United States General Accounting Office

GAO

Report to the Chairwoman
Subcommittee on Technology
Committee on Science
House of Representatives

March 1996

MANUFACTURING EXTENSION PROGRAMS

Manufacturers' Views About Delivery and Impact of Services

G A O
75 years
1921 - 1996

GAO/GGD-96-75

GAO

United States
General Accounting Office
Washington, D.C. 20548

General Government Division

B-261875

March 14, 1996

The Honorable Constance A. Morella
Chairwoman
Subcommittee on Technology
Committee on Science
House of Representatives

Dear Chairwoman Morella:

Manufacturing extension programs (MEP) offer manufacturers assistance in modernizing or upgrading their operations, often with state and federal funding. The National Institute of Standards and Technology (NIST) manages federal MEP funding through its Manufacturing Extension Partnership Program, also known as MEP. In this report, MEP collectively refer to all state, federal, and university manufacturing extension programs.

In the current climate of federal budget reductions, Congress is reevaluating its funding of MEP through NIST. One issue Congress is considering is whether MEP services have helped improve companies' business performance. This report responds to your request that we obtain manufacturers' views regarding the impact of MEP services on their business performance and the factors that affected the impact and delivery of MEP services.

To identify the impact of MEP services on manufacturers' business performance, we conducted a national survey of manufacturers who had received substantive services from MEP in 1993.[1] The survey asked manufacturers to assess the impact of MEP assistance on various aspects of their business performance. In our August 1995 briefing report to you,[2] we summarized the overall impact of MEP assistance on the business performance of manufacturers we surveyed, and presented the views of a number of companies that had not used MEP services. We reported that about 73 percent (or 389) of 535 respondents indicated that they believed MEP assistance had positively affected their overall business performance. About 15 percent (or 82) reported they believed MEP assistance had not

[1]We sent questionnaires to 766 manufacturers that had completed at least 40 hours of assistance from one of 57 MEP, in one or more of four service categories, in 1993. Thirteen of these MEP received NIST funding in fiscal year 1994. These 13 MEP accounted for 36 percent of the 551 total respondents to our survey. See app. II for details on our scope and methodology.

[2]Manufacturing Extension Programs: Manufacturers' Views of Services (GAO/GGD-95-216BR, Aug. 7, 1995).

affected their overall business performance.[3] In addition, most respondents reported that MEP assistance had positively affected their use of technology in the workplace (about 63 percent), the quality of their product (about 61 percent), and their customers' satisfaction (about 56 percent).[4] This report presents our conclusions from further analysis of our national survey results. These results cannot be generalized to all manufacturers that used MEP.

Our objectives for this report were to (1) identify factors that may have contributed to the positive impact on overall business performance reported by the majority of survey respondents; (2) determine whether companies' expectations were met regarding the impact of MEP assistance on specific business performance indicators, such as manufacturing time frames and labor productivity; and (3) determine whether companies thought that MEP actually demonstrated attributes they valued most, such as MEP staff expertise, timely assistance, and reasonably priced fees. We did not verify either positive or negative effects of MEP assistance reported by manufacturers, and we did not evaluate the operations or management of specific federal or state programs.

Background

The primary mission of MEP is to give "hands-on" technical assistance to small- and medium-sized manufacturers[5] trying to improve their operations through the use of appropriate technologies. MEP engage in a variety of activities to assist small- and medium-sized manufacturers, often in partnership with other business assistance providers such as Small Business Development Centers, community colleges, and federal laboratories. MEP offer a wide range of business services, including helping companies (1) solve individual manufacturing problems, (2) obtain training for their workers, (3) create marketing plans, and (4) upgrade their equipment and computers. MEP assistance focuses on small- and medium-sized manufacturers because research by the National Research Council and others has indicated that these companies lack the resources necessary to improve their manufacturing performance.

[3]In addition, approximately 8 percent (or 41) said it was too early to tell the effect, and another 4 percent (or 22) said they had no basis to estimate the effect. One respondent reported a generally negative effect on business performance.

[4]About 2 percent, or fewer, respondents reported a negative impact on any specific business performance indicator.

[5]The Small Business Administration generally defines a small business as having fewer than 500 employees. Some experts have further divided small manufacturers into small firms with fewer than 100 employees and medium-sized firms with from 100 to 499 employees. This report collectively refers to firms with fewer than 500 employees as small- and medium-sized manufacturers.

MEP funding typically comes from a variety of sources, which may include federal and state government agencies, universities, private industry, and fees. Between fiscal years 1988 and 1994 Congress appropriated a total of $141.7 million (in 1994 dollars) to MEP through NIST.[6] Fiscal year 1995 appropriations were $104 million. State or local agencies are to provide matching funds for NIST grants to individual MEP. A 1995 Battelle Memorial Institute report[7] estimated that states collectively spent about $57.7 million specifically on MEP in fiscal year 1994. That same fiscal year, federal MEP spending was $66 million. We were not able to determine the amount of MEP funding from other sources of support, including universities, private industry, and users' fees.

Results in Brief

The responses to our survey showed that the level of companies' involvement with MEP assistance had an important influence on companies' assessment of the outcome of this assistance. Specifically, the companies that supplemented MEP assistance with their own resources, such as additional financial investments, were more likely to report that it affected their business performance positively. We also found that company size was a significant factor. The relatively small companies (those with fiscal year 1994 gross sales of less than $1 million), and the relatively new companies (those started since 1985), were most likely to report that their overall business performance was boosted by MEP assistance. MEP funded by NIST had the same likelihood as other MEP of receiving positive assessments of their impact on the companies' overall business performance.

Most of the companies that expected MEP assistance to help improve specific areas of their business performance reported that the results "met" or "exceeded" their expectations. About 75 percent of the companies that received equipment modernization and plant layout assistance reported that their expectations were met or exceeded for improvements to production time frames. Among the companies that received product design and development assistance, large numbers reported an increase in the number of completed product development projects (77 percent) and improved research quality (71 percent) that matched or surpassed their expectations. Of the companies that received

[6]NIST has allocated MEP funds from its budget as well as from the Technology Reinvestment Project (TRP) under the Advanced Research Projects Agency. Manufacturing Extension Programs (GAO/GGD-95-124R, Mar. 24, 1995) lists NIST and TRP MEP funding for fiscal years 1994 and 1995.

[7]Partnerships: A Compendium of State and Federal Cooperative Technology Programs, ed. C. M. Coburn (Columbus, OH: Battelle Memorial Institute, 1995).

quality improvement assistance, large proportions experienced fulfilled expectations regarding increased sales to new (69 percent) and repeat (74 percent) customers. However, not all of the companies reported that their expectations were met. Between 23 and 39 percent of the companies reported that their expectations were not met for improvements to specific business performance indicators.

In general, the companies we surveyed reported that MEP demonstrated attributes that were most important to them. Over 90 percent of the companies rated staff expertise, timely assistance, and reasonably priced MEP service fees and project proposals as important attributes for any MEP to exhibit. Most respondents also said they were satisfied with the staff expertise (88 percent) and timeliness of assistance (83 percent) provided by the specific program they had used. Also, many respondents were satisfied with the fees (80 percent) and project proposal costs (81 percent) of the specific program they had used.

Scope and Methodology

This report analyzes data from questionnaires we sent to 766 manufacturers that had completed at least 40 hours of MEP assistance in 1993 in one or more of four service categories.[8] We obtained the names of these manufacturers from the directors of 57 MEP in 34 states. A total of 551 manufacturers (72 percent) completed and returned the questionnaire. We also interviewed eight manufacturers who had received MEP services and were given tours of their manufacturing facilities in Maryland, Georgia, North Carolina, and South Carolina. Appendix II provides more details on our scope and methodology.

In assessing the impact of MEP services on their companies' overall business performance, 13 percent of survey respondents reported an extremely positive impact, 59 percent reported a generally positive impact, and 15 percent reported no impact. (Less than 1 percent of respondents (0.2 percent) said the assistance had had a negative impact.) We analyzed the likelihood of the companies reporting that the impact of MEP assistance on their overall business performance was extremely positive, somewhat positive, or not positive, depending on various company and program characteristics identified through the survey. We analyzed how the reported impact of MEP assistance related to the companies' reported age, 1994 gross sales, and number of permanent employees. Also, we analyzed the reported impact of MEP assistance in relation to the companies'

[8]The four service categories were (1) quality improvement, (2) equipment modernization and plant layout, (3) product design and development, and (4) environmental or energy.

activities associated with the assistance—whether they made financial investments, spent staff time, implemented recommendations, and paid for the assistance. In addition, we analyzed how the reported impact of MEP assistance varied according to whether programs received NIST funds.

We used logistic regression techniques to determine which factors were statistically significant in predicting the reported impact of MEP assistance on companies' overall business performance. The strength of these particular statistical techniques is that they allowed us to estimate the individual influence of each factor on the reported impact, both before and after the influences of all other relevant factors identified in the survey were controlled. Appendix III provides more detailed information on our methodology, the models tested, and the results obtained.

We used simple frequency distributions to determine whether the companies' expectations were met regarding the impact of MEP assistance on specific business performance indicators and to analyze whether MEP demonstrated the attributes most valued by the companies.

Results from our work cannot be generalized to all companies that used MEP because our questionnaire covered only companies that had completed at least 40 hours of MEP assistance. In addition, our results do not apply to all MEP services because we limited our analysis to four MEP service categories.

Since we did not evaluate the operations or management of specific federal programs, we did not obtain agency comments on this report. However, on February 12, 1996, we discussed a draft of this report with NIST officials, including the Director of the NIST Manufacturing Extension Partnership Program. He agreed with the technical accuracy of the report and offered minor clarifications, which we incorporated into the report where appropriate.

We did our work primarily in Los Angeles, New York, San Francisco, and Washington, D.C., from February 1995 to January 1996 in accordance with generally accepted government auditing standards.

Factors That Influenced the Impact of MEP Assistance on Companies' Overall Business Performance

We analyzed several factors related to company and program funding characteristics to determine whether they influenced the companies' assessment of the impact of MEP assistance on their overall business performance. We found that several company characteristics—relating to company level of involvement with MEP assistance, and company size and age—influenced the companies' assessment of the impact of MEP assistance on their overall business performance. However, the program funding characteristic we examined—whether the program received NIST funds—did not influence the companies' assessment of the impact of MEP assistance.

We found that the level of companies' involvement played an important role in determining the outcome of MEP assistance. The manufacturers that had made financial investments in their company as a result of MEP assistance were 2.5 times more likely than those that did not to report an "extremely positive" impact on their overall business performance, as opposed to a "generally positive" impact. They also were 5.6 times as likely to report a generally positive impact as opposed to a "neutral" or "negative" impact. Companies whose staff spent relatively more time in activities related to MEP assistance were 1.7 times more likely to report an extremely positive impact of MEP assistance on their overall business performance, as opposed to a generally positive impact.[9]

Furthermore, the relatively small companies, which research has indicated are most in need of modernization assistance, were most likely to report that their overall business performance was improved by MEP assistance. According to the National Research Council, small- and medium-sized manufacturers generally lack the expertise, time, money, and information necessary to improve their manufacturing performance.[10] We found through our survey that the companies whose fiscal year 1994 gross sales were less than $1 million were 3.1 times more likely to assess the impact of MEP assistance as extremely positive, as opposed to generally positive. Likewise, the companies started since 1985 were 2.0 times as likely as the

[9]Our analysis also indicated that the percentage of recommendations implemented by companies may have influenced their rating of the impact of MEP assistance. When we considered the effect of this factor without controlling for the influence of other factors, we found that firms which implemented relatively more recommendations than others were 5.7 times more likely to assess the impact of MEP assistance extremely positively, rather than generally positively, and 5.2 times more likely to assess the impact generally positively, rather than not positively. However, we were not able to analyze the effect of implementing recommendations in our analysis that controlled for the influence of other factors because there were too few responses to perform this analysis. Only 70 percent of the companies surveyed received recommendations and provided information on the percentage of recommendations implemented.

