Role of Manufacturing Technology in Trade Adjustment Strategies (1986)

Pages
61

Size
8.5 x 10

ISBN
0309321387

Committee on Manufacturing Technology in Trade Adjustment Assistance; Manufacturing Studies Board; Commission on Engineering and Technical Systems; National Research Council

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Manufacturing Studies Board
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National Academy Press
Washington, D.C. 1986

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This study was supported by Contract 99-26-07196-31 between the U.S. Department of Commerce and the National Academy of Sciences.

Limited copies available from:

Manufacturing Studies Board
National Research Council
2101 Constitution Avenue
Washington, D.C. 20418

Order from
National Technical
Information Service,
Springfield, Va.
22161
Order No. PB 87-245 147

Printed in the United States of America

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PREFACE

Manufacturing technology can play an important role within the adjustment strategies of a number of trade-injured firms and industries. That role, however, has often been neglected because new technology can be too expensive, the return can be uncertain, financial assistance may be easier to arrange, and the extent and impact of available technology may not be fully realized. Furthermore, because assistance to firms has been given through regional Trade Adjustment Assistance Centers that operate fairly autonomously, successful use of manufacturing technology may not be shared or repeated nationwide. Consequently, investment in manufacturing technology as a way to regain competitiveness may not have received attention commensurate with its benefits.

To respond to this concern, the Department of Commerce's Office of Trade Adjustment Assistance asked the National Research Council's Manufacturing Studies Board to form a committee to advise it on the appropriate role and mechanisms for manufacturing technology in assistance. Accordingly, the Manufacturing Studies Board set up the Committee on Manufacturing Technology in Trade Adjustment Assistance. It comprises 10 engineers, managers, and academicians knowledgeable about economics and state-of-the-art manufacturing technologies.

The committee met five times during a year and a half, visited approximately half of the 13 Trade Adjustment Assistance Centers (TAACs), attended a meeting of TAAC directors, and heard presentations on industry assistance projects. Based on this information and its members' experience, the committee developed in detail procedures for companies to follow in planning the use of manufacturing technology. Special attention is given to the smaller companies (the majority of recipients of Trade Adjustment Assistance) and to the role of the TAAC. In addition, the committee recommends steps to enhance the delivery of manufacturing technology assistance.

The committee views manufacturing technology as inseparable from product design and marketing as part of a business strategy. Chapter 2 and the appendix to this report are, we believe, a useful manual for assisting in the development of firms' adjustment strategies. A similarly detailed set of procedures for assisting industries is worth pursuing in a future study.

In December 1985, as the committee's deliberations were drawing to a close, the Trade Act of 1974, under which the Trade Adjustment Assistance program is chartered, was revised. At that time, some of the Trade Adjustment Assistance Centers were asked to begin shutting down. As this report goes to press, some TAACs are operating and others are not. Whether or not the portions of this report that address the specific administration of the program will continue to be applicable is uncertain. The advice on the role of manufacturing technology in trade adjustment strategies, however, remains true, whether it is used by Trade Adjustment Assistance Centers, the Office of Trade Adjustment Assistance, consultants outside the TAA program, or the trade-injured firms themselves.

ACKNOWLEDGMENTS

The Committee on Manufacturing Technology in Trade Adjustment Assistance is responsible for organizing and conducting the research and writing the findings of this study. However, the committee wishes to acknowledge the invaluable contributions of the Manufacturing Studies Board staff who facilitated our efforts: Executive Director George Kuper, Staff Officers Janice Greene and George Krumbhaar, NRC Fellow Margaret Dewar, and Administrative Assistants Michael Resnick and Lucy Fusco. In addition, we wish to thank Daniel Harrington and Jeffrey Gren of the Office of Trade Adjustment Assistance and the directors of the Trade Adjustment Assistance Centers. This report would not have been possible without their willing and candid participation.

Emory G. Orahood
Chairman

EXECUTIVE SUMMARY

While the importation of manufactured goods has tended to lower inflation and serve consumer needs, it has hurt large and small companies in the United States, and even entire industries. In addition, the United States has lost competitive advantage in those industries that get new manufacturing equipment and leading-edge process technology from offshore original equipment manufacturers; this problem can only increase the plight and number of import-injured firms and industries in the future.

Factors that may induce customers to buy imports are product features, selling price, quality, and delivery time. These factors can be traced within a company or industry to product design advantages, production cost advantages, marketing superiority, and government aids and restrictions. While price is the most visible reason for the purchase of imports, a variety of the factors above are usually responsible.

Manufacturing process upgrades within the context of a long-range business strategy often provide an important opportunity for lasting improvements in a firm or industry's competitiveness. Recognizing when manufacturing process improvements are needed can be done only in the context of the whole manufacturing operation: the three disciplines of product design, manufacturing process, and marketing, as well as overall management. No single area improved without commensurate improvement in the others can provide genuine and perceived value to the customer at a price he will pay that will return adequate profit to maintain or increase manufacturing jobs.

The problem facing most U.S. manufacturing companies is how to use their available resources to compete effectively with imported goods. The strength of the dollar may prevent this entirely in some cases. In others, subsidies by foreign governments or other low-price approaches may block U.S. companies. However, if domestic manufacturers have a chance to maintain sales volume and jobs, then the conceptual framework of the three interrelated disciplines of product design, process technology, and marketing can be helpful in diagnosing the problem and accomplishing the necessary improvements.

Any assistance to move companies to a higher level of technology usage in each area and to cause them to link closely the three disciplines will improve their competitive posture. However, it is

essential that the application of a more advanced technology be balanced against the true needs of the business. Many U.S. firms have spent large sums on advanced manufacturing technology with less than expected results, and smaller firms often cannot afford large manufacturing investments.

Given this situation, what can a manufacturing firm do to maintain jobs and profits? And what assistance can be provided to such firms? The Trade Adjustment Assistance (TAA) program of the U.S. Department of Commerce is one source of assistance. Its clients are, in general, relatively small (under $50 million in sales) and are operating at a relatively low level of technological sophistication in all three key disciplines. The TAA program aims to give incremental aid to firms and industries that are damaged by imports but expected to survive if given assistance.

The Office of Trade Adjustment Assistance asked the National Research Council's Manufacturing Studies Board to form a committee to advise the program on ways to increase the effectiveness of trade adjustment assistance aimed at manufacturing technology. This report presents at length the committee's findings on assistance to firms: diagnosing when manufacturing technology upgrades are needed, choosing the right manufacturing technology, and implementing it. The detailed steps to follow, presented in Chapter 2 and the appendix, are meant to be a useful handbook for Trade Adjustment Assistance Centers and small to medium-sized companies. The steps are described in the basic terms that are appropriate to the companies most likely to seek Trade Adjustment Assistance.

The committee's findings about the administration of the TAA program and recommendations for its improvement are in Chapters 3 and 4. The TAA program has provided an average of $17 million a year in technical assistance to a number of trade-injured firms and industries. Anecdotal evidence suggests that the program has indeed helped some firms to become more competitive. Because the program has lacked the funds and authority for a meaningful follow-up of the results of assistance, it has been unable to document its success rate. Partly as a consequence of that, the program has had its funding eliminated and restored almost annually. This, in turn, has diverted program resources--time and money--from assisting trade-injured firms and industries.

The program is too small to solve all of the problems of competition from imports; however, it can be an effective alternative or complement to other strategies if the program (1) follows up the results of assistance, and (2) takes steps to transfer successful strategies from TAAC to TAAC, both of which depend on (3) gaining some stability of funding within the budget cycle. In addition, the program, if expanded, has the opportunity to offer greater assistance (1) by using an early warning mechanism to assist industries before their need is acute, and (2) by making trade adjustment assistance a requirement before trade protection is offered to an industry.

Because of the uncertainty of the future of the Trade Adjustment Assistance program as this report goes to press, the report has been written with two audiences in mind. The recommendations for

improved incorporation of manufacturing technology in Trade Adjustment Assistance are in response to the request of the sponsoring agency. The whole of Chapter 2, which details the steps for incorporating manufacturing technology in a business strategy, is intended to be used by the Office of Trade Adjustment Assistance, by Trade Adjustment Assistance Centers, by managers of firms themselves, or by anyone seeking to help a firm improve its financial health in today's global economy.

The committee's deliberations on these matters raised further, as yet unanswered questions: To what extent has the annual uncertainty of the program's funding affected its effectiveness? In light of the growing number of companies and industries injured by imports, is the TAA program funded at an appropriate level? Is the system of regional centers the best mechanism for delivery of trade adjustment assistance?

1 PERSPECTIVES ON THE NEED FOR TRADE ADJUSTMENT ASSISTANCE AIMED AT MANUFACTURING TECHNOLOGY

The increasing industrialization and integration of the world economy bring both challenges and opportunities to American business. Because the United States is the world's largest single economic market, it is a natural target for foreign manufacturing firms' attempts to gain a share of international markets. In many cases, such firms have cost advantages based on local labor costs, direct or indirect government subsidies, currency valuations, or some combination of these factors.

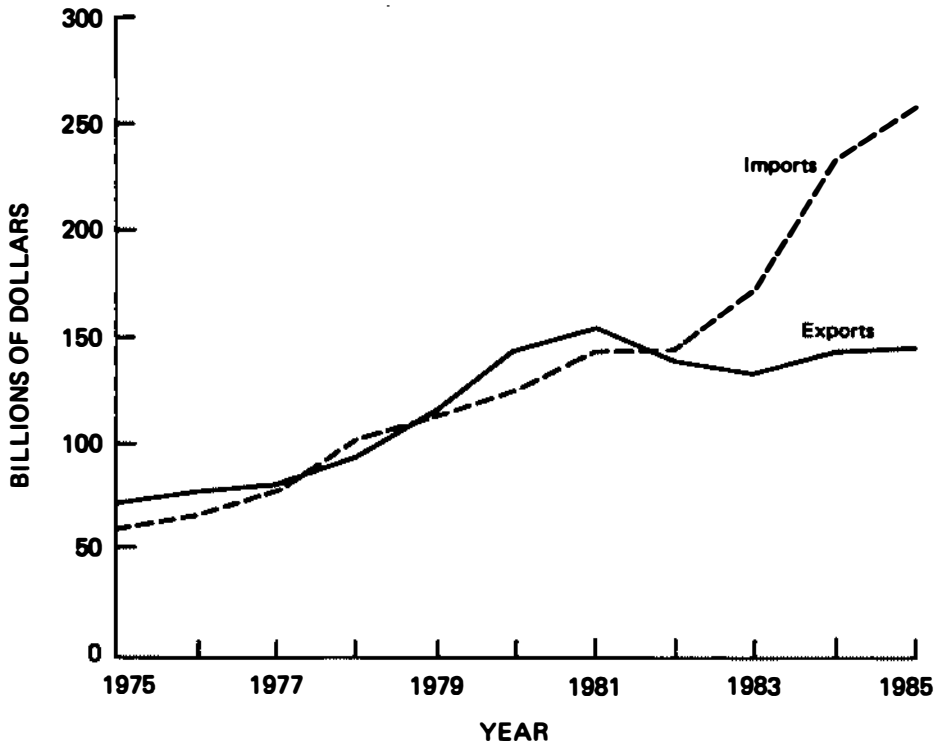
This chapter describes the global economy, which is the environment in which trade adjustment assistance aimed at manufacturing technology upgrades is given today. The chapter briefly examines the nature of competition from imports, the role of manufacturing technology in enabling U.S. firms to remain or become internationally competitive, and the appropriateness of federal involvement in trade adjustment assistance to firms and industries.

THE SCOPE OF COMPETITION FROM IMPORTS

Although some manufacturing sectors have maintained a strong competitive position, overall data on the balance of trade in manufacturing indicate severe challenges ahead for U.S. manufacturers. In 1978, the United States suffered its first trade deficit in manufactured goods, as shown in Figure 1. In 1982, for the first time the amount of manufactured goods exported fell from the previous year. Although this figure has rebounded somewhat, the level of exports is not yet up to the 1981 record of $154 billion. In the meantime, manufactured imports have continued to climb, posting an impressive 16 percent average annual rate of increase since 1981. In 1984, this country had its largest ever annual trade deficit for manufactured goods--$78 billion. For the first time, manufactured goods are the major category contributing to the country's deficit in merchandise trade.[1] The Export-Import Bank estimates that each $1 billion of trade deficit means that 24,000 jobs move overseas.

