and A.T. Kearney, Inc., 1996: 13-14.

¹⁵⁹ Robert J. Thomas et al. "Manufacturing Management: The Work Force of the Future." Cambridge, Massachusetts: Arthur D. Little, Inc., *Prism*, (Fourth Quarter 1995).

¹⁶⁰ Michael S. Flynn and David J. Andrea. "Corporate Learning from Japan: Partnership, People and Process Technology." Proceedings of IPC '94 Conference & Exposition, The Engineering Society of Detroit, April 1994.

¹⁶¹ Dean M. Schroeder et al. "Linking Competitive Strategy and Manufacturing Process Technology." *Journal of Management Studies*, (March 1995): 164.

¹⁶² Linda K. Schuch. "Keeping Up With Change: Changes in Manufacturing Technologies." *Assembly* 38, no. 10 (1995).

On the other hand, manufacturing likely will become less separate and distinct from product conception, design, delivery, and disposal. Manufacturing—the people, the systems, and the knowledge base—will be fully integrated into a seamless process of value creation. Process knowledge and continual learning will be key. Robert Thomas and his associates at A. D. Little put it this way, “The factory of the future will not be a ‘lights out’ monument to the triumph of technology over human beings. Instead, it will be a system that thrives on a vital and highly complementary relationship between technology and human beings.”¹⁶³

Communications with Suppliers and Customers

Sophisticated information and communications systems, together with deregulation, may permit businesses to communicate directly with desktop computers in the consumer’s home or business, permitting the offering of complete home and business services. Better electronic links with suppliers and customers are likely to enable businesses to conduct electronic purchasing, automated inventory control, and on-line customer service and product support.¹⁶⁴

Better electronic links with suppliers and customers may come through software resembling the World Wide Web and the Internet. The evolution of high-speed networks that are independent of the particular make of computer and the particular operating system in use at each user’s node in the network will represent a decided improvement in communications over present cumbersome and costly company-specific proprietary links. Security and capacity issues presently inhibiting use of the Web are likely to be solved within the next few years.

Workplace of the Future

Technology is likely to have a profound impact on the way people work. In the future, mobile computing and wireless communications will create a different model of how people work together. Electronic mail and video-conferencing will enable employees to share documents with each other and have meetings at a distance.¹⁶⁵ Just as companies are developing communication links to suppliers and customers using Internet concepts, some companies are also developing low-cost flexible intranets—Internet-like software for internal communications across all makes of personal computers and their various operating systems.

Advances in interactive design capability linking U.S., European, Japanese, and other engineering sites are being reported by Ford and Chrysler. From desktop computers, engineers will increasingly confer with colleagues at other sites, call up design files, modify designs, and see their results in full-color automated form. For example,

¹⁶³ Robert J. Thomas et al. “Manufacturing Management: The Work Force of the Future.” Cambridge, Massachusetts: *Prism*, (Fourth Quarter 1995): 40.

¹⁶⁴ “The Next 25: What Today’s Leading CEOs, Management Gurus, and Futurists See Coming for Your Company, Your Job, and Your Life Between 1995 and 2020.” *Industry Week* 244, no. 15, (1995): 44.

¹⁶⁵ *Ibid.*

software will convert linear drawings of suspension engineers' work to three-dimensional form, allowing them to see the suspension system bouncing and springing on the screen, even rolling the suspension over a depiction of a typical pothole.¹⁶⁶

ISSUES

Technology Leadership and Competition

In the past, Japan was generally acknowledged to be the leader in both product and process technology. Rapid technological advances in the United States should allow the United States to catch up during the next ten years. Rapid improvement in Korean technology also can be expected in this period. Even though Japanese products and processes today exhibit technological leadership, the Japanese do not lead in every aspect of technology. Their implementation of computer technology lags behind both the United States and Germany, but their employment of worker skills in quality improvement, cycle time analysis, and process simplification is substantially ahead of U.S. and German firms. Leadership is important because America's current international competitiveness is still uncertain. The real challenge the North American automotive industry is facing today—both from Japan and from such developing countries as China, India, Malaysia, and Mexico—may be less low-cost labor than low-cost technology.¹⁶⁷

Differences in rates of learning and application of new process technology have been observed in Japan and the United States, depending on the type of technology involved. Flynn and Andrea have identified four types of process technology based on two underlying dimensions.¹⁶⁸ On one dimension, technology is "hard" if it is imbedded in a machine, while it is "soft" if it is vested in humans. Hard technologies abound in automotive production and include robotics, stamping presses, and lathes. Soft automotive technologies include many engineering routines, statistical process control, and just-in-time production. On a second dimension, technology may be focused, targeting relatively narrow and specific elements or operations in a process, while linking technologies target the coordination or connection of sets of focused elements or operations. In the past, technological development has emphasized the intersection of hard and focused applications, and much of today's automation is the result. Increasingly, attention is turning toward the intersection of the soft and linking technologies, where the advances of the future are likely to occur. Flynn and Andrea's research indicates that difficulty in learning increases as we move toward the soft and linking technologies, but at the same time, the potential gains to be realized are much greater. These observations have significant implications for the technology leadership issues.

¹⁶⁶ Oscar Suris. "Behind the Wheel." *Wall Street Journal*, (November 18, 1996): R14.

¹⁶⁷ Robert H. Hayes. "U.S. Competitiveness: 'Resurgence' Versus Reality." *Challenge* 39, no. 2 (1996): 36.

¹⁶⁸ Michael S. Flynn and David J. Andrea. "Corporate Learning from Japan: Partnership, People and Process Technology." Proceedings of IPC '94 Conference & Exposition, The Engineering Society of Detroit, April 1994, pp. 27-28.

Another leadership issue is the rate of technological learning. In general organizational change theory, there are two ways that change, learning, and knowledge transfer take place. In *continuous improvement*, change is a series of small incremental improvements that are cumulative, while in *process reengineering*, radical leaps or breakthroughs are the source of improvements. In reality, both kinds of change are important, and over time, both may be observed in any system. Technological change can be expected in the same manner, and both can contribute to technological leadership.

Environmental Issues

The forthcoming level of global economic activity will probably not be ecologically sustainable with existing technologies and production methods. Successfully competing for these markets of the future may depend upon a firm's ability to envision sustainable technologies and products that do not yet exist and to develop them ahead of competition. Firms that adopt sustainable development strategies probably will lead in developing new, low-impact technologies and competencies.¹⁶⁹

CONCLUSION

Advancing technology will present many opportunities for competitive advantage. Technology will yield ways to doing more, better, faster, and cheaper. Product technology advances are likely in fuels and propulsion systems, light-weight and cost-effective materials, and electronic control and accessory systems. Process technology advances are likely in systems for design and styling of vehicles, engineering of systems and components, integration of engineering and manufacturing, communications with suppliers and customers, and internal communications and interactions throughout the value creation chain. Continuing and perhaps accelerating advances in computer and communications technologies are likely, providing the underpinnings for many other technological advances.

¹⁶⁹ Stuart L. Hart. "A Natural-Resource-Based View of the Firm." *Academy of Management Review* 20, no. 4 (1995).