[10]Learning to Change: Opportunities to Improve the Performance of Smaller Manufacturers, National Research Council (Washington, D.C.: National Academy Press, 1993).

older companies to report an extremely positive effect of MEP assistance on their overall business performance, as opposed to a generally positive effect.

Our visits to manufacturers provided examples of how MEP assistance benefited growing companies. A furniture manufacturer said his company needed MEP assistance to make fewer mistakes in the growth process. This manufacturer said he used MEP experts to help identify and correct environmental and worker safety hazards, so the facility would comply with federal workplace standards. At a company that makes molded plastics, the company president said that the company needed MEP assistance to guide its rapid growth. MEP helped this company with strategic management, planning, worker training, and quality improvement.

Our survey revealed no significant differences in how the companies viewed the impact on their overall business performance of MEP that did and did not receive NIST funds. MEP funding typically comes from a variety of sources, which may include federal and state government agencies, universities, industries, and fees.[11] The combination of funding sources varies across programs, but our analysis revealed no significant distinction in how the companies assessed the impact of MEP that did and did not receive NIST funds. Specifically, MEP that received NIST funds were equally as likely as other MEP to have their impact on business performance rated positively by the companies. In commenting on our analysis, NIST officials said that, given the manufacturers' positive responses to our survey, they expected no difference in how the manufacturers viewed the impact of MEP that did and did not receive NIST funds. Moreover, they said that the function of NIST funding is to help MEP serve more clients, with a wider variety of services. Also, they said that they believed NIST support improves programs' efficiency and effectiveness, which are dimensions of MEP that our survey did not address.

[11]Whether the companies paid for MEP assistance did affect their rating of its impact. The companies that paid fees for MEP assistance were half as likely as those that paid no fees to credit the assistance for having an extremely positive impact, as opposed to generally positive impact, on their business performance.

Improvements to Specific Business Performance Indicators Met Most Companies' Expectations

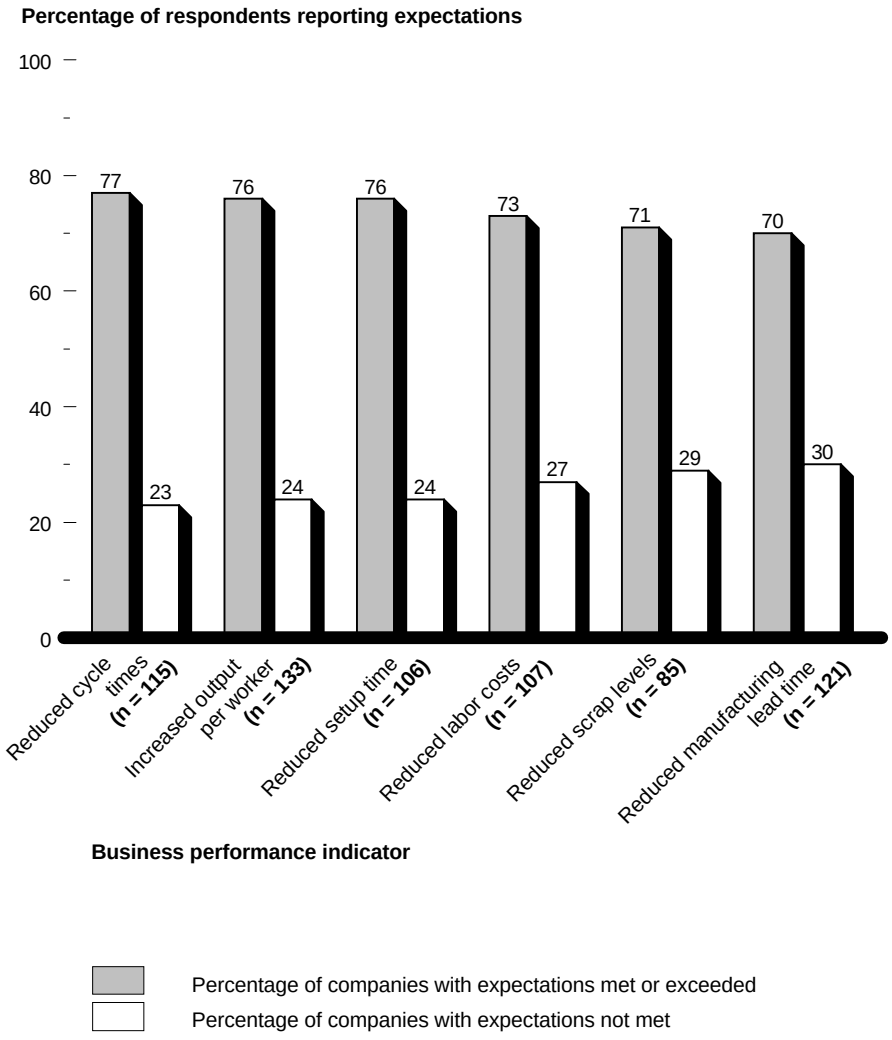
As part of our analysis, we compared what the companies said they expected from MEP assistance to the results they reported.[12] We found that most of the companies (between 61 and 77 percent) reported that MEP assistance met or exceeded their expectations for improvements to specific business performance indicators, such as manufacturing time frames, the quality of market research, and sales to new and repeat customers. However, between 23 and 39 percent of the companies reported that their expectations were not met for improvements to these indicators.[13]

Our survey results indicate that equipment modernization and plant layout assistance improved manufacturing time frames for most of the companies expecting these improvements (see fig. 1). In particular, the survey results indicate that equipment modernization and plant layout assistance met or exceeded the expectations of a substantial number of the companies for reducing cycle times—the times required by machines or work stations to fully complete their sequence of operations (77 percent)—and setup time—the time it takes to prepare equipment for changes to production (76 percent). In addition, the assistance met a large number of the companies' expectations for improvements to worker output (76 percent). However, about 30 percent of companies we surveyed that received equipment modernization and plant layout assistance reported that they did not have their expectations met for reductions to manufacturing lead time, the time it took them to process an order, from start to finish, after design approval.

[12]In this section, we do not report the results of our analysis of the environmental or energy assessment survey because we received too few responses to conduct the analysis.

[13]Our analysis also shows that most companies (an average of 87 percent) that expected the assistance they received to have no effect on a business indicator had their expectations met. However, for some of these companies, MEP assistance had unanticipated positive effects. For example, 23 percent of companies that did not expect equipment and plant layout assistance to change production time frames found that the assistance actually helped reduce them.

Figure 1: Equipment Modernization and Plant Layout Assistance Indicators



Note: Companies that had expectations for no improvement, or were unable to report the actual effect of the assistance, are not included.

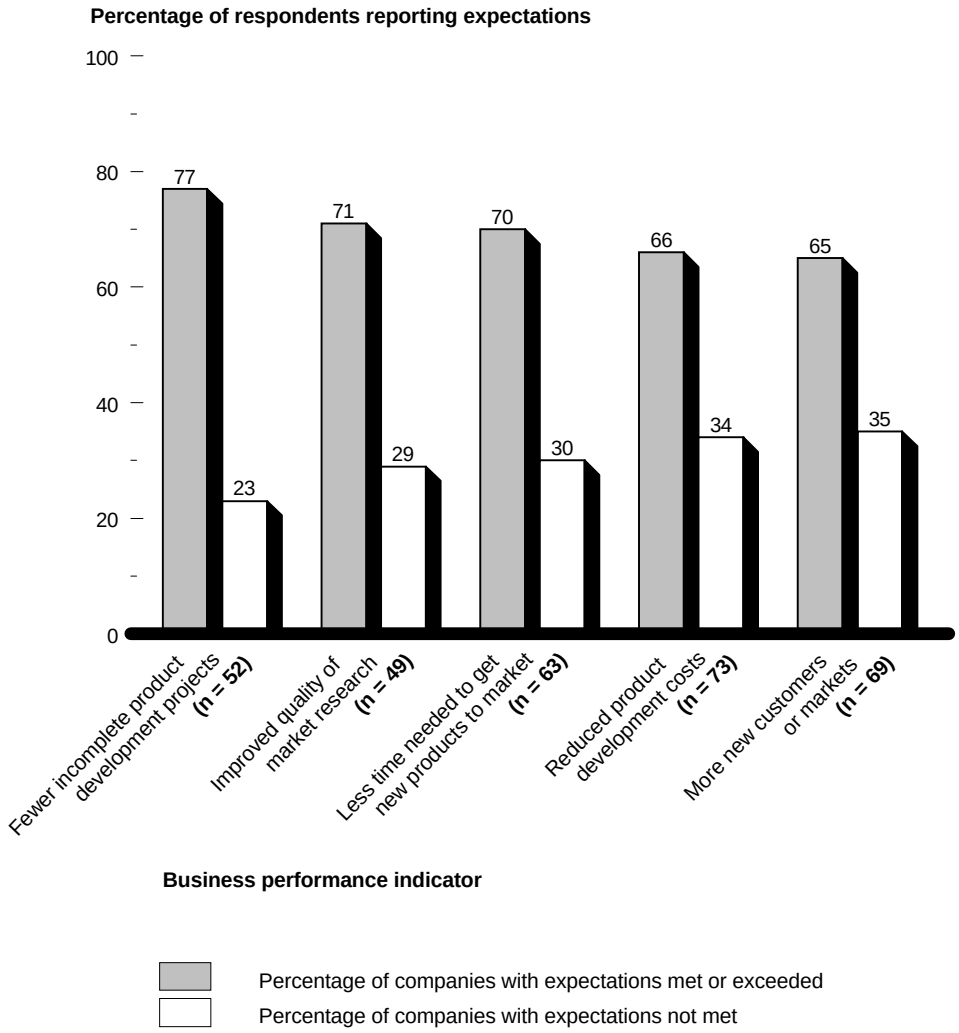
Source: GAO questionnaire.

Several companies commented on how MEP assistance affected their efforts to improve plant layout and modernize equipment. One

manufacturer that we visited said the company was able to solve problems with congestion and redundant product movement on the plant floor after implementing MEP plant layout recommendations. The company was rewarded with faster production and lower costs. Another manufacturer responding to our survey commented that, by modernizing equipment and improving plant layout, the company was better able to meet its delivery schedules and, thus, satisfy its customers' needs.

Most of the companies that received product design and development assistance reported in our survey that they achieved anticipated improvements to quality (see fig. 2). In particular, large proportions of these companies reported fewer incomplete product development projects (77 percent) and improved quality of market research (71 percent). Most of the comments we received regarding product design and development assistance were positive. For example, one respondent commented that the assistance it received made it possible for the company to develop a process that it could not have developed on its own. However, not all companies shared such views. One respondent wrote that it took too much management time to work with MEP consultants, and he felt that the company had educated the consultants, and not vice versa.

Figure 2: Product Design and Development Assistance Indicators



Note: Companies that had expectations for no improvement, or were unable to report the actual effect of the assistance, are not included.