Contrary to widespread belief, the foreign challenges to U.S. producers are no longer restricted primarily to older industries with apparently matured technologies and mass-produced products. Instead,

FIGURE 1 Balance of Trade in Manufactured Goods



SOURCE: U.S. Department of Commerce, Economic Indicators, August 1985, and U.S. International Trade Commission, Flash Tables

these challenges are being directed across the entire industrial spectrum, beyond such early industries as textiles, clothing, and shoes, and even beyond the more recent pressures on steel, automobiles, consumer electronics, machinery, and machine tools. Serious threats are also imminent for such high-technology industries as computers, semiconductors, aircraft, aircraft components, pharmaceuticals, telecommunications, robotics, and flexible manufacturing systems. As the recent report of the President's Commission on Industrial Competitiveness states, "Virtually all sectors of our industrial economy are being challenged."[2] Further, the same report continues, the trends in international trade in technology-intensive goods "do not show a broad-based pattern of adjusting our exports toward high-technology areas, as would be expected from the world's most advanced economy. These trends, taken together, suggest a weakening in the ability of U.S. firms to produce products that meet the test of international markets."[3]

Although Japan is a major world presence in many industrial sectors, challenges to U.S. technology and trade competitiveness come from an increasing number of countries. The 50 percent drop in the U.S. share of world pharmaceutical exports since 1960, for example, is

the result primarily of European firms' efforts to establish a broad multinational base.[4] Semi-industrialized countries such as Korea and Brazil have developed industrial policies that signal their intention to acquire an increased world market share of technologically sophisticated products.

SOURCES OF IMPORT COMPETITION

Field studies of the factors that have had most influence on the relative market strength of foreign and domestic firms[5] have highlighted the following:

- product design advantages,
- production cost advantages,
- marketing superiority, and
- governmental aids and restrictions.

Some product design advantages--including attractiveness of appearance, variety of types and sizes, and availability of features offering greater convenience in use--need not involve the application of sophisticated technology. They are, however, often related to a second level of product design advantages--those involving the degree and consistency of product quality, as well as such aspects of product performance as operating efficiency, durability, reliability, safety, and ease of maintenance. Incremental changes in a product's design usually offer increased customer value and reduce the cost of production or improve the quality (yield rate) of the product. In some cases, new materials may lead to changes in process technology, such as from machining to plastics molding, that further enhance the firm's competitive posture.

Production cost advantages may be traced to two different sources. The first reflects the availability and price of inputs--including natural resources, energy, labor, and investment funds--but need not involve any technological superiority. The second includes superiority with respect to one or more of the following determinants of efficiency in production operations:

- a highly trained, experienced management that provides pressure for productivity improvements;
- a sophisticated technical staff with incentives to keep improving technological capabilities;
- a productive labor force that willingly accepts technological innovations and has mobility among tasks;
- modern, technologically advanced, and effective processes, facilities, and equipment;
- easily produced designs; and
- efficient use of capacity, either through flexible equipment that offers economies of scope, or through limited product-mix, highly standardized product components, long production runs, and high rates of capacity utilization.

Among these six, the degree and rate of technological innovation is likely to play a major role only with respect to processes, facilities, and equipment, although the technological sophistication of engineering personnel will play a significant supporting role.

Marketing superiority results from six factors:

- effective market research;
- a reputation for good service after sales;
- responsiveness to customer preferences relating to product design, availability, and financing arrangements;
- rapid changes in the product in response to customer demand, resulting from interaction of product design and production technologies;
- matching or surpassing competitive price/quality/order-size combinations; and
- aggressive selling efforts.

Successful marketing efforts often result from the ability to identify technological applications that satisfy consumer needs; such efforts can rapidly translate into a competitive advantage. Examples include the portable stereo cassette tape player, electronic refinements on new cameras, and even the latest generation of roller skates.

The remaining major source of competitive advantage is the array of governmental aids, such as various types of subsidies and tax relief as well as restrictions on foreign competitors, that are practiced currently and are often motivated by the promise of a technology-based trade advantage. Examples of such assistance include the Japanese government's support and coordination of efforts to develop next-generation computers, the Brazilian government's ban on computer imports, and the West European consortium that developed the Airbus.

Thus, the competitiveness of domestic firms is being challenged on a wide variety of fronts. Of the many causes of competitive difficulties, those particularly related to manufacturing technology are product quality, product performance, and efficient processes, facilities, and equipment. The relative importance of these and other factors is bound to differ among industries, among regions, and among firms within an industry.

THE NEED FOR UPGRADED MANUFACTURING TECHNOLOGY TO RESPOND TO IMPORTS

U.S. industries that are strong in international trade are knowledge-intensive. That is, industries that successfully export or compete effectively with imports have a higher than average R&D component themselves or in their supplier industries.[6] They are innovative industries; they develop new products and adopt new processes frequently. Even if the industries with which they compete in other nations use labor-intensive, technically primitive processes, their advantage in international markets depends on their continually operating near the technological frontier.

As the competitive advantage of foreign firms in Europe and Japan also becomes increasingly technology-based, U.S. firms will have even more pressing needs to upgrade their manufacturing and product technology. Competitive disadvantages with respect to product quality, product performance, and production efficiencies cannot be overcome for long by intensified marketing efforts or financial expedients. Thus, while technological competitiveness alone may not be a sufficient condition for achieving and maintaining a strong market position, it is a necessary condition.

Furthermore, some non-technological influences on competitive disadvantages, such as interest rates or the exchange rate of the dollar, are beyond the control of the individual firm. Manufacturing technology upgrades, which are within the control of the firm, can help compensate for those problems that are not.

New production technology is at the heart of the strategies that enable firms to produce higher-quality products, respond more rapidly to changes in demand patterns, offer greater customization of products to a wider range of customers, and incorporate efficiencies that at least temporarily lower the costs of production. Further, certain quality improvements are possible only through the introduction of new technology. Operations that involve 100 percent inspection at several points along a manufacturing system, for example, providing immediate correction within the system through a closed loop process, can ensure high product quality.

In the past, many U.S. firms have relied on a competitive advantage based on a "technology gap." The view that this technology gap would permanently favor the United States[7] is being disproven by the success of foreign firms in such high-technology fields as computers and semiconductors. International competitiveness in the future will be based less on the exclusive possession of superior technology[8] than it will on the selection, application, and continued refinement and development of technologies.[9]

Adoption of advanced manufacturing technologies without relating them to a business plan, however, is counterproductive, particularly in a smaller firm having little experience with new operating procedures generally. For these firms, identifying the appropriate manufacturing technology is essential to gaining a competitive advantage. This approach may require extensive revision of business practices in many U.S. firms, inasmuch as choosing and applying technologies is a continuing process that becomes more complex as the technologies themselves become so. In a manufacturing business, selecting and applying appropriate new technologies requires the formulation of a systematic manufacturing technology strategy, which will be the subject of Chapter 2.

THE FEDERAL ROLE IN MANUFACTURING TECHNOLOGY

ASSISTANCE TO RESPOND TO IMPORTS

Governments have traditionally used a variety of indirect (e.g., tax) and direct subsidies, tariffs, quotas, and marketing agreements in

attempting to maintain a healthy domestic business sector in the face of international competition. In addition, governments support research, which may have substantial business applications in years to come. To a lesser degree, vehicles to transfer commercially usable technology into a finished product have been established and operated successfully. Many of these policies are legitimate, but a large number of protectionist policies used in the world today both violate the General Agreement on Trade and Tariffs and open a country to retaliatory actions by its trading partners. Expansion of the policies only increases the potential for challenges and objections.

The recent trend toward larger and larger trade deficits has resulted in dramatic intensification of demands that the Administration and Congress take action to prevent the further loss of sales and jobs. Unless this trend reverses, it appears likely that action in some form will be taken.

A federal program that assists industries and firms injured by imports to become more competitive demonstrates concern on the one hand and concrete measurable action on the other. By assisting trade-injured firms and industries to assess strengths and weaknesses and to identify problems, such a program can have substantial impact on the economy. Its recommendations can induce firms and industries to change markets or products, improve product designs, reduce product costs, and improve quality and delivery. While the current Department of Commerce Trade Adjustment Assistance program is too small to create a widespread impact, it has provided such assistance to a number of clients. The mechanisms that have been put in place by this program have great potential to reverse the trend toward lost jobs and sales, were Congress and the Administration to decide to expand it.

NOTES

1. Economic Indicators, August 1985, (Washington, D.C.: Government Printing Office, December 1984), p. 35.

2. President's Commission on Industrial Competitiveness, Global Competition: The New Reality (Washington, D.C.: U.S. Government Printing Office, 1985), Vol. II, p. 35.

3. Ibid., p. 14.

4. National Academy of Engineering/National Research Council, The Competitive Status of the U.S. Pharmaceutical Industry (Washington, D.C.: National Academy Press, 1983), p. 50.

5. Bela Gold, "Technological and Other Determinants of the International Competitiveness of U.S. Industries," Institute of Electrical and Electronic Engineers Transactions on Engineering Management, May 1983.

6. For example, according to Research and Development in Industry (National Science Foundation, 1983), from 1972 to 1980, the textile and apparel industry's annual investments in R&D were 0.4 percent of net sales. During that same period, the comparable figures were 6.8 percent for the electronic components industry and 8.1 percent for communications equipment.

7. See, e.g., J.J. Servan-Schreiber, The American Challenge (New York: Atheneum Press, 1968).

8. See, e.g., International Competitiveness In Electronics (Washington, D.C.: U.S. Congress, Office of Technology Assessment, November 1983), p. 170.

9. See, e.g., National Academy of Engineering/National Research Council, The Competitive Status of the U.S. Electronics Industry (Washington, D.C.: National Academy Press, 1984), p. 3:

> "Japan's current success in electronics lies in the careful selection and purchase of foreign technology, the speed and extent of its adoption, and the ability to refine purchased technology."

2 THE ROLE OF MANUFACTURING TECHNOLOGY IN IMPROVING THE FINANCIAL HEALTH OF A TRADE-INJURED FIRM OR INDUSTRY

Successful upgrading of a firm's manufacturing technology is a three-stage process: (1) diagnosis of the firm's problems, which will suggest the possible role of manufacturing technology in the solution; (2) selection of the appropriate type and level of technology; and (3) implementation of the technology according to short- and long-range strategic plans. This chapter provides a framework for use by Trade Adjustment Assistance Centers or others in assisting firms in many industries. It treats manufacturing technology in the context of a firm's business strategy.

DIAGNOSIS: ARE MANUFACTURING TECHNOLOGY UPGRADES NEEDED?

Determining whether manufacturing technology is an appropriate element in a firm's trade adjustment strategy requires an understanding of why that firm is in trouble. Chapter 1 identified four factors from a global viewpoint--product design advantages, production cost advantages, marketing superiority, and governmental aids and restrictions--that can give imports a competitive advantage. These are manifested in four product characteristics of interest to the customer. Although selling price is frequently the most visible reason for the purchase of imports, product quality, product features, and delivery time are also important. All four product characteristics--price, quality, features, and delivery--are affected by both manufacturing technology and other factors.

We suggest two alternative approaches to diagnosing whether a deficiency in manufacturing technology is a major cause of a firm's present problems. The first approach is to compare the client company to a group of well-run, successful companies of comparable size, though not necessarily in the same industry. The second approach is to analyze from within the firm why the business is in trouble. The two approaches are not mutually exclusive, and either approach should point out major opportunities to solve competitive problems.

Diagnosis Through Comparison With Like Firms

The first approach to diagnosis is based on the recognition that successful companies have similar characteristics in many areas. Examples that cut across industries include well-documented quality control procedures; the keeping of accurate, up-to-date records of inventories; a knowledge of product costs on a timely basis; and procedures for identifying customer wants and needs. According to data gathered and analyzed by the PIMS (Profit Impact of Market Strategy) program, companies that achieved a large percentage of their potential growth had two things in common relative to other companies. They were more aggressive at marketing and they invested more in new plant capacity, relative to the growth of their markets.[1]

By reviewing the condition of these and other key areas, one can identify weak spots and develop a list of corrective actions. Such an approach assumes the existence of a comprehensive list of the procedures, policies, and processes found in the healthier companies. With such a list, the diagnostic process can be fairly rapid and can become the basis for the trade adjustment strategy.

Two industries that already compile comparative data for their member firms are food marketing and footwear. Their procedures could be models for other industries.

For many years the National American Wholesale Grocers Association (NAWGA) has maintained statistics on warehousing operations, broken down by size of firm and by type of operation (e.g., delivery, stacking, sweeping). Indeed, the data collection effort has been computerized since 1969. Data are supplied by individual firms, which are given secret identification numbers. The comparative figures, including the identification numbers, are then compiled in an annual report that enables each firm to determine exactly where it stands vis-a-vis the industry average and the industry best practice. An annual symposium enables participants to catch up on the most up-to-date techniques in warehousing. This reporting system, which continues to this day, is one of the factors behind the high level of automation in the food warehousing business. An additional effort is now attempting to apply the same concept to delivery operations.