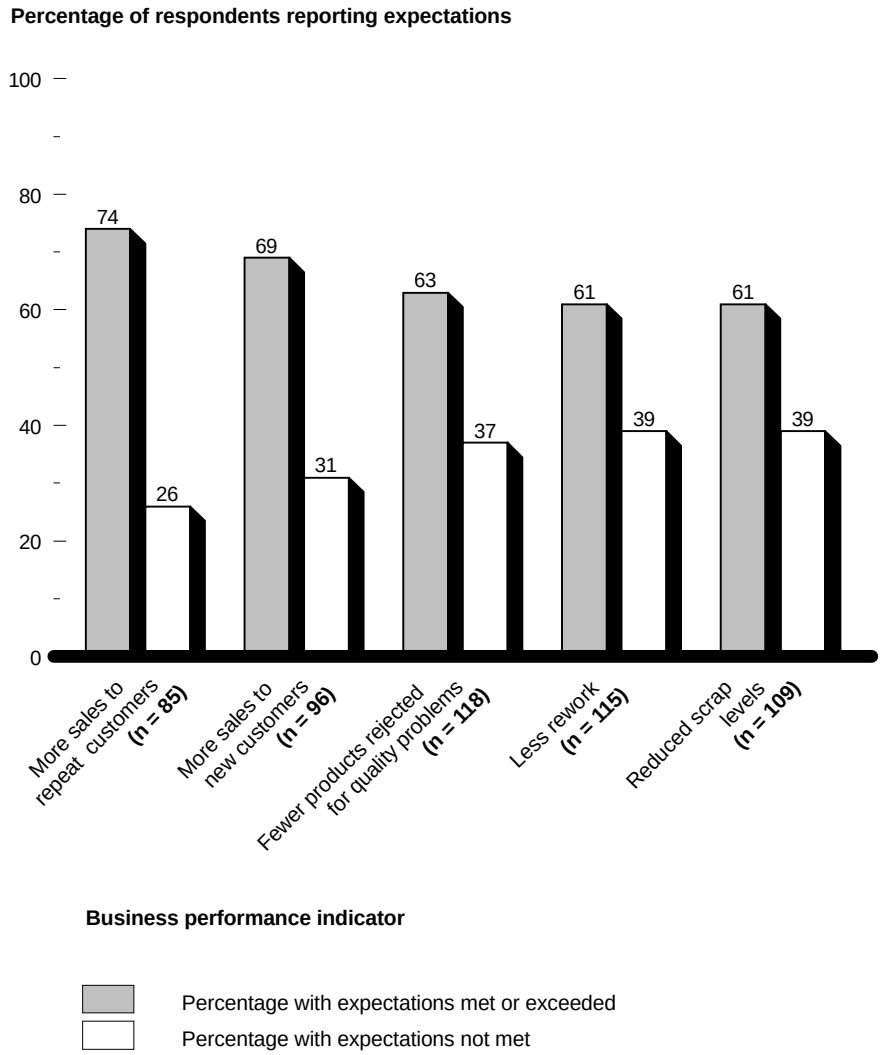
Source: GAO questionnaire.

Our survey also indicated that most companies' expectations for reduced product design and development time frames were satisfied. Seventy

percent of the companies reported they received anticipated reductions in the time needed to get new products to market. One survey respondent commented about the importance of MEP assistance in getting a new product to market, noting that the assistance helped the company to overcome equipment problems, which freed the company to market new machine technology. Despite positive assessments such as these, our survey results show that product design and development assistance met fewer of the companies' expectations for reducing costs of product development (66 percent) and increasing access to new customers (65 percent), compared to other business performance indicators.

Between 61 and 74 percent of the companies we surveyed that expected quality improvement assistance to bolster specific business performance indicators were satisfied with the results they received (see fig. 3). A substantial percentage of the companies had their expectations fulfilled regarding increased sales to repeat customers (74 percent) and new customers (69 percent). However, our results indicate that, for 39 percent of the companies, quality improvement assistance did not meet expectations for reducing rework and scrap levels.

Figure 3: Quality Improvement Assistance Indicators



Note: Companies that had expectations for no improvement, or were unable to report the actual effect of the assistance, are not included.

Source: GAO questionnaire.

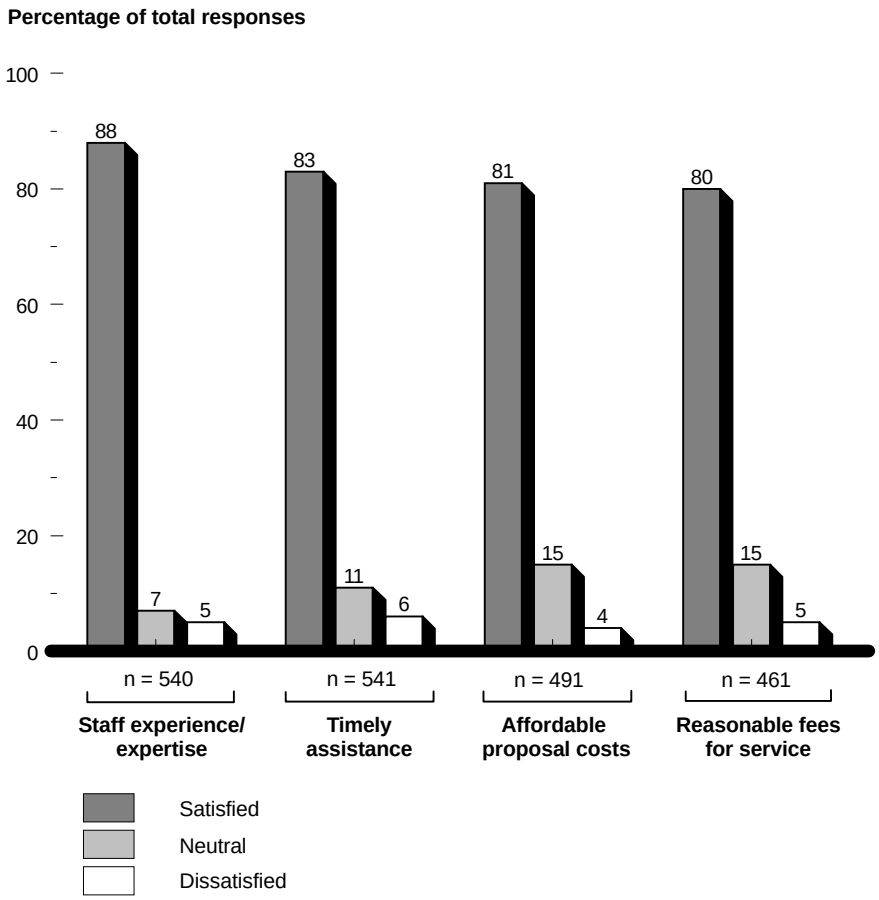
Customer satisfaction was an important goal of the companies seeking quality improvement assistance. Ninety-four percent of the companies we

surveyed regarding quality improvement assistance said they sought the assistance in order to enhance their competitive position in the marketplace. In interviews, several manufacturers told us that they undertook quality improvement initiatives in order to retain and attract customers. They said that an increasing number of customers had high expectations for the quality of products. For example, at a foundry we visited, the company president said that many customers of foundry products were reducing the number of suppliers and were working on a closer, more long-term basis with the remaining suppliers. He said that this new customer-supplier relationship put more emphasis on quality than ever before and that it was extremely important to guarantee quality in order to retain customers. Another survey respondent said that the company was "forced" to comply with a quality assurance program by its customers, even though customers rejected virtually none of its products.

MEP Had Features Companies Valued

Most of the companies that responded to our survey were satisfied with the service delivery features of the program they used. The companies ranked MEP staff expertise, timeliness, and affordability as the features most important to them. A majority of the companies (80 percent or more) also responded that they were satisfied that their program demonstrated each of the service delivery features they deemed important (see fig. 4).

Figure 4: Companies' Satisfaction With MEP Service Delivery Features



Note: Ninety percent or more of survey respondents said that each of these service delivery features was important to them.

Source: GAO questionnaire.

About 93 percent of the companies responding to our survey rated staff expertise as an important attribute for MEP in general, and 88 percent of

respondents said they were satisfied with the expertise of the staff at the specific program they had used. In our visits to manufacturers, they cited several examples of how MEP staff expertise benefited their company.

- A manufacturer of heavy agricultural equipment said its three staff engineers were fully occupied solving day-to-day manufacturing problems, with no time to address the "big picture." The company used MEP experts to support company efforts to develop innovations to keep the company moving forward.
- A manufacturer of souvenir and collectible items was considering investing in over $600,000 worth of advanced production equipment. The manufacturer told us that MEP located a consultant who had the expertise to provide the company with an independent opinion about whether the equipment under consideration was appropriate for the company's needs.
- A hosiery mill had installed advanced knitting machines but continual machinery breakdowns had cut productivity by 70 percent. A senior company official told us that MEP brought experts in training, engineering, and human resources to help the company reverse this decline and benefit from the machinery upgrade.

Most respondents looking for timely and affordable assistance said they found it through MEP.[14] About 92 percent of the survey respondents rated timely assistance as an important MEP attribute, and 83 percent said they were satisfied with the timeliness of the assistance provided by the program they had used. Ninety-one percent of respondents rated reasonably priced MEP service fees and project proposals as important MEP attributes, and most were satisfied with the price of fees and proposals costs at their own program. Eighty percent of respondents who paid fees were satisfied that the fees were reasonable, and about 81 percent of respondents were satisfied that their program had project proposal costs within their financial means. Three hundred twenty-eight survey respondents (60 percent) paid a fee for MEP assistance. Of those, 58 percent said that the value added or worth of the assistance was worth more than what they paid for it, 27 percent said the assistance was worth about what they paid, and 11 percent said the assistance was worth less than the fee they had paid.[15]

[14]The percentages presented in this section include only the respondents who had an opinion.

[15]Four percent of respondents said they had no basis to judge the worth of MEP assistance.

As agreed with you, unless you announce the contents of this report earlier, we plan no further distribution until 14 days after the date of this letter. At that time, we will send copies to the Director of NIST, the Secretary of Commerce, and the Chairmen and Ranking Minority Members of congressional committees that have responsibilities related to these issues. Copies also will be made available to others upon request.

The major contributors to this report are listed in appendix IV. Please contact me at (202) 512-8984 if you have any questions concerning this report.

Sincerely yours,

JayEtta Z. Hecker, Associate Director
International Relations and Trade Issues

Contents

Letter 1

Appendix I Questionnaire With Aggregate Responses 20

Appendix II Objectives, Scope, and Methodology 43

Appendix III Technical Appendix: Loglinear and Logistic Methodologies and Analysis Results 49

Appendix IV Major Contributors to This Report 54

Table

Table III.1: Odds Ratios from Logistic Regression Analysis 50

Figures

Figure 1: Equipment Modernization and Plant Layout Assistance Indicators 9

Figure 2: Product Design and Development Assistance Indicators 11

Figure 3: Quality Improvement Assistance Indicators 13

Figure 4: Companies' Satisfaction with MEP Service Delivery Features 15

Abbreviations

MEP	Manufacturing extension programs
NIST	National Institute of Standards and Technology
TRP	Technology Reinvestment Project

Questionnaire With Aggregate Responses

U.S. General Accounting Office

Federal and State Manufacturing Extension Programs - Survey of Companies Receiving Assistance - (All Types of Assistance Combined)

INTRODUCTION

The U.S. General Accounting Office (GAO), an independent agency of Congress, is reviewing federal and state manufacturing extension programs. Congress has asked GAO to (1) determine how well these programs meet the needs of small and medium-sized companies, and (2) determine the impact these programs have on the performance of small and medium-sized companies.

As part of GAO's review, it is conducting this survey to obtain information on how services, such as quality improvement, provided by manufacturing extension programs affect company performance. The program identified on the label below only provided GAO with your company's name and address. It did not divulge any information about your company or details about the assistance provided.

Most of the questions in this survey can be answered easily by checking boxes or filling in blanks. A few questions require short narrative answers. Additional comments may be written at the end of the questionnaire.

Your responses will be kept confidential and will not be released outside GAO, unless compelled by law or required by Congress. While the results are generally provided in summary form, individual answers may be discussed in GAO's report, but **they will not identify individual companies**. It is also GAO policy not to identify names of individual employees of private sector organizations in GAO reports.

This questionnaire should take about 20 minutes to complete. If you have any questions, please call Ray Hendren at (916) 974-3341 or Amy Finkelstein at (213) 346-8077.

Please return the completed questionnaire in the enclosed preaddressed envelope within 10 days of receipt. In the event the envelope is misplaced, the return address is:

U.S. General Accounting Office
441 G Street, NW
Room 3B28
Washington, DC 20548
Attention: Stuart Kaufman

Thank you for your assistance.

The information on the label below identifies the manufacturing extension program, the year the assistance project was completed, and the field agent or affiliated consulting company who provided the service.

Label here

We define "facility" as the physical manufacturing plant that received assistance from the manufacturing extension program identified on the label on page 1. When responding to the following questions, please answer for that facility only.

A. Background Information

1. Please describe your facility's major product lines or activities. *(e.g., We stamp and weld steel parts.)*

_____

2. Please indicate the most appropriate SIC Code for your facility. *(Check only one.)*

N=547

Standard Industrial Classification (SIC) Codes:

- ☐ **20 - Food and kindred products** *(Manufacturing or processing foods and beverages for human consumption, and certain related products.)* 3.3%
- ☐ **23 - Apparel and other textile products** *(Producing clothing and fabricating products by cutting and sewing woven or knit textile fabrics and related materials.)* 2.2%
- ☐ **24 - Lumber and wood products, except furniture** *(Cutting timber and pulpwood; mills engaged in producing lumber and wood basic materials, etc.)* 2.0%
- ☐ **25 - Furniture and fixtures** *(Manufacturing household, office, public building, and restaurant furniture; and office and store fixtures.)* 3.5%
- ☐ **27 - Printing and publishing** *(Printing by one or more common processes, such as letterpress; and performing services for the printing trade, such as bookbinding.)* 3.1%
- ☐ **28 - Chemicals and allied products** *(Producing basic chemicals and manufacturing products by predominantly chemical processes.)* 4.2%
- ☐ **30 - Rubber and plastic products** *(Manufacturing products from plastics resins and from natural synthetic or reclaimed rubber.)* 10.6%
- ☐ **32 - Stone, clay, and glass products** *(Manufacturing glass products, cement, concrete, clay and gypsum products, abrasive and asbestos products, etc.)* 2.0%
- ☐ **34 - Fabricated metal products** *(Fabricating ferrous and nonferrous metal products, such as metal cans, tinware, handtools, cutlery, metal forgings, etc.)* 29.8%
- ☐ **35 - Industrial machinery and computer equipment** *(Manufacturing industrial and commercial machinery and equipment and computers.)* 14.6%
- ☐ **36 - Electronic and electrical equipment, except computers** *(Manufacturing machinery, apparatus, and supplies for the generation, storage, transmission, etc. of electrical energy.)* 9.7%
- ☐ **Other** - If you know it, please supply your 2 digit SIC code in the space below 7.5%

  SIC Code - ___ ___

- ☐ **I do not know the SIC code for my facility** 7.5%

3. How many permanent employees (including full-time and part-time) worked at your facility as of January 1, 1995? *(Check one.)* N=550

1. ☐ Less than 10 employees	7.5%
2. ☐ 10-19 employees	6.9%
3. ☐ 20-49 employees	20.4%
4. ☐ 50-99 employees	18.2%
5. ☐ 100-199 employees	20.5%
6. ☐ 200-299 employees	9.6%
7. ☐ 300-399 employees	3.1%
8. ☐ 400-499 employees	3.3%
9. ☐ 500 or more employees	10.5%

4. Your facility . . . *(Check all that apply.)*

1. ☐ sells products directly to consumers and/or to distributors.	N=345
2. ☐ sells products to defense contractors or the Department of Defense.	N=134
3. ☐ sells products used by other non-defense companies in their manufacturing process.	N=263
4. ☐ supplies intermediate products to other manufacturing facilities within your company.	N=57
5. ☐ Other - Please describe:	N=39

_____

_____

5. When did your facility start operating? *(Check one.)* N=550

1. ☐ January 1, 1990 or later	13.6%
2. ☐ 1985 to 1989	14.2%
3. ☐ 1980 to 1984	8.5%
4. ☐ 1975 to 1979	9.1%
5. ☐ 1970 to 1974	8.5%
6. ☐ Prior to 1970	46.0%

6. For your facility's 1994 fiscal year, what were gross sales? *(Check one.)* N=553

1. ☐ $500,000 or less	6.9%
2. ☐ More than $500,000 but not more than $1 million	4.1%
3. ☐ More than $1 million but not more than $5 million	29.3%
4. ☐ More than $5 million but not more than $10 million	14.6%
5. ☐ More than $10 million but not more than $25 million	19.7%
6. ☐ More than $25 million but not more than $50 million	11.1%
7. ☐ More than $50 million but not more than $100 million	5.6%
8. ☐ $100 million or more	8.6%

B. Program Attributes

7. Thinking about manufacturing extension programs **in general**, how important or unimportant do you consider the following attributes? *(Check one box in each row.)*

General Program Attributes	Very important (1)	Somewhat important (2)	As important as unimportant (3)	Somewhat unimportant (4)	Very unimportant (5)
a. On-site assistance at your facility N=545	56.9%	27.9%	8.4%	4.8%	2.0%
b. Facility staff training assistance N=543	34.1%	41.6%	16.0%	6.3%	2.0%
c. Demonstrations of equipment and/or processes N=537	23.3%	38.9%	22.9%	11.2%	3.7%
d. Timely/responsive assistance N=539	62.3%	30.1%	6.5%	0.9%	0.2%
e. Staff experience and/or expertise N=541	72.8%	20.5%	5.7%	0.4%	0.6%
f. Followup after a project has been completed N=542	28.4%	48.0%	17.2%	5.4%	1.1%
g. Project proposals within your financial means N=544	66.4%	24.1%	6.1%	2.8%	0.7%
h. Fair and reasonable fees, if charged N=538	64.5%	26.6%	7.6%	0.6%	0.7%

8. Looking at the attributes listed in question 7 above, please indicate which you consider to be the three most important attributes of a manufacturing extension program.
(Please circle the letter designations of the attributes from the previous question.)

	Attributes (by letter designation) from question 7							
	a	b	c	d	e	f	g	h
The most important attribute is: N=542	30.1%	7.7%	4.1%	14.2%	29.3%	0.7%	10.0%	3.9%
The next most important attribute is: N=539	13.2%	10.8%	5.8%	23.0%	20.8%	3.3%	14.1%	9.1%
The third most important attribute is: N=538	11.0%	6.3%	5.2%	14.1%	15.6%	8.6%	19.3%	19.9%

C. Assistance Type (All types of assistance combined)

Questions 9 through 25 focus specifically on the (type of assistance) that your facility received from the manufacturing extension program identified on the label on page 1.

These questions pertain to all assistance provided by manufacturing extension program staff or by consultants in conjunction with this manufacturing extension program.

9. Based on your experience with this manufacturing extension program, how satisfied or dissatisfied were you with the extent to which it **actually demonstrated** the following attributes? *(Check one box in each row.)*

Program Attributes Demonstrated	Very satisfied (1)	Somewhat satisfied (2)	As satisfied as dissatisfied (3)	Somewhat dissatisfied (4)	Very dissatisfied (5)	Not applicable/ Don't know (6)
a. On-site assistance at your facility N=546	54.0%	21.8%	10.3%	2.0%	0.9%	11.0%
b. Facility staff training assistance N=542	31.2%	25.5%	16.1%	2.8%	0.9%	23.6%
c. Demonstrations of equipment and/or processes N=534	19.3%	22.3%	18.5%	3.2%	1.3%	35.4%
d. Timely/responsive assistance N=547	51.7%	30.0%	11.3%	3.8%	2.0%	1.1%
e. Staff experience and/or expertise N=546	57.1%	30.0%	7.1%	2.9%	1.6%	1.1%
f. Followup after the project was completed N=543	31.9%	31.7%	20.4%	4.6%	2.6%	8.8%
g. Project proposals within your financial means N=544	45.0%	28.3%	13.1%	2.6%	1.3%	9.7%
h. Fair and reasonable fees, if charged N=545	47.3%	20.0%	12.5%	3.1%	1.7%	15.4%

10. Did any of the following factors prompt you to seek quality improvement assistance? *(Check one box in each row.)*

NOTE: This question appeared only in the Quality Improvement Assistance questionnaire.

		Yes (1)	No (2)
a. One or more of our customers required quality improvements.	N=172	59.9%	40.1%
b. Our recognition of a need to improve quality.	N=174	90.8%	9.2%
c. Desire on our part to improve our competitive position in the marketplace.	N=173	93.6%	6.4%
d. Desire on our part to obtain quality certification (e.g., ISO 9000, supplier certification, etc.).	N=171	49.7%	50.3%
e. Other - Please specify: _____ _____	N=20	95.0%	5.0%

11. How did you or someone else in your facility hear about the manufacturing extension program that provided this assistance to your facility? *(Check all that apply.)*

1. ☐ Marketing/outreach such as program advertising, phone calls, presentations at conferences or workshops N=269
2. ☐ Heard about the program from one or more of our customers N=26
3. ☐ Heard about the program from another company or facility N=101
4. ☐ Referred by another program such as a Small Business Administration program N=81
5. ☐ Other - Please specify: _____ N=130

12. Did the facility pay any fees to receive this assistance? *(Check one.)* N=550

1. ☐ Yes ⟶ ***Continue with Question 13.*** 60.2%
2. ☐ No ⟶ ***Skip to Question 14.*** 39.8%

13. Thinking about the value added or worth of the assistance that your facility received, would you say it was . . . *(Check one.)* N=328

1. ☐ worth much more than what we paid for it 25.0%
2. ☐ worth somewhat more than what we paid for it 32.6%
3. ☐ worth about what we paid for it 27.4%
4. ☐ worth somewhat less than what we paid for it 8.5%
5. ☐ worth much less than what we paid for it 2.7%

---

6. ☐ No basis to judge 3.7%

14. Using the categories provided below, please provide an estimate of how much time your facility's staff spent on activities related to this assistance? *(Check one.)* N=547

Note: *Please also include all time spent training facility staff in quality improvement.*

1. ☐ 100 hours or less 37.7%
2. ☐ More than 100 hours but not more than 250 hours 25.8%
3. ☐ More than 250 hours but not more than 500 hours 12.1%
4. ☐ More than 500 hours but not more than 1,000 hours 11.5%
5. ☐ More than 1,000 hours but not more than 2,500 hours 6.0%
6. ☐ More than 2,500 hours but not more than 5,000 hours 3.3%
7. ☐ More than 5,000 hours but not more than 7,500 hours 0.9%
8. ☐ More than 7,500 hours but not more than 10,000 hours 0.7%
9. ☐ More than 10,000 hours 2.0%

15. Would you say that the amount of time your facility's staff spent on activities related to this assistance was worthwhile? *(Check one.)* N=549

1. ☐ Definitely yes 60.3%
2. ☐ Probably yes 31.9%
3. ☐ Probably no 4.4%
4. ☐ Definitely no 1.3%

---

5. ☐ Unsure at this time 2.2%

16. Apart from any fees your facility might have paid for this assistance, as of January 1, 1995, did your facility make any financial investments (e.g., buy or upgrade equipment or plant facilities) as a result of this assistance? *(Check one.)* N=550

1. ☐ Yes ⟶ ***Continue with Question 17.*** 58.5%
2. ☐ No ⟶ ***Skip to Question 18.*** 41.5%

17. Would you say that the additional financial investment made as a result of this assistance was worthwhile? *(Check one.)* N=320

1. ☐ Definitely yes 70.3%
2. ☐ Probably yes 26.6%
3. ☐ Probably no 0.6%
4. ☐ Definitely no -

---

5. ☐ Unsure at this time 2.5%

18. Did the assistance include recommendations of any type for your facility? *(Check one.)* *N=549*

1. ☐ Yes → ***Continue with Question 19.*** 67.8%
2. ☐ No → ***Skip to Question 22.*** 32.2%

19. As of January 1, 1995, about how many of these recommendations have been implemented or do you plan to implement in the future? *(Check one.)* N=372

1. ☐ All recommendations have been or will be implemented. (100%) 15.3%
2. ☐ Most recommendations have been or will be implemented. (70-99%) 43.3%
3. ☐ Some recommendations have been or will be implemented. (40-69%) 32.0%
4. ☐ Few recommendations have been or will be implemented. (1-39%) 7.3%
5. ☐ No recommendations have been or will be implemented. (0%) 2.2%

20. If any recommendations have been implemented, how was this achieved? *(Check all that apply.)*

Total N with recommendations = 372

1. ☐ **Not applicable, no recommendations have been implemented** N=20

---

2. ☐ By facility staff N=285
3. ☐ By manufacturing extension program personnel N=46
4. ☐ By individuals not from the manufacturing extension program N=84

21. For those recommendations that have not been implemented, which of the following reasons explains why? *(Check all that apply.)*

Total N with recommendations = 372

1. ☐ **Not applicable, all recommendations have been implemented** N=49

---

2. ☐ More time is needed to implement the recommendations. N=162
3. ☐ Implementing the recommendations are beyond the financial means of the facility. N=56
4. ☐ The cost to implement the recommendations would exceed the expected benefits. N=52
5. ☐ We do not believe that the recommendations were relevant or would be useful to the facility. N=64
6. ☐ Recommendations are no longer appropriate due to changing business situation. N=53
7. ☐ Other - Please specify: N=18

_____

_____

22. In general, how well did the assistance received meet the needs of your facility? *(Check one.)* N=550

1. ☐ Completely met or exceeded the needs of the facility 16.5%
2. ☐ Met most of the needs of the facility 48.5%
3. ☐ Met some of the needs of the facility 22.5%
4. ☐ Met few or none of the needs of the facility 5.1%

---

5. ☐ Too early to tell 7.3%

23. The following business indicators may have been affected by the (type of assistance) that your facility received. Please indicate in column a. what you expected the effect of the assistance to be and in column b. what the actual effect of the assistance was as of January 1, 1995 on each of the indicators listed below.
(Check one answer for each indicator in column A and one answer for each indicator in column B.)