The Footwear Industries of America (FIA) is in the middle of a multi-year program of trade adjustment, the first phase of which was supported by the Office of Trade Adjustment Assistance (OTAA). The trade adjustment strategy aims to implement advanced manufacturing technologies on a wider scale in the industry and to push the state of the art with regard to selected technologies.

Phase One, which has been completed, accomplished three tasks: (1) identified 54 separate operations in footwear manufacture; (2) classified technology in each operation as low, average, or advanced, and assessed the degree of diffusion of advanced technologies in the industry; and (3) developed a formula for identifying which operations could yield the most benefits to the industry if they were automated.

Phase Two, aimed at broad utilization of existing technology, will take a similarly organized approach. Individual plants will be given a

"plant audit" to determine the degree of technological development in the plant. The FIA has published data indicating the degree of cost savings to be expected through the adoption of more advanced technologies, and firms are being encouraged to use the plant audit and cost savings data as measures of the degree to which they need to install more advanced systems to remain competitive.

Phase Three will be aimed at filling the gaps in technology identified in Phase One. The FIA's president hopes to interest universities, foundations, and firms in carrying out basic and applied research on the eight priorities that the Phase One report identified.

The NAWGA and the FIA programs are models of the use of comparative cost and other data to assess the extent of need for technological upgrades. The warehousing effort is particularly effective because it is continuing and cumulative: some firms develop data every four weeks, all firms know exactly where they stand, and the effort can be used as a vehicle for diffusing new technologies quickly.

Diagnosis Through Examination of Four Possible Problem Areas Within the Firm

The second approach to diagnosis, an analysis of the specific trade-injured business, requires a more detailed look at the troubled firm but less access to information from other firms. Because the process of accomplishing this analysis is similar across a variety of firms and industries, the committee developed procedures in greater detail for this approach.

A review of documentation on assisted firms indicates that problems within a firm can be divided into four general areas--management, marketing, product development, and manufacturing process. The responsibilities of these areas, and possible competitive problems related to each, are presented below.

First, corporate management supports and governs all three of the other areas. It has responsibility for establishing a mission for the business and for allocating human and capital resources. Management also has the responsibility for providing support of personnel, data processing (where it exists), and legal, financial, and other functional areas.

No amount of resources, including those applied to the manufacturing process, will make a firm successful if it does not have a perceptive business strategy and a management that has the ability and authority to make decisions and see that they are implemented quickly. Management comes in all forms and styles, and no one form can guarantee success. In a small enterprise, corporate management may be a single person who has many responsibilities, such as setting corporate policies and procedures as well as marketing policies and programs. What is required for success in any enterprise is an involved management that understands the business and can respond quickly to changes in the environment.

The second of the four general areas, marketing, is the link between the needs of customers and the organization's plan to respond

to those needs. Traditional marketing responsibilities include sales, service, customer relations, product distribution, and product planning.

Effective use of new and expanded marketing techniques is an essential element of business today. In today's marketplace, companies threatened by imports would do well to look at global markets, which need not be done only from the base of a home market. It is clear from Japanese export-import ratios, for example, that their approach is to design and manufacture products for world consumption.

Two examples illustrate the importance of marketing technology. Several years ago, a group of high-level electronics engineers (most with Ph.D.s) within a large company undertook the task of designing a special electronic product for use on underground mine vehicles. Although these engineers were highly skilled in control circuits, they made no attempt to interact with the manufacturing people who would build the electronic control and similarly made no effort to visit mines to see such devices at work and to understand the environment. Even worse, the company structure did not provide a means to ensure these contacts; no real marketing technology was in place. As a result, the electronic device worked perfectly in the lab but was difficult to manufacture--production costs could never become competitive. Furthermore, the device would not perform in mines--it was not rugged enough and had many failures. In short, the lack of communication among the three areas of technology led to a business disaster.

A similar lesson about the important coordinating role of marketing technology can be learned from Charles F. Kettering's technical debut at General Motors Corporation. From 1919 to 1923 he developed an air-cooled engine, using thin sheets of copper around each cyclinder to lower the heat transfer. Compared with its water-cooled competitors, Kettering's "copper-cooled" engine weighed less, did not freeze in winter, eliminated the need for radiator and hoses, had a simplified design, and attained increased power and fuel economy. The organizational alignment of the project was unusual, however, and contributed to its eventual failure: the research organization ran the project, and the manufacturing division managers who were to produce the engine had an advisory role only. Without coordination between design engineers (who worked for Kettering) and production engineers, no one anticipated that the transition to successful production would entail a long process of testing and incremental adjustments. Further, crucial market factors were overlooked: the auto industry in 1919-1923 was dominated by Ford's mass production, but consumers' tastes were beginning to move beyond inexpensive, strictly utilitarian automobiles. In 1922, standard water-cooled Chevrolets were selling in near record numbers; while the copper-cooled car was the surprise hit of the New York Auto show that year, only 750 were manufactured because of intracorporate communication breakdowns, technical malfunctions, and a changing market. By summer of 1923 all copper-cooled cars were recalled, and the project ceased to be an active concern of the corporation.[2]

The third area, product development, translates customers' needs and wants as specified by marketing into a product concept and then

into a product. This function includes the development and perfection of products, research into internal production technologies, detail design, and in some cases, the definition of manufacturing procedures. This process is generally performed once for every product design; it is subsequently repeated as a product moves through successive improvements and modifications towards maturity.

In successful businesses, marketing and product development work together closely. The finest manufacturing technology in the world--one that produces a high quality product at low cost--is of no value if there is no market for the product. Customers will not buy products that do not meet their needs, no matter how high the quality or how low the cost. For example, Japanese manufacturers developed cost-competitive, high-quality, small automobiles at a time when most Americans were driving large vehicles. U.S. customers' subsequent choice of the Japanese products was motivated by a demand for more fuel-efficient vehicles, caused by sudden changes in global energy supplies, as well as for the quality and lower cost of the manufactured product. When American manufacturers recognized this and met the customers' demands, American vehicles regained a portion of their market share.

Another example of aiming a product at a market niche is the introduction by the Chrysler Corporation of its front-wheel-drive mini-van in 1984. This vehicle was built with technology developed in the United States, was a high-quality vehicle, but was not necessarily the lowest priced vehicle in the generic van classification. The buying public, however, was immediately attracted to the utility and quality of the van, which resulted in Chrysler's capturing a very high percentage of the small-van market. Vision and a competitive product strategy are fundamental to a successful business, large or small.

The last area in analyzing a business, manufacturing technology, deals with the production of the product as specified by marketing and as quantified by product development. The responsibilities of manufacturing technology include management of the work force that produces the products; procurement of facilities and equipment; determination of how to produce the product design; acquisition of raw materials; fabrication, inspection, and testing of parts; subassembly, assembly, and shipping of the product; and management of inventories throughout the production process. In most cases, production functions are performed repeatedly for the end items that are produced in any facility.

Two sources of information should be tapped to find manufacturing weak spots in a business. One approach is to examine traditional financial or quantitative indicators; the second is a factory walk-through. Quantitative indicators that can suggest a need for manufacturing technology upgrades before one looks at the actual manufacturing processes include the following:

1. Direct manufacturing costs, exclusive of administrative and selling costs, that result in a product for which there is a demand but for which price competition cannot be met.
2. Warranty costs that are related to production processes rather than the basic product design.

3. Labor costs assigned to rework and modification that are high in comparison to labor costs associated with the initial production. In a modern manufacturing process there should be little or no rework effort if the process is within quality control tolerances.

4. Repeated machine-down work stoppages that can be attributed to antiquated or ill-maintained shop floor machines.

5. A lack of flexibility that results in a manufacturing process that resists product design changes and is insensitive to customer needs.

The factory walk-through, which can be accomplished in a day or less, is a critical source of information for the second approach to diagnosing a firm's problems. It is designed to evaluate the overall condition of the facility, equipment, control systems, and management of human resources in a manufacturing company. The detailed information to gather on a factory walk-through is described in a checklist in an appendix to this report.

The checklist approach assumes that the evaluator has experience in manufacturing and is accustomed to seeing factories, and that factory management is open to diagnosis and is forthcoming with information. During the factory walk-through, informal discussion with senior management officials about the overall health of business operations can be revealing. Useful insights can be gained by asking how certain key business indicators have changed over the past year; are they up, down, or unchanged? The evaluator should especially ask about:

- sales volume,
- profit margin (net income),
- number of employees,
- inventory size and turnover rate,
- percent of goods returned, and
- claims against warranties.

On the walk-through, the evaluator examines the condition of the facility and offices, the condition of the equipment, the inventory, the effectiveness of the layout, and the work effort and attitude of employees. When summarized, they should give clear insights into the plant's overall condition and its ability to compete. Walk-throughs also point out areas for rapid improvement, as well as areas that require longer-term remediation.

CHOOSING THE RIGHT MANUFACTURING TECHNOLOGY

The next step for incorporating manufacturing technology is to identify, based on the diagnosis, the types and levels of technology that meet a company's short- and long-term needs. Appropriate choices at this stage are crucial to helping the firm keep pace competitively without overinvesting and thus exceeding its financial and human resources.

Suppliers are one possible source of information on technologies. In addition, many states have regionally oriented advanced manufacturing technology programs. These are often located at universities and are aimed at assisting regional industries. Examples include Ohio's Thomas Edison Program, composed of six manufacturing centers that link various universities with regional industry; Pennsylvania's Benjamin Franklin Program, which includes the University of Pennsylvania, Carnegie-Mellon, and Lehigh; and the Industrial Technology Institute in Ann Arbor, Michigan, which--though separate from the University of Michigan--is directed by a committee that includes state and industry representatives as well as the president of the university. Further, the smaller engineering or technical schools are a good source for assistance in applying manufacturing technology.

Three Levels of Technological Sophistication

Manufacturers will employ varying degrees of technological sophistication, depending on the size of the business, the complexity of the product, the processes used to manufacture that product, and the length of the manufacturing cycle. The continuum of technological sophistication can be divided into three broad categories. First, advanced, the most sophisticated technology found among competitors in a given industry. Second, conventional, the accepted level of technology that would be found among most competitors, both domestic and foreign. Third, low, the level of technology used in the past and now largely replaced by more advanced technology.

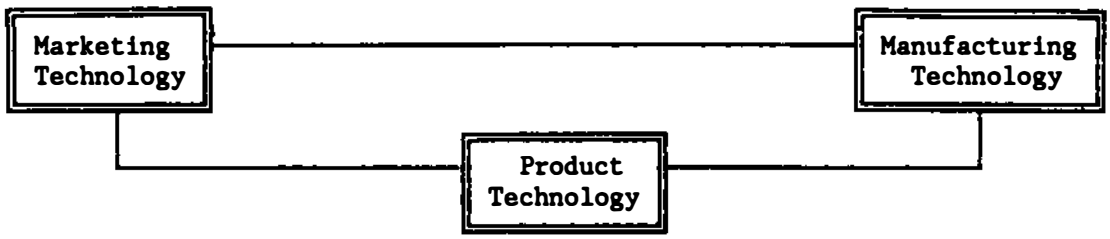
Figure 2 shows the examples of these three technological levels for each of the three major technological activities in a firm, marketing technology, product technology, and manufacturing technology. The fourth major activity in a firm, corporate management, controls and directs the other three.

The chart should not imply a chronological sequence in the functions as they appear in the actual manufacturing process. On one hand, a product cannot be marketed until it is produced; therefore marketing should be in the column at the right, following the manufacturing process. On the other hand, product development cannot proceed until a market need is perceived; hence marketing belongs in the left column. For this reason, the column headings are shown as three interconnecting boxes, so that each of the three major areas lies adjacent to the other two.

KEY MANUFACTURING TECHNOLOGIES OF INTEREST TO THE TAA PROGRAM

The majority of the clients of the Trade Adjustment Assistance program are smaller companies without sophisticated technology. Therefore, most adjustment strategies that include manufacturing technologies will aim for conventional technologies in the short term and advanced technologies in the long term. Today's advanced

FIGURE 2 The Three Technologies and Levels of Technological Sophistication



Marketing Technology	Product Technology	Manufacturing Technology
Advanced	**Advanced**	**Advanced**
Overall strategic marketing plan Close links to product and manufacturing technology Detailed knowledge of customers' wants and competitors' plans	Newest materials and components Tied to customer needs through marketing Designed for producibility Latest design tools (CAD, CAE)	Flexible manufacturing systems Robotics Computer controls Manufacturing cells Integrated, continuous process Link to other 2 columns
Conventional	**Conventional**	**Conventional**
Strong sales closely linked to basic marketing Some "intelligence" concerning customers and competitors Basic marketing and sales plan Some link to product; none to manufacturing	Sound but limited tools for basic engineering design New designs often aimed at catching up Little innovation Some input from marketing; no link to manufacturing	Numerical control Material requirements planning Some automation, but with batch process & queuing Good bill of materials and work flow Manufacturing viewed as island that need not link to other 2 columns
Low	**Low**	**Low**
Marketing includes sales representatives; no corporate staff No sales plan No effort to gather intelligence on customers or competitors	Old designs that lag those of competitors Poor choice of materials and components No attempt to design for ease of maufacture No interest in marketing or in customer	Stand-alone machines, with queue at each Poor work flow Out-of-date drawings and bill of materials High material waste Poor production control No interest in others 2 columns

technologies, after all, will be conventional in 10 or 20 years. In general, clients of TAACs will have continuing difficulty competing if they do not use the technologies in common practice, yet advanced technology solutions will often be beyond their financial and managerial abilities in the near term. The ultimate gains in quality and flexibility, and reductions in delivery time and inventory that result from computer-integrated manufacturing can be enormous.[3] Further, despite a prevailing opinion in the United States that automation is applicable only to larger companies, experience in Japan suggests that automation can have rapid payoffs for small companies as well.[4] Therefore, the benefits of automation and, ultimately, computer integration should be kept in mind as a goal even for smaller companies.

As general guidance for selecting appropriate technologies, this section describes available and emerging technologies for product design, production, and marketing. A short section follows on management trends that respond to the changing nature of industrial competition.

Product Design Technology

The first move in the area of product design should be to ensure that there are up-to-date and accurate drawings, specifications, and bills of material representing the current product line. Current technology can produce these items.

The next level of improvement, still within the middle or conventional level, is the introduction of computer-aided drafting and design. Such designs can be more easily changed to take account of product variations in response to user demand; they can provide data for materials requirements planning; and they can ultimately provide design data for numerical control (NC) programming, tool and fixture design, and process planning. These paths of data communication can be implemented independently, in accordance with an overall long-range plan to achieve computer-integrated manufacturing.

Computer-aided design (CAD), either alone or directly linked to computer-aided manufacture (CAD/CAM), offers enormous potential for rapid response to customer needs. CAD technology is now readily accessible to most firms via low-cost personal computers and software. CAD/CAM systems, as we describe in the next section, are not far behind.

Independent of CAD development are opportunities to substitute new materials for old (e.g., composites or plastics instead of metals, high-strength low-alloy steels to reduce product weight and cost, ceramic materials to withstand high temperatures with low thermal conductivity); to change methods of joining (e.g., adhesives instead of welding or brazing); or to change processes (e.g., electric discharge milling for rotary milling cutters).

Although new materials are usually thought of in association with high-technology applications, they are often better choices than conventional materials for familiar products. Their use can no longer be considered at the most advanced level of technology and therefore

out of reach for most small firms. The change to these new materials originates in the product design area or in the interface between product design and production and can enhance both the design and the production.

Whatever the level of technological sophistication, products must be designed to be compatible with the process technology being used to produce the product. Goods that are designed with forethought of the kind of manufacturing automation to be used in their production can be produced at lower cost and with higher quality. If process technology upgrades are being considered in the manufacturing strategy, there is a unique opportunity to reexamine the product design for ease of manufacture. Typical of the issues involved are:

Hardware:	Simplicity through materials substitution (e.g., plastics) or stampings, to eliminate costly machining and castings.
Fastening:	Adhesives to replace welding, brazing, or soldering; snap fasteners to replace threaded joints or taper pins.
Electricals:	Common feedthroughs.
Assembly:	Product configured so all assembly operations are conducted from a single direction, to eliminate manipulating the product and to facilitate later automated assembly.

Manufacturing Process Technology

The minimum improvement in the production arena is to upgrade the physical condition of existing machinery. At this level, the following questions should be considered:

- Is the machine worn or aged to the point of unacceptable output? The least action would be rebuilding, retrofitting, or maintenance.
- Would a new machine of the same functional type be enough improvement to justify the replacement cost? This would have little impact on other parts of the design and production department.
- Is a new machine of superior performance justified--e.g., an automatic lathe in place of a manual lathe? This could have an impact on other parts of the production department.

The next level of production improvement is the introduction of "islands of automation"--e.g., numerically controlled (NC) machine tools, automatic storage and retrieval systems, material handling conveyors, shop-floor data-collection systems, continuous process painting or plating lines. Pick-and-place robots are often lower-cost alternatives to manual labor in repetitive tasks such as palletizing and machine tending. Robots are easy to program, and their flexibility allows them to be used in several different applications. Robots also have valuable applications in noxious environments, such as spray

painting. Introduction of such automation projects will inevitably have an effect on other units in the production sequence. For example, it will have a significant effect on production scheduling and control, as well as on the quality and uniformity of the product.

In large companies today, no islands of automation would be installed that have not been planned to fuse ultimately into a computer-integrated manufacturing system. In small companies, such as those served by the TAACs, application of such planning may be too technical and too costly, particularly when the company has fundamental concerns about its survival. For the small companies, computer-integrated manufacturing would initially be best approached in ties among product design, manufacturing engineering, and production, effected by computer networks for information exchange.

Marketing Technology

Marketing technology is a new term, parallel to the more familiar concepts of product design technology and manufacturing process technology. Marketing technology goes beyond the conventional elements of marketing--selling, supervising or managing selling, advertising, and planning the advertising strategy. It is not limited to dealing with the world outside the enterprise but is also concerned with the functions and the communications within the enterprise.

The "technological" approach to marketing is an integrated function of the whole business, both inside and outside. It has close links with manufacturing, product design, finance, and sales. Its objective is to ensure that the business responds rapidly to current and potential markets.

Using information about both foreign and domestic customers and competitors, marketing technology forecasts customer and market needs and desires, as well as competitive actions and developments. It is important to get and upgrade continually the best possible intelligence because these forecasts are the basis for decisions that should ensure that the right product with right features and delivery schedule is made at the right cost. Marketing technology assists manufacturing process technology in preparing a long-range manufacturing strategy and assists product design technology in preparing a long-range product strategy.

In addition, marketing technology works closely with the financial department to define product cost and product profit or loss all the way to the corporate bottom line of profit and loss. It must, therefore, be involved in making financial allocations to products to ensure fairness and accuracy. Further, it must accept responsibility for both product pricing and product profitability, which cannot be uncoupled from each other. True advanced marketing technology will push manufacturing to seek new technologies in order to become more cost competitive and will push product technology to new and better designs with improved features/cost ratio. It will also focus on staff and corporate overhead costs that can create difficulties in competing with imported products.

The marketing technology function, therefore, should include degreed engineers, preferably those who have had experience in product design and production. To achieve effective working relationships and cooperation, other functions--product design technology, production, financial, and especially top management--must understand this concept of marketing technology.

The so-called long-range strategic plans that many companies now have are merely financial plans with sales data included. These plans fall into the low or conventional level of marketing technology. Although new products are often included in these plans, specific long-range product plans are unusual and long-range manufacturing strategic plans are even more rare. Such financial plans are filled with assumptions because the cost data and market positioning are rough guesses.

One significant trend in advanced marketing technology is for original equipment manufacturers (OEMs) and their major suppliers to pull their small suppliers into the new era of automation by the purchasing agreements they require. Some examples are:

- production of parts directly from NC tape provided, not from drawings,
- computer-aided design and paperless storage of "drawings," and
- quality control based on vendor self-certification.

Management Trends

Changes in the nature of competitive forces have a strong effect on the viability of small and medium-sized manufacturers. The United States is losing market share to foreign manufacturers in part because of lower wages and the recent strength of the U.S. dollar. What the United States loses in cost-of-labor penalties, however, it can make up in quality and in the substitution of capital for labor in knowledge-intensive processes. The United States currently lags much of the industrialized world (including some newly industrialized nations) in the use of modern manufacturing equipment. Smaller businesses must keep pace by adopting new production automation that can provide productivity gains and enable more precision work to be performed.

Office automation--often as simple as a personal computer (PC) and printer--can enable the automatic generation of bills of material and production scheduling, and the tracking of orders through to shipping. Production systems and units can be designed for automated assembly. In the years just ahead, automation will displace more and more manual assembly, and this trend will touch small shops and suppliers. Owners and managers of small manufacturing concerns need not become technical experts in computer-related technologies, but without some knowledge and appreciation of products and capabilities of new manufacturing automation, their firms will continue to suffer.

A trend for slightly larger companies is increased communication among all parts of the organization through local- and wide-area networks. These provide means for the various computers, data bases,

machine tools, inventory points, and material handling devices to exchange information, controls, and reports. Such networks lead to manufacturing flexibility and adaptability. Often, partial integration is possible with simple, inexpensive systems involving no more than personal computers.

Manufacturers in the United States today have exhibited a definite trend toward product specialization. General job shops are specializing, and manufacturers are narrowing their product lines. It is unproductive and unprofitable to be "all things to all customers."

Another trend is toward large companies' creation of preferred supplier status. The supplier who can provide appropriate quality control programs, including self-certification, and who can be responsive to delivery demands will have a competitive edge and a stable market. Here is where offshore competition is disadvantaged: "just-in-time" (JIT) delivery programs require supplier propinquity. It is hard to be a JIT supplier 5,000 miles from one's customer.

Large suppliers and OEMs are also insisting that suppliers have well-developed and documented quality control programs. The trend among major manufacturers is away from inspection of incoming materials; as a result, the burden of quality is on the suppliers.

The tools of manufacture and the sophistication of technologies vary radically with the size of the industry, its customer base, and level of domestic and foreign competition within the industry. Table 1 provides typical characteristics of the kinds of technologies found in firms. Although the table is not exhaustive, it can serve as a guide in assessing where a firm stands with respect to the level of technology typical of its industry.

Small manufacturing firms that are willing to take the risks and make the investments needed to become more productive, and that reexamine continuously the nature of the markets they are serving, are in an excellent position to prosper in the years ahead. In this context, the key to prosperity lies in the ability of the firm to make a serious reexamination of itself and then to take appropriate action.

IMPLEMENTING NEW MANUFACTURING TECHNOLOGY

The third, and final, stage in assistance to trade-injured firms is the implementation of manufacturing technology and other aspects of the trade adjustment strategy. The key to successful implementation--successful in the sense of enabling a firm to compete effectively in the long term--is a business plan. A business plan has four levels:

- the basic business plan, which addresses the company's core problem(s) and needs, and determines how to implement the plan;
- the basic manufacturing plan, which contains the manufacturing aspects of the basic business plan;
- the short-range strategic manufacturing plan, which has detailed steps for the next couple of years; and
- the long-range strategic manufacturing plan, which is based on the short-range plan and on forecasts of the future.

TABLE 1 Characterization of Manufacturing Technologies

	LEVEL OF MANUFACTURING SOPHISTICATION		
	Low	Conventional	Advanced
Product Design Technology	Out-of-date paper drawings and bills of material; traditional design, materials, assembly methods	CADrafting; automated storage of drawings, specifications, bills of material; some use of new materials	CAD/CAM; innovative use of substitute materials; designs frequently revised
Manufacturing Process Technology	Stand-alone conventional machines, manually controlled; manual sharpening and setting of machines; manual assembly	EDM, NC/CNC machining; some use of pick-and-place robotics; automation assisted manual assembly; advanced welding technology	DNC machining; adaptive control of machine tools; lasers for machining, cutting, heat treating; robotics for material handling and assembly
Production Organization	Manual tending of conventional machine tools; manual material handling; no formal inventory control; poorly scheduled work flow; high scrap rate; unknown inventory turns	Batch processing with good work flow; islands of fixed automation; programmable controllers; transfer lines & material handling conveyors; no strategy for inventory control; controlled scrappage; shop-floor data collection; moderate inventory turns	Flexible manufacturing systems; automated guided vehicles; just-in-time and customer pull; automatic storage & retrieval; bar coding; computerized Mfg. Resource Planning; MIS; decision support; rapid inventory turns; close link among product design, production, and marketing
Quality	No formal quality control program; casual inspection of finished goods; manual product testing	Formal quality control (QC) program; inspection of work-in-process;automated product testing; some user feedback	QC through rigid standard on incoming supplies and process control; self-certification for customers; automated product testing for QC and process control; organized for customer feedback
Product Mix	Varies from narrow to broad, but longstanding products; little product response to changing customer needs	Tending toward product and market specialization; some focus on product planning	Highly specialized products and markets; fast product development cycle; aggressive product planning with marketing

The elements of each plan are described below.

The Basic Business Plan

The basic business plan encompasses the other three levels of the overall business plan and includes the following:

1. The company's objective. What product(s) or service(s) is it aiming at what market(s)?
2. The company's core problem(s). In the case of trade adjustment assistance, why has the client lost sales volume? Who has captured business and why? Usually the principal reason is low price by competitors, although quality, custom features, and delivery time also enter the picture.
3. A strategy for improving the company's competitive outlook. To develop this strategy, analyze the total product cost, including all indirect costs and all department staff and corporate overhead costs. Then analyze product and quality features as seen from customers' eyes. Use these and the factory walk-through as the basis for a basic manufacturing review and plan, including a short-range strategic manufacturing plan, using product and marketing technology as shown in Figure 2 earlier in this chapter.