Note: Business indicators differed in each of the four questionnaires. The results of this question will be presented separately for each type of assistance. These results are located immediately following this questionnaire.

Note: Results for question 24 and 25 are being presented here for all types of assistance combined. They will also be presented for each type of assistance separately at the end of this appendix.

24. In your opinion, as of January 1, 1995, what effect, if any, did the assistance your facility received have on the following aspects of your facility's business performance? *(Check one box in each row.)*

Aspects of business performance	Assistance had a very positive effect (1)	Assistance had a generally positive effect (2)	Assistance had no effect (3)	Assistance had a generally negative effect (4)	Assistance had a very negative effect (5)	Not applicable/ No basis to judge (6)
a. Sales N=533	9.9%	34.0%	35.6%	0.6%	-	19.9%
b. Profits N=537	9.5%	42.1%	30.4%	1.7%	-	16.4%
c. Technology in the workplace N=536	17.4%	46.1%	25.0%	0.2%	-	11.4%
d. Worker productivity N=537	10.4%	45.3%	31.1%	0.4%	-	12.8%
e. Employee-management teamwork N=539	15.4%	40.4%	29.1%	0.7%	-	14.3%
f. Customer satisfaction or confidence N=537	14.9%	41.0%	28.5%	-	0.2%	15.5%
g. Product quality N=533	15.4%	45.6%	28.1%	0.4%	-	10.5%
h. Ability to meet production schedules N=536	14.6%	34.9%	34.9%	1.1%	0.2%	14.4%
i. Other - Please specify: _____ N=64	32.8%	10.9%	25.0%	-	-	31.3%

25. Considering your responses to the previous two questions, overall, as of January 1, 1995, did the assistance your facility received have a positive impact, a negative impact, or no impact on your facility's business performance *(i.e., your facility's ability to work better, smarter, faster, etc.)*? *(Check one.)* N=535

1. ☐ Extremely positive impact on business performance	13.3%
2. ☐ Generally positive impact on business performance	59.4%
3. ☐ No impact on business performance	15.3%
4. ☐ Generally negative impact on business performance	0.2%
5. ☐ Extremely negative impact on business performance	-
6. ☐ Too early to tell	7.7%
7. ☐ No basis to estimate the impact on business performance	4.1%

If you desire, please use the space below to comment on any impacts that the assistance had on your facility's business performance.

_____

D. Conclusions

26. In your opinion, would your facility be more likely to use services from a manufacturing extension program if your customers offered some incentive(s) to do so? *(Check one.)*

(Incentives may include long-term purchase commitments, guaranteed volume, etc.) N=536

1. ☐ **Not applicable to our facility's products/customer base**	24.8%
---	
2. ☐ Definitely yes	35.3%
3. ☐ Probably yes	34.3%
4. ☐ Probably no	4.9%
5. ☐ Definitely no	0.7%

27. How likely or unlikely would it be that you would contact this same manufacturing extension program for assistance in the future? *(Check one.)*

N=539

1. ☐ Very likely	62.3%	***Skip to Question 29.***
2. ☐ Somewhat likely	28.9%	
3. ☐ Somewhat unlikely	4.5%	***Continue with Question 28.***
4. ☐ Very unlikely	2.6%	
---		
5. ☐ Not sure at this time	1.7%	

28. Please explain why you may be reluctant to use this manufacturing extension program again.

_____

_____

_____

_____

29. In your opinion, how useful would each of the following services be for your facility to improve its business performance? *(Check one box in each row.)*

Services		Very useful (1)	Somewhat useful (2)	Of limited use (3)	Of no use (4)	Do not know (5)
a. Access to technical information databases	N=530	43.4%	36.2%	16.6%	2.3%	1.5%
b. How to use/apply database information	N=521	37.6%	38.6%	18.6%	3.3%	1.9%
c. Direct financial assistance	N=528	47.5%	27.1%	13.4%	7.2%	4.7%
d. Opportunities to meet managers from other facilities like yours and possibly visit their facilities	N=530	40.6%	44.3%	11.9%	2.6%	0.6%
e. Opportunities to meet with potential customers	N=526	60.1%	22.2%	10.1%	4.6%	3.0%
f. Referrals to other programs offering forms of business assistance, e.g., financial, management, export, etc.	N=526	39.7%	35.9%	16.9%	4.2%	3.2%
g. General training (e.g., TQM, teamwork, etc.) for all facility staff	N=525	42.5%	37.9%	15.2%	2.9%	1.5%
h. Technical training for production staff	N=529	44.0%	38.0%	13.4%	2.8%	1.7%
i. Marketing advice	N=525	26.1%	37.9%	24.6%	7.4%	4.0%
j. Equipment demonstrations	N=526	20.3%	40.9%	28.5%	6.7%	3.6%
k. Seminars/workshops	N=530	28.7%	49.6%	17.4%	2.3%	2.1%
l. Other - Please specify: _____	N=13	69.2%	23.1%	-	-	7.7%

30. If you have any additional comments on any aspect of the assistance your facility received or on this survey, please provide them in the space below. If necessary, you may attach additional sheets.

☐ **Please check this box if you would like us to send you a copy of our report when it becomes available.**

Thank you for your assistance.
Please return your completed questionnaire in the preaddressed envelope.

22. The following business indicators may have been affected by the **equipment modernization and plant layout** assistance that your facility received. Please indicate in column a. what you expected the effect of the assistance to be and in column b. what the actual effect of the assistance was as of January 1, 1995 on each of the indicators listed below.
(Check one answer for each indicator in column A and one answer for each indicator in column B.)

A. Expected effect of equipment modernization and plant layout assistance on . . .	B. As of January 1, 1995, the actual effect of equipment modernization and plant layout on . . .
Manufacturing lead time* - We expected that manufacturing lead time would be . . . 1. ☐ reduced greatly 29.7% 2. ☐ reduced somewhat 53.9% 3. ☐ unchanged 16.4% * We define manufacturing lead time as the time between the start and finish of all processing of an order, after design approval. N=165	**Manufacturing lead time** - Manufacturing lead time was actually . . . 1. ☐ reduced greatly 13.4% 2. ☐ reduced somewhat 52.4% 3. ☐ unchanged 18.9% 4. ☐ increased rather than reduced 1.8% 5. ☐ Too early to tell effect 12.2% 6. ☐ Do not know 1.2% N=164
Setup time* - We expected that setup time would be . . . 1. ☐ reduced greatly 19.8% 2. ☐ reduced somewhat 52.5% 3. ☐ unchanged 27.8% * We define setup time as the time required to change tooling on a machine so that it can change from producing one part to producing a different part. N=162	**Setup time** - Setup time was actually . . . 1. ☐ reduced greatly 15.5% 2. ☐ reduced somewhat 47.2% 3. ☐ unchanged 27.3% 4. ☐ increased rather than reduced 0.6% 5. ☐ Too early to tell effect 8.7% 6. ☐ Do not know 0.6% N=161
Cycle times* - We expected that cycle times would be . . . 1. ☐ reduced greatly 24.2% 2. ☐ reduced somewhat 57.0% 3. ☐ unchanged 18.8% * We define cycle times as the times required by machines or work stations in a manufacturing facility to perform the assigned operations on a part or work piece. N=165	**Cycle times** - Cycle times were actually . . . 1. ☐ reduced greatly 14.6% 2. ☐ reduced somewhat 48.2% 3. ☐ unchanged 22.6% 4. ☐ increased rather than reduced 1.2% 5. ☐ Too early to tell effect 12.2 % 6. ☐ Do not know 1.2% N=164
Output per worker - We expected that output per worker would be . . . 1. ☐ increased greatly 28.5% 2. ☐ increased somewhat 64.2% 3. ☐ unchanged 7.3% N=165	**Output per worker** - Output per worker was actually . . . 1. ☐ increased greatly 17.1% 2. ☐ increased somewhat 53.0% 3. ☐ unchanged 15.9% 4. ☐ decreased rather than increased 1.2% 5. ☐ Too early to tell effect 12.2% 6. ☐ Do not know 0.6% N=164

Question 22 continued on next page.

Question 22 *(Continued)*

A. Expected effect of equipment modernization and plant layout assistance on . . .

Scrap - We expected that scrap levels would be . . .

1. ☐ reduced greatly	15.8%
2. ☐ reduced somewhat	45.5%
3. ☐ unchanged	38.8%

N=165

Labor costs - We expected that labor costs would be . . .

1. ☐ reduced greatly	15.2%
2. ☐ reduced somewhat	58.2%
3. ☐ unchanged	26.7%

N=165

B. As of January 1, 1995, the actual effect of equipment modernization and plant layout on . . .

Scrap - Scrap levels were actually . . .

1. ☐ reduced greatly	11.0%
2. ☐ reduced somewhat	36.2%
3. ☐ unchanged	36.8%
4. ☐ increased rather than decreased	1.2%
5. ☐ Too early to tell effect	11.7%
6. ☐ Do not know	3.1%

N=163

Labor costs - Labor costs were actually . . .

1. ☐ reduced greatly	6.1%
2. ☐ reduced somewhat	50.6%
3. ☐ unchanged	28.7%
4. ☐ increased rather than decreased	3.0%
5. ☐ Too early to tell effect	11.6%
6. ☐ Do not know	-

N=164

23. In your opinion, as of January 1, 1995, what effect, if any, did the **equipment modernization and plant layout** assistance your facility received have on the following aspects of your facility's business performance? *(Check one box in each row.)*

Aspects of business performance		Assistance had a very positive effect (1)	Assistance had a generally positive effect (2)	Assistance had no effect (3)	Assistance had a generally negative effect (4)	Assistance had a very negative effect (5)	Not applicable/ No basis to judge (6)
a. Sales	N=164	14.0%	36.6%	34.1%	0.6%	-	14.6%
b. Profits	N=165	12.1%	51.5%	23.6%	1.2%	-	11.5%
c. Technology in the workplace	N=164	22.6%	45.7%	25.0%	-	-	6.7%
d. Worker productivity	N=166	12.7%	62.0%	20.5%	0.6%	-	4.2%
e. Employee-management teamwork	N=164	18.3%	45.1%	28.7%	0.6%	-	7.3%
f. Customer satisfaction or confidence	N=164	15.2%	39.0%	34.8%	-	-	11.0%
g. Product quality	N=164	15.9%	48.8%	29.9%	-	-	5.5%
h. Ability to meet production schedules	N=165	23.0%	49.1%	21.2%	0.6%	-	6.1%
i. Other - Please specify: _____	N=16	37.5%	18.8%	18.8%	-	-	0.25

24. Considering your responses to the previous two questions, overall, as of January 1, 1995, did the equipment modernization and plant layout assistance your facility received have a positive impact, a negative impact, or no impact on your facility's business performance *(i.e., your facility's ability to work better, smarter, faster, etc.)*? *(Check one.)*

N=161

1. ☐ Extremely positive impact on business performance	16.8%
2. ☐ Generally positive impact on business performance	62.7%
3. ☐ No impact on business performance	11.8%
4. ☐ Generally negative impact on business performance	-
5. ☐ Extremely negative impact on business performance	-
---	
6. ☐ Too early to tell	6.2%
7. ☐ No basis to estimate the impact on business performance	2.5%

22. The following business indicators may have been affected by the **product design and development** assistance that your facility received. Please indicate in column a. what you expected the effect of the assistance to be and in column b. what the actual effect of the assistance was as of January 1, 1995 on each of the indicators listed below.
(Check one answer for each indicator in column A and one answer for each indicator in column B.)