To implement the basic manufacturing plan, the company must (a) define actions designed to reduce overhead costs, (b) define actions designed to reduce direct and indirect manufacturing costs, and (c) use the short-range manufacturing strategic plan in connection with product and marketing technology to reduce product cost and to improve quality and customer features as needed.

The TAAC should encourage client companies to establish clear individual responsibilities for actions to be taken. All actions should have definitive time tables with clear completion dates. The TAAC should follow up at regular intervals to see if the client is following the schedule from the action plan. In our recommendations section we suggest 12- and 24-month follow-ups.

The Basic Manufacturing Plan

Many TAACs already have in place systems for advising client firms on the creation of manufacturing plans that are similar to or more detailed than this basic manufacturing plan. The minimum requirements for a manufacturing plan are as follows:

1. The business needs to have at all times up-to-date and accurate drawings (or their automated equivalent), specifications, and bills of material.
2. A simple but formal scheduling and order-tracking capability should define what is to be made and when.

3. The plan needs to include a materials planning system. For many of the trade-injured firms, this can be a simple input/output plan, e.g., pounds in compared to pounds out. When components are purchased, more detail is required and the system must be more sophisticated.

4. A system is needed for quality measurement. It can be as simple as scrap reports or rework analyses by plant, by department, and by operator/machine.

5. There should be a cost tracking system based on time (work-hours) plus materials plan and quality measurement.

6. Analyses should be made of part numbers usage compared to dollar volume relating to the parts. An "ABC analysis" lists (A) parts used in high quantity, (B) medium-range usage, and (C) low-range usage. Typically, 20 percent of part numbers account for 80 percent of volume, while 50 percent of part numbers may account for only 3 percent of dollar volume. This analysis defines which areas yield the greatest benefit from upgrades; it is generally not efficient to invest in a new process for a part that is used only infrequently in the finished product.

7. The business needs to be able to translate market requirements (which calls for accurate work from marketing technology) into manufacturing responses. Specifically, the basic manufacturing plan will determine delivery cycles; amount of off-the-shelf stock; balance among standard product, slight modifications, and special products; and desired quality level. Do manufacturing plant capabilities fit market requirements? If not, what changes are needed in machinery and processes?

After the basic manufacturing plan has been completed, the business is in a position to establish strategic manufacturing plans, both short range and long range. TAACs will probably bring in outside consultants to assist in these plans.

Short-Range Strategic Manufacturing Plan

The following seven areas should be covered in the short-range manufacturing plan:

1. The business needs to establish a system for accurate allocation of indirect costs. Most plants record direct costs accurately but spread indirect costs based on dollar volume. Low-volume special products with actual high indirect costs end up with apparent lower cost while high-volume products are penalized with higher costs.

2. Machines and equipment should be grouped to manufacture parts in sequence. This approaches, as nearly as possible, continuous process, which eliminates queues, reduces inventory, improves quality, and cuts cycle time. The ABC analysis described in the basic manufacturing plan can be used to identify the important parts that will most profit from being reorganized in this manner.

3. The product technology staff should create designs that maximize commonality among parts. New parts are often used in designs because of perceived lower cost. A new part with less material but low-volume usage usually has a higher real cost. The company should plan to use existing high-volume parts and make design fit where possible.

4. The company should establish a formal system to subcontract to others work that does not fit its own manufacturing plant or where the supplier has a lower cost for the part. Use total part cost from Paragraph 1, above, to identify in-plant cost. The system should guard against the typical manufacturing plant inclination to make everything and thereby retain control, instead of relying on good suppliers.

5. The business should be able to modify and improve its product offerings based on careful analyses by marketing technology staff of customer needs and desires (sometimes two different things) and competitive products (both domestic and offshore), with special attention to competitors that are gaining market share. The product development and manufacturing staffs should work together closely to meet requirements and to ensure that the product is easily manufactured at lowest total cost. Product design staff should look for advanced product engineering and for improved materials and components.

6. The manufacturing staff should look at modifications and changes that can be made in manufacturing processes and in information systems that can reduce cost and improve customer service. TAAC manufacturing experts, consultants, universities, and other companies are sources for this knowledge.

7. The business needs to evaluate carefully its management of human resources, including staffing levels and training designed to implement improvements.

Long-Range Strategic Manufacturing Plan

The basic manufacturing plan and the short-range strategic manufacturing plan are useful only if their elements are constantly reviewed and kept up to date and active. Many clients will want to stop at this level. These plans, however, can form the foundation for a long-range strategic manufacturing plan, which businesses need in order to remain competitive.

As firms progress to more differentiated product lines, shorter product life cycles, smaller production lots, and more complex product designs, the information handling capabilities of traditional process machinery, production planning and control systems, and manually produced designs do not have sufficient speed or capacity. Cams and gears, paper and pen, and the unaided human mind will need to be replaced by microprocessor-based machine controls, computer-based information systems, and computer-aided design, drafting, engineering, and quality control to provide the manufacturing capability required. Paper-based systems cannot economically manage the data required by short, high-speed runs of complex technology products for many different customers in an environment of constant product innovation.

The elements of the long-range strategic manufacturing plan follow:

1. The business needs a plan to establish and maintain open and intensive communication and teamwork among marketing technology, product technology, and manufacturing technology.
2. Marketing technology should attempt to forecast changes in customer needs and desires and the resulting probable competitive products. It should also try to forecast what may happen to customers' markets. (OTAA can help in forecasting offshore competitive changes by using listening posts in other countries.)
3. Product technology should attempt to forecast changes and advances in materials, components, final product technology, and product design automation. Intelligence about foreign developments is helpful here also. Product technology should plan new designs based on forecasts from marketing technology and on its own forecasts but using proven technology for product. Information and advice from consultants and the technical community will help product technology staff keep abreast of new materials, processes, and technologies.
4. Manufacturing technology should look at competitors in the United States and elsewhere to identify the best or most useful manufacturing machinery and processes. It should also look at other industries and seek advice from consultants and should attempt to forecast future process improvements.
5. Final designs for new products should be integrated with manufacturing processes to achieve lowest product cost with desired quality and features.
6. Investments in new products and in new machinery and processes should reflect the constant changes of the marketplace and competitive influences. The best efforts at forecasting will often be inaccurate. Product designs, machines, and processes need to be kept flexible so that future changes and improvements can be made on short cycles.
7. Finally, any change will ultimately need to be fused into the long-range plan. Like the short-range plan, any long-range plan should look at human resources issues in addition to facilities and machinery. Staffing needs may change with the introduction of newer technologies and people must be trained on new equipment in order to maximize the machines' capabilities.

CONCLUSION

Manufacturing technology upgrades can improve production efficiency, product quality, inventory turns, and delivery cycle as well as provide the opportunity for additional product features. A firm's inability to compete, therefore, may be related to weaknesses in the manufacturing process. Often inflexibility in the manufacturing system prevents improvements necessary to meet changes in consumer taste. When analysis determines that manufacturing technology upgrades are needed, a wide range of options is available. The challenge faced in applying a solution is to adopt technology that is timely, affordable, and maintainable after the experts leave, and deals

squarely with the competitive problem. This is a sizeable task in a well-run, healthy firm. It is formidable indeed in a business that is in trouble.

NOTES

1. Robert D. Buzzell and Mark J. Chussil, "Managing for Tomorrow," Sloan Management Review (Massachusetts Institute of Technology, summer 1985), vol. 26, no. 4.

2. Stuart W. Leslie, Boss Kettering (New York: Columbia University Press, 1983), pp. 123-148.

3. See, for example, National Research Council, Manufacturing Studies Board, Computer Integration of Engineering Design and Production (Washington, D.C.: National Academy Press, 1984).

4. Peter F. Drucker, "Automation Payoffs Are Real," Wall Street Journal, Sept. 20, 1985, p. 26.

3 THE TRADE ADJUSTMENT ASSISTANCE PROGRAM AND MANUFACTURING TECHNOLOGY

This chapter describes the operation and activities of the Department of Commerce's Trade Adjustment Assistance (TAA) program in offering assistance with manufacturing technology. It does not provide a comprehensive description of the program; readers interested in greater detail should request information from the Office of Trade Adjustment Assistance, Department of Commerce, Room 4004, Washington, D.C. 20230, 202-377-4031.

The Trade Adjustment Assistance program offers assistance to two types of clients. (1) An individual firm that demonstrates injury from imports, based on criteria established in the Trade Act of 1974 as amended, is eligible for assistance from one of the regional Trade Adjustment Assistance Centers (TAACs) funded by the Department of Commerce. As of December 1985, there were 13 TAACs. TAACs have the authority and the capability to implement specific recommended innovations in process technology in a factory. (2) When a number of firms in an industry are certified or a whole industry demonstrates injury from imports, the Office of Trade Adjustment Assistance (OTAA) in Washington can provide assistance to that industry in such broader areas as developing and implementing industrywide production, marketing, and technology assistance.

The program has tended to get high leverage from its funds. Although in many years it faced uncertainty as to whether it would be continued, the program's funding for technical assistance has been relatively stable from year to year, as shown in Table 2.

The procedures for incorporating manufacturing technology into a trade adjustment strategy, and the impact of that strategy, will differ depending on whether that assistance is directed at a firm or an industry. Because these two types of assistance are different, the Committee addresses them separately in this chapter.

DELIVERY OF ASSISTANCE TO FIRMS

The Three Phases of Assistance

Firms applying for trade adjustment assistance go through a three-step process: (1) the firm submits a petition for certification

TABLE 2 Trade Adjustment Technical Assistance

Fiscal Year	TAACs and Direct Firm Assistance	Industry Assistance	Total
1978	$10,553,000	$7,123,000	$17,676,000
1979	11,180,000	6,567,000	17,747,000
1980	10,516,000	6,841,000	17,357,000
1981	12,863,000	4,601,000	17,464,000
1982	8,695,000	3,468,000	12,163,000
1983	12,990,000	4,480,000	17,470,000
1984	13,151,000	2,929,000	16,080,000
Total	$79,948,000	$36,009,000	$115,957,000

SOURCE: U.S. Department of Commerce, Office of Trade Adjustment Assistance

through its regional Trade Adjustment Assistance Center to OTAA; (2) if the firm is certified by OTAA, the TAAC conducts a diagnostic survey of the firm's strengths and weaknesses, which leads to an adjustment strategy; (3) if the strategy is accepted by OTAA, it is then implemented jointly by the firm and the TAAC or consultants.

Certification (Step 1)

A firm is certified if it can demonstrate (1) a decline in sales or production, and (2) an actual or threatened decline in employment, while (3) imports of similar or competing products have increased. The Department of Commerce is required by law to approve or deny certification within 60 days of petition acceptance; it usually does so within 30 to 40 days.

Diagnosis and Adjustment Strategy (Step 2)

Early diagnosis of a firm's strengths and needs is essential to solving a firm's competitive problems. The diagnostic survey may be the most important service provided by the TAAC, in that it forms the basis of any further actions taken by the firm. In some cases, a firm chooses not to receive further assistance, but to respond to the diagnosis itself. Each TAAC has its own method for conducting and recording the diagnostic survey. In November 1984, the program began a pilot test of the New England TAAC's simplified mini-diagnostic form as a standard for use by all TAACs in simple cases.

Implementation (Step 3)

In contrast to the diagnostic survey, which can be done by either TAAC staff or consultants under contract with the TAAC, the adjustment strategy is usually implemented by consultants under the supervision of TAAC staff. The strategy can include technical assistance, loans or loan guarantees, or both.* The TAAC may not purchase equipment or software; however, it may pay for advice in selecting equipment and computers and developing unique software or prototypes.

During these three steps, the TAA program provides both administrative and substantive services to a client. Administrative help is provided in preparing the petition for certification. Substantive assistance is of two types: (1) the diagnosis--in step 2--of a firm's strengths, weaknesses, and needs, and (2) assistance--in step 3--in implementing a specific strategy for improving its competitive posture. The latter is more costly and time-consuming, but its success depends on having a correct diagnosis.

The costs of these services are shared by the TAAC and the assisted firm. Up to three days of assistance in preparing the certification petition are provided free. Recent changes in the Trade Act provide for helping a firm prepare its certification petition at no cost share even if more than 3 days is required. The firm pays 25 percent of the cost of conducting the diagnostic review and developing the recovery strategy. The shares of the cost of implementing the adjustment strategy depend on its size and the ability of the firm to pay a larger share. The higher the cost, the larger the percentage borne by the client firm. For projects up to $75,000, the firm pays a minimum of 25 percent. At the other extreme, firms pay a minimum of 75 percent of the cost of projects over $115,000. Firms with substantial resources may be asked to pay more than the minimum charges.