A. Expected effect of product design and development assistance on . . .	B. As of January 1, 1995, the actual effect of product design and development assistance on . . .
Product development costs - We expected that product development costs would be . . . 1. ☐ reduced greatly 16.4% 2. ☐ reduced somewhat 51.6% 3. ☐ unchanged 32.0% N=128	**Product development costs** - Product development costs were actually . . . 1. ☐ reduced greatly 10.2% 2. ☐ reduced somewhat 39.1% 3. ☐ unchanged 26.6% 4. ☐ increased rather than reduced 5.5% 5. ☐ Too early to tell effect 10.2% N=128 6. ☐ Do not know 8.6%
Incomplete product development projects - We expected that the number of incomplete product development projects would be . . . 1. ☐ reduced greatly 9.7% 2. ☐ reduced somewhat 44.4% 3. ☐ unchanged 46.0% N=124	**Incomplete product development projects** - The number of incomplete product development projects was actually . . . 1. ☐ reduced greatly 3.2% 2. ☐ reduced somewhat 32.3% 3. ☐ unchanged 40.3% 4. ☐ increased rather than reduced 0.8% 5. ☐ Too early to tell effect 9.7% N=124 6. ☐ Do not know 13.7%
Time needed to get new products to market - We expected that the time needed to get new products to market would be . . . 1. ☐ reduced greatly 16.8% 2. ☐ reduced somewhat 48.0% 3. ☐ unchanged 35.2% N=125	**Time needed to get new products to market** - The time needed to get new products to market was actually . . . 1. ☐ reduced greatly 5.6% 2. ☐ reduced somewhat 36.8% 3. ☐ unchanged 36.0% 4. ☐ increased rather than reduced 1.6% 5. ☐ Too early to tell effect 9.6% N=125 6. ☐ Do not know 10.4%
Quality of market research - We expected that the quality of market research would be . . . 1. ☐ improved greatly 20.8% 2. ☐ improved somewhat 30.8% 3. ☐ unchanged 48.3% N=120	**Quality of market research** - The quality of market research was actually . . . 1. ☐ improved greatly 12.5% 2. ☐ improved somewhat 23.3% 3. ☐ unchanged 44.2% 4. ☐ worsened rather than improved - 5. ☐ Too early to tell effect 8.3% N=120 6. ☐ Do not know 11.7%

Question 22 continued on next page.

Question 22 *(Continued)*

A. **Expected effect of product design and development assistance on . . .**		B. **As of January 1, 1995, the actual effect of product design and development assistance on . . .**	
New customers or markets - We expected that the number of new customers or markets would be . . .		**New customers or markets** - The number of new customers or markets was actually . . .	
1. ☐ increased greatly	15.5%	1. ☐ increased greatly	7.0%
2. ☐ increased somewhat	50.4%	2. ☐ increased somewhat	34.9%
3. ☐ unchanged	34.1%	3. ☐ unchanged	37.2%
		4. ☐ decreased rather than increased	2.3%
		5. ☐ Too early to tell effect	11.6%
N=129		N=129 6. ☐ Do not know	7.0%

23. In your opinion, as of January 1, 1995, what effect, if any, did the **product design and development** assistance your facility received have on the following aspects of your facility's business performance?
(Check one box in each row.)

Aspects of business performance	Assistance had a very positive effect (1)	Assistance had a generally positive effect (2)	Assistance had no effect (3)	Assistance had a generally negative effect (4)	Assistance had a very negative effect (5)	Not applicable/ No basis to judge (6)
a. Sales N=129	11.6%	34.9%	34.1%	0.8%	-	18.6%
b. Profits N=130	10.0%	37.7%	31.5%	2.3%	-	18.5%
c. Technology in the workplace N=131	23.7%	47.3%	16.8%	-	-	12.2%
d. Worker productivity N=131	14.5%	29.0%	36.6%	0.8%	-	19.1%
e. Employee-management teamwork N=131	12.2%	24.4%	37.4%	0.8%	-	25.2%
f. Customer satisfaction or confidence N=131	22.9%	33.6%	23.7%	-	0.8%	19.1%
g. Product quality N=131	22.1%	36.6%	25.2%	0.8%	-	15.3%
h. Ability to meet production schedules N=132	14.4%	30.3%	32.6%	0.8%	0.8%	21.2%
i. Other - Please specify: _____ N=20	30.0%	5.0%	25.0%	-	-	40.0%

24. Considering your responses to the previous two questions, overall, as of January 1, 1995, did the **product design and development** assistance your facility received have a positive impact, a negative impact, or no impact on your facility's business performance *(i.e., your facility's ability to work better, smarter, faster, etc.)*? *(Check one.)*

N=132

1. ☐ Extremely positive impact on business performance	17.4%
2. ☐ Generally positive impact on business performance	54.5%
3. ☐ No impact on business performance	14.4%
4. ☐ Generally negative impact on business performance	0.8%
5. ☐ Extremely negative impact on business performance	-
---	
6. ☐ Too early to tell	6.1%
7. ☐ No basis to estimate the impact on business performance	6.8%

23. The following business indicators may have been affected by the **quality improvement** assistance that your facility received. Please indicate in column a. what you expected the effect of the assistance to be and in column b. what the actual effect of the assistance was as of January 1, 1995 on each of the indicators listed below. *(Check one answer for each indicator in column A and one answer for each indicator in column B.)*

A. **Expected effect of quality improvement assistance on . . .**	B. **As of January 1, 1995, the actual effect of quality improvement assistance on . . .**
Rework - We expected that rework would be . . .	**Rework** - Rework was actually . . .
1. ☐ reduced greatly 28.2%	1. ☐ reduced greatly 8.9%
2. ☐ reduced somewhat 52.9%	2. ☐ reduced somewhat 46.2%
3. ☐ unchanged 18.8%	3. ☐ unchanged 25.4%
	4. ☐ increased rather than reduced 4.1%
	5. ☐ Too early to tell effect 13.6%
N=170	N=169 6. ☐ Do not know 1.8%
Scrap - We expected that scrap levels would be . . .	**Scrap** - Scrap levels were actually . . .
1. ☐ reduced greatly 25.1%	1. ☐ reduced greatly 7.2%
2. ☐ reduced somewhat 53.9%	2. ☐ reduced somewhat 45.8%
3. ☐ unchanged 21.0%	3. ☐ unchanged 27.1%
	4. ☐ increased rather than reduced 3.6%
	5. ☐ Too early to tell effect 15.1%
N=167	N=166 6. ☐ Do not know 1.2%
Products rejected due to quality problems - We expected that the number of products rejected due to quality problems would be . . .	**Products rejected due to quality problems** - The number of products rejected due to quality problems was actually . . .
1. ☐ reduced greatly 27.8%	1. ☐ reduced greatly 11.3%
2. ☐ reduced somewhat 54.4%	2. ☐ reduced somewhat 47.0%
3. ☐ unchanged 17.2%	3. ☐ unchanged 22.6%
	4. ☐ increased rather than reduced 6.5%
	5. ☐ Too early to tell effect 11.3%
N=169	N=168 6. ☐ Do not know 1.2%
Sales to repeat customers - We expected that sales to repeat customers would . . .	**Sales to repeat customers** - Sales to repeat customers actually . . .
1. ☐ increase greatly 13.1%	1. ☐ increased greatly 10.1%
2. ☐ increase somewhat 50.0%	2. ☐ increased somewhat 34.5%
3. ☐ not change 36.9%	3. ☐ did not change 34.5%
	4. ☐ decreased rather than increased -
	5. ☐ Too early to tell effect 14.9%
N=168	N=168 6. ☐ Do not know 6.0%
Sales to new customers - We expected that sales to new customers would . . .	**Sales to new customers** - Sales to new customers actually . . .
1. ☐ increase greatly 13.8%	1. ☐ increased greatly 6.6%
2. ☐ increase somewhat 59.9%	2. ☐ increased somewhat 41.3%
3. ☐ not change 26.3%	3. ☐ did not change 28.7%
	4. ☐ decreased rather than increased 1.2%
	5. ☐ Too early to tell effect 15.0%
N=167	N=167 6. ☐ Do not know 7.2%

24. In your opinion, as of January 1, 1995, what effect, if any, did the **quality improvement** assistance your facility received have on the following aspects of your facility's business performance? *(Check one box in each row.)*

Aspects of business erformance	Assistance had a very positive effect (1)	Assistance had a generally positive effect (2)	Assistance had no effect (3)	Assistance had a generally negative effect (4)	Assistance had a very negative effect (5)	Not applicable/ No basis to judge (6)
a. Sales N=172	7.6%	40.7%	36.6%	-	-	15.1%
b. Profits N=172	9.3%	39.5%	33.7%	0.6%	-	16.9%
c. Technology in the workplace N=173	9.8%	46.2%	31.2%	-	-	12.7%
d. Worker productivity N=171	9.4%	48.5%	31.6%	-	-	10.5%
e. Employee-management teamwork N=174	20.1%	52.3%	18.4%	1.1%	-	8.0%
f. Customer satisfaction or confidence N=173	12.7%	57.8%	17.9%	-	-	11.6%
g. Product quality N=170	13.5%	61.2%	18.8%	-	-	6.5%
h. Ability to meet production schedules N=169	11.2%	32.0%	42.6%	1.2%	-	13.0%
i. Other - Please specify: _____ N=20	35.0%	15.0%	25.0%	-	-	25.0%

25. Considering your responses to the previous two questions, overall, as of January 1, 1995, did the **quality improvement** assistance your facility received have a positive impact, a negative impact, or no impact on your facility's business performance *(i.e., your facility's ability to work better, smarter, faster, etc.)*? *(Check one.)*

	N=175
1. ☐ Extremely positive impact on business performance	10.9%
2. ☐ Generally positive impact on business performance	64.0%
3. ☐ No impact on business performance	13.1%
4. ☐ Generally negative impact on business performance	-
5. ☐ Extremely negative impact on business performance	-
---	
6. ☐ Too early to tell	10.3%
7. ☐ No basis to estimate the impact on business performance	1.7%

22. The following business indicators may have been affected by the **environmental or energy-related** assistance that your facility received. Please indicate in column a. what you expected the effect of the assistance to be and in column b. what the actual effect of the assistance was as of January 1, 1995 on each of the indicators listed below. *(Check one answer for each indicator in column A and one answer for each indicator in column B.)*

A. **Expected effect of environmental or energy-related assistance on . . .**	B. **As of January 1, 1995, the actual effect of environmental or energy-related assistance on . . .**
Use of high-risk hazardous materials - We expected that use of high-risk hazardous materials would be . . .	**Use of high-risk hazardous materials** - Use of high-risk hazardous materials was actually . . .
1. ☐ eliminated 6.1%	1. ☐ eliminated 6.5%
2. ☐ reduced greatly 4.5%	2. ☐ reduced greatly 4.8%
3. ☐ reduced somewhat 15.2%	3. ☐ reduced somewhat 1.6%
4. ☐ unchanged 7.6%	4. ☐ unchanged 19.4%
5. ☐ Does not apply 66.7%	5. ☐ increased rather than reduced 3.2%
	6. ☐ Too early to tell effect 1.6%
N=66	N=62 7. ☐ Do not know/Not applicable 62.9%
Disposal costs - We expected that disposal costs would be . . .	**Disposal costs** - Disposal costs were actually . . .
1. ☐ reduced greatly 10.6%	1. ☐ reduced greatly 7.7%
2. ☐ reduced somewhat 16.7%	2. ☐ reduced somewhat 10.8%
3. ☐ unchanged 16.7%	3. ☐ unchanged 16.9%
4. ☐ Does not apply 56.1%	4. ☐ increased rather than reduced 4.6%
	5. ☐ Too early to tell effect 4.6%
N=66	N=65 6. ☐ Do not know/Not applicable 55.4%
Manufacturing waste discharges - We expected that manufacturing waste discharges would be . . .	**Manufacturing waste discharges** - Manufacturing wast discharges were actually . . .
1. ☐ reduced greatly 9.0%	1. ☐ reduced greatly 7.6%
2. ☐ reduced somewhat 29.9%	2. ☐ reduced somewhat 19.7%
3. ☐ unchanged 14.9%	3. ☐ unchanged 19.7%
4. ☐ Does not apply 46.3%	4. ☐ increased rather than reduced 1.5%
	5. ☐ Too early to tell effect 6.1%
N=67	N=66 6. ☐ Do not know/Not applicable 45.5%
Exposure to fines or other actions for non-compliance - We expected that exposure to fines or other actions for non-compliance with environmental statutes would be . . .	**Exposure to fines or other actions for non-compliance** - Exposure to fines or other actions for non-compliance with environmental statutes was actually . . .
1. ☐ eliminated 18.2%	1. ☐ eliminated 12.3%
2. ☐ reduced greatly 15.2%	2. ☐ reduced greatly 15.4%
3. ☐ reduced somewhat 15.2%	3. ☐ reduced somewhat 7.7%
4. ☐ unchanged 12.1%	4. ☐ unchanged 13.8%
5. ☐ Does not apply 39.4%	5. ☐ increased rather than reduced 1.5%
	6. ☐ Too early to tell effect 7.7%
N=66	N=65 7. ☐ Do not know/Not applicable 41.5%

Question 22 continued on next page.

Question 22 *(Continued)*

A. Expected effect of environmental or energy-related assistance on . . .

Energy-related emissions - We expected that energy-related emissions would be . . .

1. ☐	eliminated	1.5%
2. ☐	reduced greatly	14.9%
3. ☐	reduced somewhat	20.9%
4. ☐	unchanged	11.9%
5. ☐	Does not apply	50.7%

N=67

Energy used per unit of production - We expected that energy used per unit of production would be . . .

1. ☐	reduced greatly	5.7%
2. ☐	reduced somewhat	38.6%
3. ☐	unchanged	14.3%
4. ☐	Does not apply	41.4%

N=70

B. As of January 1, 1995, the actual effect of environmental or energy-related assistance on . . .

Energy-related emissions - Energy-related emissions were actually . . .

1. ☐	eliminated	-
2. ☐	reduced greatly	9.4%
3. ☐	reduced somewhat	15.6%
4. ☐	unchanged	18.8%
5. ☐	increased rather than decreased	-
6. ☐	Too early to tell effect	3.1%
7. ☐	Do not know/Not applicable	53.1%

N=64

Energy used per unit of production - Energy used per unit of production was actually . . .

1. ☐	reduced greatly	6.0%
2. ☐	reduced somewhat	29.9%
3. ☐	unchanged	20.9%
4. ☐	increased rather than decreased	-
5. ☐	Too early to tell effect	3.0%
6. ☐	Do not know/Not applicable	40.3%

N=67

23. In your opinion, as of January 1, 1995, what effect, if any, did the **environmental or energy-related** assistance your facility received have on the following aspects of your facility's business performance? *(Check one box in each row.)*

Aspects of business performance	Assistance had a very positive effect (1)	Assistance had a generally positive effect (2)	Assistance had no effect (3)	Assistance had a generally negative effect (4)	Assistance had a very negative effect (5)	Not applicable/ No basis to judge (6)
a. Sales N=68	2.9%	8.8%	39.7%	1.5%	-	47.1%
b. Profits N=70	2.9%	34.3%	35.7%	4.3%	-	22.9%
c. Technology in the workplace N=68	11.8%	44.1%	25.0%	1.5%	-	17.6%
d. Worker productivity N=69	-	27.5%	44.9%	-	-	27.5%
e. Employee-management teamwork N=70	2.9%	30.0%	41.4%	-	-	25.7%
f. Customer satisfaction or confidence N=69	4.3%	17.4%	49.3%	-	-	29.0%
g. Product quality N=68	5.9%	16.2%	52.9%	1.5%	-	23.5%
h. Ability to meet production schedules N=70	2.9%	17.1%	52.9%	2.9%	-	24.3%
i. Other - Please specify: _____ N=8	25.0%	-	37.5%	-	-	37.5%

24. Considering your responses to the previous two questions, overall, as of January 1, 1995, did the environmental or energy-related assistance your facility received have a positive impact, a negative impact, or no impact on your facility's business performance *(i.e., your facility's ability to work better, smarter, faster, etc.)*? *(Check one.)*

N=67

1. ☐ Extremely positive impact on business performance	3.0%
2. ☐ Generally positive impact on business performance	49.3%
3. ☐ No impact on business performance	31.3%
4. ☐ Generally negative impact on business performance	-
5. ☐ Extremely negative impact on business performance	-
---	
6. ☐ Too early to tell	7.5%
7. ☐ No basis to estimate the impact on business performance	9.0%

Objectives, Scope, and Methodology

At the request of Chairwoman Constance A. Morella of the Subcommittee on Technology, House Committee on Science, we obtained manufacturers' views regarding the impact of manufacturing extension programs' (MEP) services on their business performance and the factors that affected the impact of MEP services.

In August 1995, we reported[1] that most manufacturers responding to our questionnaire believed MEP assistance had positively affected their overall business performance. Our objectives for this report were to analyze (1) the factors that may have contributed to the positive impact of MEP assistance on companies' overall business performance; (2) the question of whether companies' expectations were met regarding the impact of MEP assistance on specific business performance indicators, such as manufacturing time frames and labor productivity; and (3) the issue of whether MEP actually demonstrated attributes that companies indicated they valued most, such as MEP staff expertise, timely assistance, and reasonably priced fees. We did not verify either positive or negative impacts reported by manufacturers.

To identify manufacturers that had used MEP services to survey regarding the services' impact on their business performance and the factors that had affected the services' impact, we (1) developed criteria for the type of MEP our study would include, (2) located all MEP that fit our criteria, and (3) asked these MEP for their cooperation in supplying names of clients that met our survey criteria (described in the following paragraphs).

Since the term "MEP" could include a variety of programs and organizations, we consulted MEP literature and MEP experts to develop a set of criteria to use in identifying programs to include in our study. For the purpose of our study, we considered programs to be relevant if their primary function was to provide direct technical assistance to individual manufacturers, using program staff or supervised consultants. We defined "technical assistance" as one or more of the following activities:

- providing access to and encouraging the use of innovative and/or off-the-shelf manufacturing technologies and processes;
- disseminating scientific, engineering, technical, and management information about manufacturing;
- providing access to industry-related expertise and capability in university research departments; and

[1]GAO/GGD-95-216BR.

- transferring advanced manufacturing (i.e., cutting edge) technologies and techniques to companies.

Our definition excluded business assistance programs such as the Small Business Administration's Small Business Development Centers; business incubators;[2] financial assistance, funding, and grant programs; joint research ventures with universities and/or federal laboratories; on-line technical data base services; and industry networks.

We located 80 MEP that met our criteria for inclusion and had been established before 1994.[3] We used reports from the National Governor's Association, the Northeast-Midwest Institute,[4] and the Battelle Memorial Institute in Ohio that contained references to existing MEP as the basis for identifying programs that would possibly fit our criteria. We confirmed and updated information in these reports by conducting structured telephone interviews with all programs that we believed matched our criteria. We interviewed officials from a total of 114 programs in 40 states. Eighty of them met our criteria for inclusion and had been established before January 1994.

Fifty-seven[5] of the 80 MEP that qualified for our study supplied us with the names of clients that met our survey criteria. Thirteen of these MEP received NIST funding for fiscal year 1994, accounting for 36 percent of survey respondents.[6] In an effort to determine if the qualified programs that provided client information differed from the qualified programs that did not, we compared the two sets of programs on the basis of program age, total funding, federal funding, and type of administration. The results of the comparisons indicated that there were no significant differences between MEP that did and did not provide client data.

[2]Incubator facilities provide office and lab space for start-up companies at below-market rates. Shared support services such as clerical, reception, and data processing often are made available, as well.

[3]Since our survey focused on manufacturers receiving MEP services in 1993 (for reasons explained in the text) we limited our study to MEP that were operating before 1994.

[4]The Northeast-Midwest Institute provides information and analysis to Members of Congress and the public related to economic development issues affecting the Northeast-Midwest region.

[5]Of the remaining 23 MEP, 7 were willing to provide client information but did not have any clients meeting all of our survey criteria. Ten declined our request because of concerns over client confidentiality, three never responded to our request, and three others did not participate for other reasons.

[6]According to NIST officials, 5 of the 13 MEP received NIST funds in fiscal years 1993 and 1994. The other eight MEP were first awarded NIST funding in fiscal year 1994.

We asked the 57 participating MEP to select from their records all manufacturers that met specific criteria that we developed in consultation with MEP officials and MEP evaluation experts. The client had to meet the following criteria:

- It had to be a manufacturing facility, which means that its products had to belong to one or more of the manufacturing categories in the Department of Commerce's Standard Industrial Classification codes.[7] Our survey excluded nonmanufacturing facilities, such as service providers or farmers.
- It had to have received at least 40 hours of MEP assistance[8] in 1993. Thus, when the facility received our survey in early 1995, at least 1 year would have elapsed since the MEP assistance ended. MEP evaluation experts have told us that 1 year would have been sufficient time for facilities to be able to gauge the value of the assistance and its impact on their business performance. Experts also have told us that 40 hours would have been enough assistance to have had a potential effect on a manufacturer's business performance.
- It had to have completed assistance in one or more of the four categories defined in the following paragraph. In cases in which a manufacturer completed more than one type of assistance, we asked the MEP official to choose the primary assistance provided to the manufacturer (i.e., the assistance requiring the most MEP time and/or resources).

We did not verify the client information MEP provided against the programs' records.

The assistance categories we included in our survey involved the following:

Quality improvement. Technical assistance in planning, developing, and implementing a quality system to help a manufacturer attain higher quality standards.

Equipment modernization and plant layout. The evaluation and analysis of plant layout and equipment to determine the most efficient means of

[7]The Standard Industrial Classification is the statistical classification standard underlying all establishment-based federal economic statistics classified by industry. The classification covers the entire field of economic activities and defines industries in accordance with the composition and structure of the economy.

[8]The 40 hours need not have been consecutive. Assistance may have been provided by MEP staff or by consultants affiliated with MEP. In cases involving consultants, MEP should have performed a case management role.

manufacturing or assembly through reorganization of the process flow through the facility, and/or upgrading, reconfiguring, or replacing manufacturing equipment.

Product design and development. Services to support the creation, enhancement, or marketing of a manufacturer's product.

Environmental or energy assessment. Assessment of hazardous materials, discharge, waste products, energy use, and other environmental effects within a manufacturing operation.

We chose these four assistance categories because they share important characteristics. They are types of assistance that MEP typically offer clients, so our survey potentially could include clients from most MEP. Also, the four types of assistance are defined in a similar way by most MEP, according to MEP officials. Other MEP services (such as worker training and strategic business planning) may vary considerably from one program to another.

Finally, we selected types of assistance that were directed at clients' manufacturing operations. MEP clients receiving operations-related assistance were able to tell us (1) how they expected the assistance would affect their operations and/or performance and (2) whether or not these expectations were met. Other types of MEP assistance—examples are material engineering, electronic data exchange, and computer upgrading—have effects on manufacturers' operations that are less visible and less easily measured. As a result, manufacturers may have difficulty determining the expected and actual impact of these types of services on their business operations and performance.

We designed four questionnaires, each focusing on one assistance category. In designing our survey questions, we obtained input from National Institute of Standards and Technology (NIST) and MEP officials, MEP evaluation experts, and managers at manufacturing facilities. We also reviewed client surveys that MEP used.

Each questionnaire contained identical questions to obtain background information about the respondent and to get respondents' views on the impact of MEP services on their business performance and the factors affecting the impact of MEP services. However, the four surveys also had unique questions asking about the expected and actual outcomes of the assistance, because each type of assistance focuses on a different aspect

of manufacturers' operations. We tailored these questions to ask about the kind of impacts that reasonably could be expected to result from the particular kind of assistance received.