Organizational Structure of TAACs**

Most Trade Adjustment Assistance Centers have a parent organization or sponsor. One of the TAACs' parents is affiliated with a state government, three with non-profit organizations, and six with universities. In addition, three TAACs are administered by non-profit organizations set up solely for that purpose. In general, the TAACs affiliated with universities appear to have more technically oriented staff, while the staff at other TAACs have more emphasis on financial and marketing backgrounds. The use of outside consultants does much to

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*In December 1985, the Trade Act was amended so that loans are no longer offered.

**This section describes the situation before the December 1985 changes to the Trade Act. The organizational structure is still in flux as this report goes to press.

even up the services provided by the TAACs, but there are noticeable variations among TAACs.

TAAC staffing has been characterized by high turnover and vacancies of more than minimal duration. These have caused disruptions sufficient to have been acknowledged in some of the TAAC annual reports. The following examples from the FY 1984 annual reports of various TAACs are illustrative.

- Southeastern TAAC: During the first two quarters of FY 1984, three new project managers were added to the existing staff of four project managers. A vacancy on the outreach staff was unfilled for four months.
- Midwest TAAC: In a professional staff of 12, there were three vacancies (including the TAAC Director), and an additional vacancy was expected before the end of FY 1984.
- Western TAAC: The average term of employment among professional staff was two and one half years.
- Mid-Atlantic TAAC: Its annual report acknowledged a "significant personnel turnover. . . . During the year three (3) members of the seven member consulting group left the organization and only one (1) replacement was hired. These re-hiring delays effectively lost fifteen (15) man months of consulting time."
- New England TAAC: It also acknowledged "a fairly high degree of staff turnover," though no reasons were cited.

Client Base

There are regional differences in the industries that form the client base of the TAACs. Because of geographic concentration of industries, the New England TAAC has assisted a large number of jewelry manufacturers, for example, while textile manufacturers are more likely to be served by the Southeastern TAAC.

Until 1980, more than half of the client firms were from the apparel and footwear industries. The TAACs now serve a more diverse group of industries. Table 3, compiled for the Department of Commerce, documents the general shift from apparel and textiles toward machinery and manufacturing.

With some exceptions, firms receiving trade adjustment assistance are small. Most fall in the range of $1 million to $50 million in annual sales. The average client has $10 million in sales and fewer than 200 employees.

By the time a firm applies for trade adjustment assistance, its need for that assistance is urgent and immediate. The diagnostic survey, coming early in the process, is critical in determining whether manufacturing technology is needed by the client and, if so, whether trade adjustment assistance is likely to be sufficient to enable the firm to become and remain competitive.

Most TAAC clients suffer from the special problems that face small companies. These include:

TABLE 3 Number of Firms Certified by Major Industry Groups

	Firms Certified Prior to 1/1/82		Firms Certified 1/1/82 - 12/31/82		Firms Certified 1/1/83 - 12/31/83		Cert. Activity 1/1/84 - 10/1/84	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Apparel	393	31.5	57	25.9	71	17.5	60	16.5
Leather	195	15.6	18	8.2	25	6.2	32	8.8
Textiles	101	8.1	15	6.8	27	6.7	10	2.7
Subtotal	689	55.2	90	40.9	123	30.4	102	28.0
Agri. & Mining	83	6.7	7	3.2	36	8.9	23	6.3
Lumber & Wood	68	5.4	14	6.4	33	8.1	21	5.8
Subtotal	151	12.1	21	9.5	69	17.0	44	12.1
Prim. & Fab. Met.	94	7.5	26	11.8	64	15.8	58	15.9
Machinery	137	11.0	37	16.8	64	15.8	86	23.6
Misc. Mfg.	88	7.1	24	10.9	31	7.7	32	8.8
Subtotal	319	25.6	87	39.5	159	39.3	176	48.4
Other	89	7.1	22	10.0	54	13.3	42	11.5
TOTAL	1284	100.0	220	100.0	405	100.0	364	100.0

NOTES: The SIC classifications for the above groupings are as follows:

1. Apparel: 23
2. Leather: 31
3. Textiles: 22
4. Agriculture and Mining: 01, 02, 09, 11, 12, 14, 20
5. Lumber and Wood Products: 24, 25, 26
6. Primary and Fab. Metals: 33, 34
7. Machinery: 35, 36
8. Misc. Mfg.: 39
9. Other: 27, 28, 29, 30, 32, 37, 38

SOURCE: Associated Research Analysis Corporation, "Listing of Firms Certified Under the Trade Act of 1974 by the U.S. Department of Commerce as of September 30, 1984."

1. In a small enterprise, the few senior managers may each have multiple executive functions. Because the senior management of the typical client of the TAAC may consist of only three or four people--or fewer--and because individuals may have blind or rusty spots as well as brilliant spots in their skills repertoire, non-achievement may be hard to correct. Replacing one of two or three people could be most difficult--even if the diagnosis suggests that it is necessary for the firm's long-term health.

2. Diagnosis from within the firm of technological deficiencies may be difficult if the diagnostician is the person with the blind spot or the rusty skill; yet the cost of an outside consultant to do diagnostics may well be formidable. Solving this problem is at the heart of what the TAAC program accomplishes.

3. In the small enterprise, the amount of funds available to modify a technology in use, or to introduce a new one, is often severely limited. Further, the effort of changing a technology can divert a manager's attention from the continuity of his functions in many other parts of the business, with potentially disastrous results.

Manufacturing Technology Assistance to Firms

Because of the small size and limited resources of most clients, most of the technology offered by TAACs has been fairly basic. The typical adjustment strategy is aimed at moving a firm from a low level of technology to the level of common practice. There have, however, been instances of sophisticated technologies included in adjustment strategies. TAACs have, for example, helped trade-injured firms to introduce a new process (e.g., precision casting to reduce scrap and machining time) or a materials requirements planning system.

The principal new technologies suggested to TAAC clients have been in the management information systems (MIS) field. The bulk of other recommendations have been for diligent application of well-known and sound principles of business operation. A focus on marketing-oriented adjustment strategies may appear reasonable considering the relative ease and lower capital cost associated with working on raising the level of marketing technology compared to upgrading manufacturing technology. The problem is that following the easier solution may miss significant opportunities for improvements resulting from the interaction of upgrades in all areas combined.

Many TAAC clients do not have funds for capital investments to incorporate such new manufacturing technologies as computer numerical control (CNC) machines or automatic assembly machines, whereas management information systems are not so expensive. Furthermore, high technology machinery is usually high-volume production machinery; it lowers costs and hence prices, which may eventually lead to higher volume requirements. Generally, TAAC clients need first to acquire the volume to justify the investment in automation. Good management systems can help cut costs, and hence lead to the desired volume of business.

Use of consultants allows the TAAC access to a wide variety of expertise in different technologies and varying industries. Although most TAACs have some staff with engineering backgrounds, these staff function as generalists, who typically recommend from among several dozen consultants for help on specific client needs.

ISSUES IN ASSISTANCE TO FIRMS

Use of Staff or Consultants

The counterpart to a firm's "make or buy" decision in the administration of the TAACs occurs in the distribution of the workload between staff and consultants. As noted above, the committee found some differences in the orientation of TAAC staff: some TAACs had more staff with technical backgrounds than others, which used a higher percentage of financial/marketing staff. Technical preparations of adjustment proposals, including those recommending changes in manufacturing technology, were done primarily by consultants.

Although there are rationales that support each approach, the committee found those for in-house technical staff to be more compelling. One reason for weighting the skills of in-house staff towards the financial side is that financial issues are more similar from industry to industry than are manufacturing technology issues. At the same time, however, the advantages of maintaining an in-house expertise in manufacturing technology include an ability (1) to recognize when manufacturing technology can be part of the solution to a firm's problems, (2) to choose wisely among consultants, and (3) to bring an independent judgment to a consultant's analysis and recommendations.

The committee found that "sharing" staff with manufacturing expertise in particular technologies among the different TAACs would be valuable, if the administration of such a system could be worked out. Thus, the Southeastern TAAC might maintain an in-house expertise in textile manufacturing technology, and the New England TAAC in footwear technology, for use by other TAACs on a reimbursable basis whenever the need might arise. The unresolved issue of information sharing (see below) prevented the committee from making a definitive judgment on how effective such an approach might be in practice.

Sharing of Manufacturing Technology Information Among TAACs

Each TAAC approaches manufacturing technology assistance independently (as it does all types of assistance). Manufacturing technology solutions are rarely discussed, shared, or transmitted from TAAC to TAAC. While a few TAACs have their own resources for manufacturing technology, other TAACs were not part of that network of information. The annual gatherings of TAAC directors tend to address TAAC management questions, not the technical substance of the aid given.

In contrast, the Committee found instances of industrywide assistance given by OTAA proving useful to TAACs in assisting firms. In the Mid-Atlantic TAAC, for example, the OTAA report of assistance to the glass industry provided a product idea that formed the basis of a successful firm adjustment strategy.

Measures of TAAC Performance

TAAC directors perceive that they are evaluated according to the number and diversity of clients served, not the long-lasting effects of adjustment strategies. TAACs are unable to spend much time or impose reporting requirements to follow up past clients and, therefore, have only sporadic information on which strategies have had a lasting effect and which have not. While the TAACs should assist as many firms as possible, the committee notes that staying competitive in today's markets, whether through the implementation of advanced manufacturing technologies or the utilization of market niches, is usually a long-term process. Business plans and manufacturing strategies must be continually updated. An adjustment proposal that aims to offer permanent relief from import competition should also contain some long-term assessment mechanism. This might take the form of percent of clients in business 12 and 24 months after receiving assistance. Performance measures could also take into consideration increases in sales and employment of assisted firms.

DELIVERY OF ASSISTANCE TO INDUSTRIES

The Office of Trade Adjustment Assistance judges that an industry has been injured by imports if: (1) a significant number of firms in the industry have been certified for trade adjustment assistance, (2) employment and U.S. market share have fallen and imports have increased, or (3) federal trade actions such as countervailing duties or anti-dumping measures have been taken. Under OTAA guidelines, assistance to industries should emphasize practical results that firms can implement in the near term that give high leverage to the OTAA funds.

While firms assisted by TAACs are known as "clients," assisted industry groups are called "cooperators," reflecting the partnership between government and industry in developing and carrying out the adjustment strategies. To date, there have been approximately 50 industry assistance projects to approximately 40 industries. Of these projects, one-fourth to one-third have been aimed at manufacturing technology upgrades.

Many industries qualifying for trade adjustment assistance do not employ manufacturing technology that can be equally utilized by all firms within the industry regardless of size. If this is true, the character of assistance with respect to manufacturing that is offered on an industry basis will differ markedly from that which is provided to individual firms. In all cases, the real test of the relevance of a

trade adjustment strategy is at the practical level of the individual enterprise.

ISSUES IN ASSISTANCE TO INDUSTRIES

Strategies to Diffuse Information Among Firms in an Industry

When assistance is given to industries, networking is fundamental to the justification of the assistance. Sharing of information is a legitimate condition for receipt of federal assistance. Manufacturing solutions that assist a firm should be conveyed to other firms in the same threatened industry; manufacturing approaches and techniques that an industry association or other industry group finds promising should be made known throughout the industry--even to firms that may not formally be party to "industry" actions and programs. Moreover, unless manufacturing technology advances are made known in a timely way across a broad front within an industry, certain firms may be given unfair advantage over others in the competitive marketplace. The purpose of trade adjustment assistance is to assist firms and industries in competing against imports, not to use federal funds to penalize stronger firms by assisting only weaker firms.

Replicated use of successful manufacturing solutions will increase the leverage of the Department of Commerce's resources devoted to trade adjustment assistance. Not only is this highly desirable, but it should be one of the tests of the management of the Trade Adjustment Assistance program at both the national and regional levels.

For information disseminated through the Trade Adjustment Assistance program beyond a given firm, the issue of the proprietary nature of the material may arise. If federal funds are employed to achieve a given solution, even particularized to a given plant, what is learned in the effort must be freely available to all who have the potential for using it in the furtherance of their own ends. Those that OTAA personnel seek to help should be advised that one of the conditions of accepting such assistance is that the outcomes will be made known broadly and freely.

Industry Cooperators--Who Should Be Getting Aid?

The large majority of industry recipients of trade adjustment assistance are trade associations. The concept of trade association is so broad as to range from those representing fairly limited sectors, such as the Work Glove Manufacturers Association, to those with such diverse membership as the American Electronics Association. The matter is further complicated by such circumstances as the membership of Yamazaki, a Japanese machine tool builder with a plant in Kentucky, in the National Machine Tool Builders Association.

The trade associations that are the most attractive cooperators in trade adjustment assistance are those that represent a very large proportion--ideally all--of an industry's constituents. The more

regular and effective the communication channels between the trade association and its membership, the better a candidate for cooperative activities it is. The size, scope, and administration of a trade association ought to be considered in determining how appropriate it is to make an award to the association.

No implication should be drawn, however, that lack of a trade association that qualifies to serve as a conduit or cooperating entity in a TAA project makes a given industry inappropriate for assistance. In fact, an industry's weakness and need for assistance may partially be reflected by the lack of healthy trade associations serving the industry.

Where trade associations are lacking, perhaps trade adjustment assistance can incorporate the establishment of industrywide mechanisms to support the development of relevant and needed technology and then to catalyze its dissemination quickly and thoroughly. Among the aggregation points that have proved successful in the past are universities that have special capabilities with regard to specific industries.

An Early Warning System for Cooperating Industries

Now that more industries want assistance than can be helped, the trade adjustment assistance program faces important choices about how to use its limited resources. As Table 2 showed, the TAA program is not large by federal standards and is not in a position to solve long-standing, deeply entrenched problems. It could see greater results from a small investment earlier in the process of responding to trade injury, especially if matched by investments from industry.

It is not now within the program's charter to provide early warnings to sectors of industry facing impending major increases in imports; however, that could be a valuable extension of the program. Such mechanisms could change the nature of trade adjustment assistance. By catching industries before their need for assistance is urgent, OTAA would be able to stretch its resources further.

Early warning mechanisms inevitably involve threat identification and analysis. In the present context, this requires timely information about developments in other nations. The Departments of Commerce and State should have the capability to provide this information about numerous industries in appropriate nations. The early warning mechanism could request the information it requires for analysis.

When original equipment manufacturers (OEMs) in this country begin to lose market position to foreign OEMs, that is usually a sign of trouble for their customers as well. When foreign OEMs are supplying a large portion of equipment to U.S. companies, then much of the innovation in new equipment for manufacturing and in new processes is also occurring outside the United States. As a result, firms outside the United States have earlier access to those innovations, and U.S. firms may lag their foreign competitors in technology by as much as two years. The Office of Trade Adjustment Assistance might use balance-of-trade statistics for OEMs as one indicator in an early warning system.

Timely, accurate, and persuasive information relevant to specific industries should be welcomed by the private entrepreneurs that manage the individual units of such industries. One might argue, in fact, that if action is not taken by businessmen under those conditions, they do not deserve to be favored with further expenditures of federal funds to ameliorate losses they may suffer at the hands of competitors in other nations. In any event, an early warning system that focuses on manufacturing technology should be especially productive in terms of jobs retained, industrial growth sustained, and the preservation of U.S. industrial competitiveness in domestic and world markets over the long term.

The Content of Trade Adjustment Assistance

Few would criticize strengthening governmental services providing more prompt and fuller information about foreign technological developments, economic policies, and governmental practices that, through their exports, are likely to affect U.S. domestic market pressures. Additional benefits would result from expanding such efforts to provide early warnings to specific sectors of U.S. industry facing impending major increases in imports. These services all clearly benefit large groups of companies. Chapter 2 of this report outlines two approaches to determining whether deficiencies in manufacturing technology are a major cause of a trade-injured firm's present problems. The first approach involves comparing the client firm to a group of well-run successful companies of comparable size. Such a comparison could help identify for the client firm those procedures, processes, and policies that need immediate attention. The second approach diagnoses possible weaknesses in individual manufacturing firms relative to the four factors that make foreign goods competitive.

An active government policy in pursuit of international trade competitiveness for domestic businesses could conceivably extend the "early warning" concept for firms and industries facing increased import competition to incorporate these two approaches. The result would be a detailed industry-by-industry analysis of policies and procedures common to successful manufacturers, and of factors behind a real or probable surge in imports. It may well be, moreover, that industry-by-industry diagnoses could enable TAACs to become more efficient in the diagnosis of routine cases, and to concentrate more on a smaller target population of firms, i.e., those for whom the adoption of the industrywide diagnostic is not sufficient.

4 CONCLUSIONS AND RECOMMENDATIONS

In this final chapter, the Committee on Manufacturing Technology in Trade Adjustment Assistance presents its conclusions about the objectives, accomplishments, and opportunities of the technical assistance activities of the Trade Adjustment Assistance program. The chapter offers specific recommendations for improving the competitive health of trade-injured companies and industries by improving their manufacturing technology, product technology, and marketing technology.

The committee sees multiple objectives for the Department of Commerce's trade adjustment assistance. The program should aim to improve the competitive health (encompassing cost, product features, quality, and delivery) of U.S. manufacturing industries and individual U.S. manufacturing companies to help them maintain and gain market share in the U.S. domestic market, and gain market share in the worldwide market both short range (1-5 years) and long range (5-15 years).

These are worthwhile objectives, and the program is to be commended for accomplishing them in part. The program is a vehicle for financial and technical collaboration between government and business but does not violate the General Agreement on Trade and Tariffs or provoke retaliatory measures by trading partners. The program has spread its limited resources to a large number of trade-injured companies with a variety of solutions aimed at short-term improvements in competitive status. Trade adjustment assistance cannot solve all the problems of competition from imports; however, it can be an effective alternative or complement to other strategies.

Manufacturing technology as part of a business strategy must be a fundamental part of the Trade Adjustment Assistance program. As foreign firms base their competitive advantage on new product and process technology, the need for U.S. firms to upgrade their technology becomes more urgent. Even where foreign firms are competing on the basis of lower labor costs, greater responsiveness to customers' needs, or favorable exchange rates, technology offers U.S. firms an opportunity to counter those advantages.

Many more firms can meet the eligibility criteria for trade adjustment assistance than the program, with its limited resources, can help. Further, the need for assistance in upgrading product and process technology and relating them to customer need has become

greater than ever. Our recommendations for meeting these needs are organized in the following sections:

- better TAAC assistance to firms,
- OTAA changes to improve assistance to firms,
- better OTAA assistance to industries, and
- a larger role for trade adjustment assistance.

BETTER TAAC ASSISTANCE TO FIRMS

1. A basic business plan incorporating a manufacturing strategic plan should be the basis of all company adjustment strategies.

A successful trade adjustment strategy can not only help a firm solve its immediate problems but also should change the firm in such a way as to improve its long-term competitive health. The development and continual updating of a manufacturing strategic plan, with help from the TAACs, is at the heart of this change. While most TAACs do, in fact, focus on a basic business plan, this step should be an explicit part of all strategies.

A business plan that states a firm's objectives and identifies core problems, then diagnoses what needs to be done in the short and long term and sets out steps for improving the firm's competitive position, should be the basis of every firm adjustment strategy. For any manufacturing firm, the heart of this business plan must be a simple, clear manufacturing plan. Because investments and longer-range improvements in manufacturing call for definitive strategic plans, including product and market technology, most manufacturing companies should have a manufacturing strategic plan in addition to the basic business plan.

The steps for TAACs to follow in diagnosing a firm's needs and developing a business plan and manufacturing strategy are set out in Chapter 2 of this report. Briefly, they are (1) to diagnose by a factory walk-through or by comparison with similar firms, (2) to choose appropriate technologies, and (3) to implement them according to the business strategy.

Clients of TAACs are, in general, small and able to make only incremental upgrades of their product and process technology. Most TAAC clients have aimed to move one step ahead technologically. However, sporadic incremental improvements without a longer-term perspective will not encourage the firm to keep upgrading technology. In assisting with the development of a strategic plan, the TAAC will help its clients to create a climate in which continual change is expected and improvement is planned.

2. The Trade Adjustment Assistance program should assist trade-injured firms before that injury becomes acute.

By the time most firms become eligible for trade adjustment assistance, their needs are immediate. The firms must have

demonstrated that imports have increased while either sales or production have decreased and there is an actual or threatened decline in employment. From a firm's initial application to the receipt of assistance in implementing an adjustment strategy, up to a year is likely to have passed. As a result of the tendency of firms to apply for trade adjustment assistance only when their need is acute, the TAA program serves primarily severely troubled firms.

The scope of work for TAACs authorizes them "to assist trade-impacted and potentially trade-impacted firms. . . ." Firms that are relatively healthy but either are in industries beginning to have trade problems or are the strongest firms in industries already hit hard by foreign competition can receive assistance in submitting a petition. Unless they meet the eligibility criteria, however, they will not be certified for further assistance. We believe that it is important for the long-term health of the U.S. industrial base to assist trade-injured firms that do not yet meet all the eligibility criteria--not only in preparing a petition, but also in diagnosing their needs and implementing strategies--before their need is acute.

Two strategies, both of which would require a change in legislation, could make it possible to offer quick assistance to firms that are beginning to face injury from imports. First, if an industry meets the eligibility criteria for trade adjustment assistance, any firm in that industry should also be considered eligible for technical assistance. Under the program's legislative mandate, industry assistance projects are intended to be applicable and disseminated to all firms within a trade-injured industry. Extending this recommendation to give individual assistance to any firm in a trade-injured industry, however, would require new legislation. A second strategy is to change criteria for certification to include early signs of problems, such as declining sales over a period of months (not necessarily lower employment) or a history of the need to reduce prices to maintain sales, combined with an increase in imports.

3. TAACs should follow up the results of client engagements 12 months and 24 months after the adjustment strategy has been implemented.

The lack of follow-up to adjustment strategies has three serious consequences: (1) TAAC directors perceive that they are currently evaluated by the number and diversity of clients. In keeping with the program's goal of improving the competitiveness of import-injured firms, TAACs should be rewarded for effective assistance, which cannot be determined without some follow-up. (2) If successful strategies are known, they can be transferred to other clients with similar characteristics, enabling the program to make more efficient use of its resources. (3) Benefits of the program are currently obscured by the lack of follow-up; documenting the benefits of trade adjustment assistance should head off the program's critics and reduce the uncertainties that interfere with program efficiency.

Follow-up can and should be done inexpensively. Each TAAC can require its clients, as a condition of receiving assistance, to submit a one-page follow-up report. A succinct statement of the initial problem, the approach, accomplishments from the recommended strategies, and any continuing problems should convey the essence of successful strategies without imposing burdensome writing requirements. OTAA should find a way to recognize and reward TAACs for achievements in product and process technology.

OTAA CHANGES TO IMPROVE ASSISTANCE TO FIRMS

4. The Office of Trade Adjustment Assistance should authorize TAACs to carry out recommendations 1-3 and should reward them for doing so.

As "cooperators" with the Office of Trade Adjustment Assistance, TAACs will do what they are rewarded for. Therefore, OTAA should take responsibility to see that recommendations 1-3 are carried out. Specifically, OTAA should (1) require that a business plan including a manufacturing plan be the basis of every firm's adjustment strategy, (2) design a one-page form for follow-up and require that TAACs use it and send completed forms to OTAA, and (3) reward the TAACs that contribute to the long-term competitiveness of a company.

5. OTAA should use political leaders to advise firms of their eligibility for trade adjustment assistance.

A firm's early awareness that it faces the threat of increased foreign competition may prompt it to take preventive action sooner. Notice that individual companies in an industry are eligible for trade adjustment assistance (via correspondence jointly signed by executive and legislative branch leaders and addressed personally to the chief executive officer) can call attention to the potential competitive problem and to the government's interest in seeing that the problem is overcome. This approach will make more organizations in need of assistance aware of the program and help to distribute the program's resources where needed.

OTAA should use its list of currently or about-to-be trade-injured industries as the basis for compiling as exhaustive a list as possible of chief executive officers of firms in those industries. It can then sort those names by congressional district and provide a suggested joint letter from those Congressmen and the Secretary of Commerce explaining the intent of the Trade Adjustment Assistance program and the fact that the firm might be eligible for assistance.

6. The Office of Trade Adjustment Assistance should transfer information about practices that are effective for one TAAC to other TAACs.

The committee found on its visits to Trade Adjustment Assistance Centers a number of practices that, if transferred, could raise the effectiveness of all TAACs. These practices, principally staffing and administrative procedures, are recommended for all TAACs. They should improve the manufacturing technology assistance given but not detract from other responsibilities of the TAAC. All TAACs will find that they follow some of these practices, and a few follow most of them, but no TAAC has all the characteristics summarized as follows:

a. Whether the most frequent assistance offered is technological or otherwise, each TAAC needs staff with a solid foundation in financial analysis, sales analysis, and general business. The selection of TAAC directors has very appropriately reflected this emphasis; this should continue.

b. At least one staff member of each TAAC should have the broad manufacturing experience necessary to make informed judgments about the clients' needs for technological assistance and about appropriate selections of consultants. An industry retiree is one good possibility; there are obviously others. This in-house knowledge is so important that it should be a requirement imposed by OTAA.

c. The high turnover rate of TAAC staff in the past is cause for concern. Suggestions to increase the attractiveness of TAAC employment to people knowledgeable in manufacturing are greater stability in funding and encouragement of TAAC staff, particularly those with manufacturing technology experience, to attend seminars and trade shows (where equipment and systems are demonstrated) to keep current with technological developments that might be helpful to their clients. Attendance at seminars and trade shows should be included in the TAACs' quarterly reports, and OTAA should encourage such behavior. Where OTAA has a choice in locating a TAAC, it should consider that access to technological information is greater at university-based TAACs.

d. Each TAAC should take full advantage of opportunities to make the availability of its services known, notwithstanding the proscription against advertising for clients. Sources of successful "publicity" include articles and letters to the editor in newspapers and periodicals, mailings by congressmen and state legislators, and presentations at meetings and colloquia. TAACs are motivated to pursue all legitimate avenues of publicity in order to increase their case loads and income. It only remains for OTAA to spread information about successful approaches.

e. TAACs have individual approaches to the diagnostic survey, ranging from detailed forms to general forms to less structured approaches. The use of a detailed checklist of things to look for that relate to a specific industry seems to lead to more accurate diagnoses. This checklist should have the level of detail of the

factory walk-through described in the Appendix of this report. OTAA should collect the industry-specific diagnostic forms used by TAACs and require that the best of those be used.

BETTER OTAA ASSISTANCE TO INDUSTRIES

7. OTAA should assist trade-injured industries to develop comparative data on the costs and state of technology of individual manufacturing operations.

The OTAA has a unique ability to work at the level of an entire industry to help respond to international competitive issues. One particularly useful activity is to help firms in an industry recognize their relative position in that industry.

The footwear and food industry initiatives described in Chapter 2 are more broadly applicable. In response to OTAA's request that the committee suggest strategies that could have a "major effect on the future delivery of manufacturing technology assistance to industries," we recommend that OTAA use the approach of helping them collect comparative operating costs and manufacturing process standards so that member firms may identify areas that they need to improve. In addition, we recommend that OTAA play an active role in stimulating information exchange throughout the assisted industry. The footwear and food warehousing programs were helpful to their respective industries precisely because, through these efforts, information on manufacturing process technology could be rapidly transmitted to the constituent firms.

The effort to collect these data will require a high degree of cooperation in the industry, which is likely to be found only in manufacturing industries that are seriously troubled. Nevertheless, the concept of costing out different functions of the manufacturing enterprise and making inter-company comparisons across an entire industry can be helpful in stimulating firms to adopt more efficient manufacturing processes. Conducting the surveys and disseminating the results is an excellent organizational vehicle for promoting a more widespread and swift adoption of the state of the art.

8. OTAA should consider expanding its role to include an early warning mechanism, using data currently available from the Department of Commerce.

Had the firms that have received trade adjustment assistance been warned before their foreign competitors gained a strong market share, they might have been able to prevent the problem rather than having to regain the market shares they have lost. Similarly, some firms and industries that appear healthy now will soon face strong competitive threats from overseas.

For example, original equipment manufacturers (OEMs) can be an early indicator of potential problems. When an OEM is lost to foreign

competition, U.S. industry loses access to the innovation that OEM provides. As part of its early warning, OTAA should monitor OEMs constantly.

The Trade Adjustment Assistance program could be a vital force for regaining U.S. competitive strength. With increased funding for this function, the Office of Trade Adjustment Assistance could play a new two-part role: (1) monitor international developments, identify industries likely to be trade injured, and contact the appropriate industry associations; and (2) offer adjustment assistance to those contacted industries, and firms in those industries, that are interested.

9. To increase the effectiveness of the Trade Adjustment Assistance program, its funding and continued existence should be more certain.

The uncertainty of continued funding for trade adjustment assistance during the past five years has caused program resources to be spent other than on assisting clients. Shutting down TAACs for lack of funds, then reopening them when the program's funding is restored, is not productive use of resources--time as well as money. The program lacks political credibility because of erroneous assumptions that the program helps only dying companies and that it is not doing any good. Documenting results (Recommendation 3) would identify adjustment strategies worth transferring and would also clarify the program's accomplishments. The program has the elements of legitimate federal government support to individual U.S. firms and industries that are threatened by foreign competition.

A LARGER ROLE FOR TRADE ADJUSTMENT ASSISTANCE

10. Require a trade adjustment strategy as a condition for an industry to receive trade protection.

The past use of the Trade Adjustment Assistance Program to forestall protectionist policies is becoming less feasible because so many industries are now threatened by imports. At the time of this writing, Congress is considering more than 50 bills that offer protection to some segment of U.S. industry. If protection becomes the will of the nation, the Administration can approach it in one of two ways: accept protection or require that industries institute self-help programs as the quid pro quo for protection.

This committee strongly supports the quid pro quo requirement if protection is to be granted. Protectionist policies not only mean higher prices for consumers but also antagonize international trading partners. These consequences are palatable only if they are treated as a temporary condition and steps are taken to mitigate the need for them in the future.

There is a precedent in the Trade Adjustment Assistance program for the combination of trade adjustment assistance with protectionist measures. After the International Trade Commission recommended protection for the footwear industry in 1976, the Carter Administration granted weak protection in combination with a much enlarged trade adjustment assistance effort. While this approach has not solved all the problems of the footwear industry, it has caused a number of good things that would not have happened otherwise: joint research in the industry, several firms that have successfully targeted niches, and competitive prices for the consumer.

If the Administration wanted to integrate its response to the present demand for protection, the related need for firm and industry trade adjustment assistance would be far greater than the present Trade Adjustment Assistance program can handle. OTAA has experience relevant to such a role, but at present it has neither the mandate nor the resources to carry it out. It would need to add experts in product, process, and marketing technology for the industries that need assistance.

The Department of Commerce's Trade Adjustment Assistance program, like many other federal programs with multiple objectives, has its supporters and detractors. Trade adjustment assistance, within its limited mandate, has helped a number of firms and industries. However, the potential good that could be done if the concept were tied to a greater purpose--that is, mitigating the drawbacks of trade protection--is much larger.

Appendix
THE FACTORY WALK-THROUGH

The factory walk-through, which can be accomplished in a few hours with a detailed checklist, is a critical part of the second approach to diagnosing a firm's problems and is designed to evaluate the overall condition of the facility, equipment, control systems, and management of human resources in a manufacturing company. The checklist approach assumes that the evaluator has previous experience in manufacturing and is accustomed to seeing factories. In addition, the evaluator should be accompanied by someone who can answer questions. Comments by someone familiar with the plant are as important as what is viewed on a factory walk-through.

The walk-through process evaluates six separate areas. When summarized, they should give insights into the plant's overall condition and its ability to compete. Walk-throughs also point out areas for rapid improvement, as well as areas that require longer-term remediation.

The six separate areas, discussed in detail below, are:

- condition of the facility and offices,
- material flows and condition of the equipment,
- amount, age, and condition of inventory,
- effectiveness of layout,
- work effort, and
- attitude of employees.

CONDITION OF THE FACILITY AND OFFICES

The evaluator begins his observations while approaching the plant site. If the exterior is run down, the equipment inside will likely be equally run down. The evaluator should look at:

a. Parking lot(s): Are they conveniently located, with easy access to the factory? Are they paved? Are there drainage problems? How good is the lighting?

b. Exterior grounds: Are there weeds, grassy areas, trash? What is the overall level of maintenance?

Upon entering the building and beginning the tour, the evaluator should look for settlement cracks, condition of caulking and paint, existence of water stains or broken windows, unrepaired damage, daylight through the roof or obvious leaks, and other signs of neglect. The evaluator should continue to look for similar signs of neglect as he walks through the plant.

The evaluation of interior facilities begins with the plant's administrative office. These are some of the areas that should be checked:

a. General condition: What is the overall level of cleanliness and maintenance? Check lighting and floor condition.

b. Office equipment: Age, type, and condition of all equipment. Does the business have word processors, personal computers, and/or main-frame computers? If so, how old are they; what kind are they; and what software is being used on them?

c. General office layout: Flow, orderliness, degree of crowding, size, light level.

The evaluator should then subjectively view the ornateness and level of decoration of managerial offices. Are they out of proportion to the size and current performance of the business? How large is the staff compared to the size of the business and plant? As he tours the office, the evaluator should be absorbing a general impression of the efficiency and work pace.

MATERIAL FLOWS AND CONDITION OF THE EQUIPMENT

The factory tour begins at the receiving area, in order to observe how material flows through the shop. Starting at the receiving dock, these are some of the items the team should be looking at:

a. Type and number of docks and how they are equipped;

b. Types and timeliness of controls on material as received;

c. Type, age, and condition of material handling devices (such as forklifts);

After checking the dock, the evaluator should look at raw material storage areas. Are materials, cartons, and accessories kept in an orderly fashion? Are they accessible? How old are the materials? How is valuable material stored, received, and managed? What process is used in moving material out (such as FIFO); who has access to the area; and how often is inventory verified?

The team should then move into the manufacturing area, reviewing type of production machines being used, their ages, and types of controls (manual, digital, computer). Careful attention should be paid to the status of maintenance, for example, looking for oil leaks, leaking seals, obvious vibration, pulled conduit, frayed hoses, and accumulation of chips, dirt, grime. The evaluator should also look for signs of creativity, such as unique fixturing, automatic gauging, automatic materials handling, or robotics.

Are there method and process sheets and quality control plans? Are they up to date and is plotted information current? What does the operator do when something goes out of control? Where does he put scrap and rework? How much rework does he get and why?

The evaluator should look under and behind the machines. Is there a clutter of odds and ends of materials, hand tools, broken pieces, chips, oil/grease, scraps of paper? Are there inoperative machines on which are stacked miscellaneous containers, cartons, spare bits of material? Are there tote pans or racks of work-in-process that seem to be set aside, temporarily waiting for something? How much work is waiting at work stations? This evaluation must be repeated for all operations in the plant to get an overall impression.

At the end of the factory tour, the team should examine the area where scrap is accumulated to see how it is handled, how much there is, and what is included. How good the records of scrap are indicates how much the company knows about what may be causing problems.

FINISHED INVENTORY

The inspection then moves to review finished inventory. The evaluator should determine how much is there, how it got there, how long it has been there, and how it is controlled. How many times has inventory turned over in the past year and has that number increased or decreased from the year before? He may want to review records to see how accurate and up-to-date they are; check the condition of items and packing cartons; and observe methods of handling and storage. He should also determine how far it is from storage to point of shipment and how finished inventory is transported.

LAYOUT

As the evaluator walks through the factory, he should note the effectiveness of work place layout. Is there a lot of walking, stooping, bending, or standing on tiptoe? Or do motion patterns seem compact, well organized, and efficient? Are tools close by or remote? Where are raw materials for the next items located? How far away are containers of fasteners or subassemblies? Where is the next operation--three feet away or in the next building? For a thorough analysis of the business' problems, the team will need to gain an overall impression of whether the flow and layout have been designed for efficient work.

WORK EFFORT

Concurrent with the factory tour is the evaluation of work effort, which is designed to answer two questions:

1. What percent of the people one sees are working?
2. Of those working, how hard are they working?

As the evaluators walk through the plant, they should be looking ahead to estimate the number of people who appear to be working as a percent of the total they see. Are groups of people standing around but break up as they see the evaluation team approach? Do individual operators appear to be working, or are they standing and waiting by a conveyor or a machine? What is a rough estimate of each operator's percent of time working compared to waiting?

ATTITUDE OF EMPLOYEES

The final item that will be evaluated is the attitude of employees. While this cannot be measured with precision, especially on a brief tour, one can gain insights. For example, do the management staff accompanying the evaluation team call employees by name and speak to them, or do they seem to be strangers to the employees? Do employees greet the evaluators with a smile or do they avoid eye contact and keep their heads down? Will they speak when spoken to? How do they respond to questions? Are they able and willing to answer questions about their operation? What comments do the management people on the tour make about the employees during the walk-through: favorable, unfavorable, or no comments?

Questions asked of management along the route can yield revealing answers. How do you communicate with employees? Are your employees knowledgeable about your business and your competitive situation? Have you asked them for suggestions on how to improve operations?

After the evaluator has completed the tour and asked any wrap-up questions, he should record his impressions while they are fresh. We recommend a structured report in a form that mimics the sequence of the walk-through. An arbitrary scale of 1 to 10 can be used to rate the various areas that were considered and evaluated, with space available for non-quantitative comments as well. The resulting write-up should offer a clear, concise insight into the operation, highlighting what the firm does well and which areas need improvement.