As part of our survey development, we tested all four surveys with manufacturers who had received MEP assistance in Texas, Iowa, New York, and Kansas. We chose those states in order to cover diverse areas of the country where MEP are located. We also interviewed eight manufacturers who had received MEP services and were given tours of their manufacturing facilities in Maryland, Georgia, North Carolina, and South Carolina. We visited these southern states because MEP directors had agreed to arrange for us to meet selected clients. We asked the manufacturers about their experiences with MEP services and the impact of those services on their business performance.

Our final surveys initially were mailed to a total of 843 manufacturers from February 1995 through March 1995. Follow-up mailings were made through May 1995. Each manufacturer was sent one survey, based on MEP information on the primary type of service the manufacturer had received.

The primary reason manufacturers did not respond to our survey was their inability to recall MEP assistance they had received. We wrote letters asking the nonrespondents why they did not return our survey. We received responses from 60 companies out of 274 nonrespondents. About 33 percent told us that no one at their facility could recall the assistance received in 1993 and/or that we had addressed the survey to a person who no longer worked at the facility. On the basis of this information, in addition to other information provided by our nonrespondents, we reduced our survey population from 843 to 766.

We obtained an overall response rate of 72 percent across all four surveys. Response rates varied from a low of 63 percent for the environmental/energy survey to a high of 76 percent for the quality improvement survey.

Our analysis of the companies that did and did not respond to our survey found nothing to indicate that our results would have been different if the nonrespondents had completed our questionnaire. The respondents and nonrespondents were similarly distributed across different geographic locations and different MEP.

Since we did not evaluate the operations or management of specific federal programs, we did not obtain agency comments on this report. However, on February 12, 1996, we discussed a draft of this report with NIST officials, including the Director of the NIST Manufacturing Extension Partnership Program. He agreed with the technical accuracy of the report and offered minor clarifications, which we incorporated into the report where appropriate.

We did our work primarily in Los Angeles, New York, San Francisco, and Washington, D.C., from February 1995 to January 1996 in accordance with generally accepted government auditing standards.

Technical Appendix: Loglinear and Logistic Methodologies and Analysis Results

We used logistic regression techniques to determine which factors were statistically significant in predicting the reported impact of MEP assistance on companies' overall business performance. We began our analysis by considering nine factors that may have affected how the manufacturers we surveyed assessed the impact of MEP assistance on their overall business performance. The factors included the following characteristics of those manufacturers: (1) the number of permanent employees as of January 1, 1995, (2) the number of hours company staff devoted to MEP assistance, (3) the year the company started operating, (4) the company's gross sales in fiscal year 1994, (5) whether the company paid any fees for MEP assistance, (6) whether the company made any financial investments as a result of the assistance, (7) whether the assistance included recommendations, and (8) the percentage of MEP recommendations the company implemented. We also considered whether the company used a program that had received NIST funds. These factors all are listed in the first column of table III.1.

Table III.1: Odds Ratios From Logistic Regression Analysis

		Odds ratios indicating the effects of the different factors on the odds of MEP being assessed as:			
		Extremely Positive vs. Generally Positive		Generally Positive vs. Neutral or Negative	
Factor	**Categories contrasted**	**Bivariate**	**Multi-variate**	**Bivariate**	**Multi-variate**
Number of permanent employees	0 = 100 or more; 1 = 20 - 99; 2 = less than 20	2.2*	[a]	0.8	[a]
Company staff hours devoted to MEP assistance	0 = less than 100; 1 = 100 - 250; 2 = more than 250	1.3	1.7*	2.2*	2.0*
Year the company started operating	0 = before 1985; 1 = since 1985	2.5*	2.0*	0.7	0.8
Gross annual sales for fiscal year 1994	0 = over $1 million; 1 = under $1 million	4.0*	3.1*	1.0	1.4
Whether the company paid any fees for MEP assistance	0 = no; 1 = yes	0.5*	0.5*	1.0	0.8
Whether the company made financial investments	0 = no; 1 = yes	2.8*	2.5*	7.0*	5.6*
Whether the assistance included recommendations	0 = no; 1 = yes	1.9[b]	1.6	1.8*	1.3
Percentage of MEP recommendations the company implemented	0 = few or none; 1 = some; 2 = all or almost all	5.7*	[c]	5.2*	[c]
Whether the company used MEP that received NIST funds	0 = yes; 1 = no	1.1	1.3	0.9	1.1

Note: Asterisk indicates odds ratios that are statistically significant at the 0.05 level.

[a]Number of permanent employees was dropped from the multivariate analysis because of its strong association with gross sales. Each of these two indicators of company size were significantly related to assessments when the other indicator was ignored. However, when we controlled for gross annual sales, the effect of number of permanent employees was not statistically significant.

[b]Significant at the 0.06 level of confidence.

[c]The percentage of recommendations implemented was dropped from the multivariate analysis because there were too few responses to perform the analysis. Only 70 percent of the companies received recommendations and provided information on the percentage of recommendations implemented.

Some of these factors had many categories. We used loglinear methods to determine which of those categories differed with respect to companies' assessment of the overall impact of MEP. We combined the categories that were not significantly different from one another. The categories which

ultimately were contrasted with one another are given in the second column of table III.1. For the purpose of our analysis, the factors were used as the independent variables.

We used simple bivariate logistic regression models to estimate the individual influence of each factor on the reported impact of MEP assistance, without controlling for the influence of all other relevant factors identified in the survey. We estimated which of the nine factors, as categorized in Table III.1, were related to (1) the odds on the overall impact of MEP being assessed as extremely positive versus generally positive and (2) the odds on the overall impact of MEP being assessed as generally positive versus negative or neutral.[1] Our bivariate estimates are given as odds ratios in the third and fifth columns of table III.1.

As can be seen in that table, seven of the nine factors had a significant relationship[2] to the likelihood that companies assessed the impact of MEP assistance as extremely positive, as opposed to generally positive. In addition, four of the nine factors were significantly related to the odds of companies assessing the impact of MEP assistance as generally positive, as opposed to neutral or negative.

The bivariate odds ratios have a straightforward interpretation. The odds ratio gives an estimate of how each factor, as categorized[3] in column 2 of Table III.1, affected companies' assessment of MEP assistance. For example, the companies with 20-99 employees were more than twice as likely as the companies with 100 or more employees to assess the impact of MEP as extremely positive as opposed to generally positive. Likewise, the companies with less than 20 employees were more than twice as likely as the companies with 20 to 99 employees to assess the impact of MEP as extremely positive, as opposed to generally positive. Similar

[1]Of the 472 companies that provided us with information on the overall impact of MEP on their business performance, 71 (15 percent) assessed the impact as extremely positive, 318 (67 percent) assessed the impact as generally positive, and 83 (18 percent) assessed the impact as negative or neutral. Using this data, the overall odds on MEP being assessed as extremely positive versus generally positive were 71/318 = 0.22. That is, 22 companies viewed MEP extremely positively for every 100 that viewed MEP as having a generally positive impact. The overall odds on the program being assessed as generally positive versus negative or neutral were 318/83 = 3.81. This implies that 381 companies assessed MEP as having a generally positive impact for every 100 that viewed the overall impact of MEP as neutral or negative.

[2]For six factors, the confidence level was 0.05. One additional factor—whether the assistance included recommendations—was significant at the 0.06 level of confidence.

[3]Our bivariate and multivariate analysis directly contrasted the factor categories. Where a factor had two categories, we compared the category coded 1 with the category coded 0. For the factors with three categories, we scored the categories linearly with codes of 0,1, and 2.

interpretations can be given to the other odds ratios in the table.[4] The bivariate odds ratios are estimates that do not take into account the effects of other variables.

We also undertook multivariate analysis of the data. Multivariate analysis also estimated the individual effect of each factor on the reported impact of MEP assistance, but it controlled for the influence of all other relevant factors. It is necessary to control for the influence of multiple factors because some factors are associated with others, making it impossible to isolate their individual effect on the dependent variable. Our multivariate analysis did not include two factors used in the bivariate analysis: the number of permanent employees and the percentage of recommendations companies had implemented.[5]

The odds ratios in the fourth and sixth columns of table III.1 provide the results of multivariate analysis. Odds ratios that are marked by an asterisk represent statistically significant effects. Five factors had significant effects on the odds of whether programs were assessed extremely positively as opposed to generally positively: (1) the number of company staff hours devoted to the assistance, (2) when the company started operating, (3) the company's 1994 fiscal year gross sales, (4) whether the company paid any fees for the assistance, and (5) whether the company made any financial investments as a result of the assistance. Only two factors had significant effects on whether assessments were generally positive as opposed to neutral or negative: (1) the number of company staff hours devoted to the assistance and (2) whether the company made any financial investments as a result of the assistance.

Many of the significant effects from the multivariate analysis are quite sizable. For example, the companies that made financial investments were 2.5 times as likely as those that had not made financial investments to assess the impact of MEP assistance as extremely positive, as opposed to generally positive. The companies that made financial investments also

[4]The size of an effect is indicated by the odds ratio. A factor with an estimated odds ratio of 1.0 indicates that the factor categories being contrasted have equal likelihood of influencing companies' assessment of the impact of MEP assistance. An odds ratio of 0.5 indicates that one category is one half as likely as the other category to result in a positive assessment by companies; an odds ratio of 2.0 indicates that one category is twice as likely as the other category to result in a positive assessment by companies.

[5]The number of permanent employees was dropped from the multivariate analysis because of its strong association with gross sales. While each of these two indicators of company size were significantly related to assessments when the other was ignored, when we controlled for gross sales, the effect of number of permanent employees became insignificant. Also, we omitted from our analysis the percentage of MEP recommendations the company implemented. A substantial percentage of companies (30 percent) had received no recommendations.

were 5.6 times as likely as companies that had not made financial investments to assess the impact of MEP assistance as generally positive, as opposed to neutral or negative. Other odds ratios can be similarly interpreted.[6]

Our letter report features the results of the multivariate analysis. The multivariate estimates may differ from the bivariate estimates because the multivariate analysis controlled for the effects of all other factors when estimating the influence of one factor. Bivariate analysis estimates the influence of one factor without controlling for the effects of other factors. In general, the multivariate and bivariate estimates for each factor are similar, with two exceptions.

The first exception is company staff hours devoted to MEP assistance. In the bivariate analysis, this factor was unrelated to whether companies assessed the impact of MEP assistance as extremely positive versus generally positive. However, multivariate results indicate that company staff hours were significantly related to companies' assessment of the impact of assistance as extremely positive, as opposed to generally positive. We believe that the significance varies because of a relationship between company size and the number of company staff hours spent on MEP assistance. In particular, larger companies devoted more staff hours to the program. In order to accurately assess the independent influence of company staff hours, we needed to control for company size. Our multivariate model controls for company size by including the variable that measures gross sales. Therefore, the multivariate model provides a more accurate assessment of the impact of company staff hours, independent of company size.

The second exception was the factor measuring whether MEP assistance included recommendations. In our bivariate analysis, this variable was significantly related to both extremely positive and generally positive assessments. However, its significance disappeared in our multivariate analysis. Companies receiving recommendations were more likely to devote more staff hours to the program and to make financial investments as a result of MEP assistance. Therefore, when the multivariate analysis controlled for company staff hours spent on the assistance and financial investments made as a result of the assistance, the effect of recommendations was rendered insignificant.

[6]Like the bivariate analysis, the categories compared in the multivariate analysis had a linear relationship to one another.

Major Contributors to This Report

General Government Division, Washington, D.C.

Susan S. Westin, Assistant Director
Douglas Sloane, Supervisory Social Science Analyst
Stuart Kaufman, Senior Social Science Analyst
Barry L. Reed, Senior Social Science Analyst
Rona Mendelsohn, Senior Evaluator (Communications Analyst)

Los Angeles Regional Office

Patrick F. Gormley, Assistant Director
Amy L. Finkelstein, Evaluator-in-Charge
Edward Laughlin, Senior Evaluator

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000
or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

PRINTED ON RECYCLED PAPER

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested