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Manufacturing Modernization:

Implications of Evaluation Results for Program Improvement and Policy Development

Proceedings of the Fourth Atlanta Workshop on the Evaluation of Industrial Modernization

edited by
Philip Shapira and Jan Youtie
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Philip Shapira conducted his part of the editing of these proceedings while a visiting researcher at the Fraunhofer Institute for Innovations and Systems Research (ISI), Karlsruhe, Germany. He is appreciative of the resources that ISI provided to help him in this task. At Georgia Tech, the assistance of Callie Ann Waters in preparing this volume for desktop publication is gratefully acknowledged.

Georgia Tech Policy Project on Industrial Modernization

The Georgia Tech Policy Project on Industrial Modernization is concerned with the analysis and evaluation of industrial modernization and technology transfer issues and policies. We conduct research that assesses the diffusion of technology, identifies modernization program best practices and evaluates industrial and regional development impacts. Further information on the project can be found at our world wide web site <http://www.cherry.gatech.edu/mod>. 
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ASM</td>
<td>Annual Survey of Manufactures, U.S. Census Bureau</td>
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<td>BFTC</td>
<td>Ben Franklin Technology Center, Pennsylvania</td>
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<td>BOS</td>
<td>Business Outreach Services, University of Georgia</td>
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<td>CAD</td>
<td>Computer-aided design</td>
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<td>CAM</td>
<td>Computer-aided manufacturing</td>
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<td>CAMP</td>
<td>Cleveland Advanced Manufacturing Program</td>
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<tr>
<td>CES</td>
<td>Center for Economic Studies, U.S. Census Bureau</td>
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<td>CMC</td>
<td>Chicago Manufacturing Center</td>
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<tr>
<td>CONN/STEP</td>
<td>Connecticut State Technology Extension Program</td>
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<td>CTC</td>
<td>Concurrent Technologies Corporation, Pennsylvania</td>
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<tr>
<td>EDI</td>
<td>Electronic data interchange</td>
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<tr>
<td>FTE</td>
<td>Full-time equivalent (employees)</td>
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<td>GAO</td>
<td>General Accounting Office, U.S. Congress</td>
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<td>GATT</td>
<td>General Agreement on Tariffs and Trade</td>
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<td>GLMTC</td>
<td>Great Lakes Manufacturing Technology Center</td>
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<td>GMEA</td>
<td>Georgia Manufacturing Extension Alliance</td>
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<td>IFC</td>
<td>Interfirm collaboration</td>
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<td>IRC</td>
<td>Industrial Resource Center, Pennsylvania</td>
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<td>ISO</td>
<td>International Organization for Standardization</td>
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<tr>
<td>LAN</td>
<td>Local area network</td>
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<tr>
<td>LRD</td>
<td>Longitudinal research database, U.S. Census Bureau</td>
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<td>MAMTC</td>
<td>Mid-America Manufacturing Technology Center</td>
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<td>MEC</td>
<td>Manufacturing Extension Center</td>
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<td>MEP</td>
<td>Manufacturing Extension Partnership</td>
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<td>MEP-SWPA</td>
<td>Manufacturing Extension Partnership of Southwest Pennsylvania</td>
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<td>MMP</td>
<td>Massachusetts Manufacturing Partnership</td>
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<td>MTC</td>
<td>Manufacturing Technology Center</td>
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<td>NIST</td>
<td>National Institute of Standards and Technology</td>
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<tr>
<td>NOM-SBDC</td>
<td>Northern Ohio Manufacturing Small Business Development Center</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
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<tr>
<td>R&amp;D</td>
<td>Research and development</td>
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<tr>
<td>REMI</td>
<td>Regional Economic Models, Inc.</td>
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<tr>
<td>RTD</td>
<td>Research and technological development</td>
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<tr>
<td>RTS</td>
<td>Regional Technology Strategies, Inc., North Carolina</td>
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<tr>
<td>SBA</td>
<td>Small Business Administration</td>
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<tr>
<td>SBDC</td>
<td>Small Business Development Center</td>
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<td>SIC</td>
<td>Standard industrial classification</td>
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<td>SME</td>
<td>Small and medium-size manufacturing enterprise</td>
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<tr>
<td>SPIRCE</td>
<td>Southwest Pennsylvania Industrial Resource Center</td>
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<tr>
<td>SSEL</td>
<td>Standard statistical establishment list, U.S. Census Bureau</td>
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<tr>
<td>TAP</td>
<td>Technical assistance project</td>
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<tr>
<td>TDC</td>
<td>Technology Development Center, Western New York</td>
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<tr>
<td>TFP</td>
<td>Total factor productivity</td>
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<td>TRP</td>
<td>Technology Reinvestment Project</td>
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Preface

Philip Shapira
and
Jan Youtie

The Manufacturing Extension Partnership (MEP) is a collaborative program between federal and state governments that provides technology and business development services to small and medium-sized manufacturers in the United States. MEP's federal sponsor, the National Institute of Standards and Technology (NIST), also involves state and local governments, educational institutions, business assistance and technology centers, private consultants, utilities, and a variety of other public and private organizations to support the services the MEP offers to manufacturers.

By 1997, a network of 75 MEP centers and affiliates were operating in all 50 states. Some 62,000 manufacturing firms have been assisted by the MEP since 1988. About 2,500 public and private organizations are affiliated with the program. Over 2,000 MEP staff are involved in service delivery at the local levels through MEP centers and affiliates. Current MEP service loads approximate 30,000 firms a year.

The MEP is shifting from the rapid growth and system building phase of 1992 to 1997 to a situation of maturity. Now at the forefront are issues of system optimization, center performance, and program efficacy. As a result, efforts to evaluate the program's outcome and impacts are refocusing toward questions such as: How well is the program working? And how can performance and effectiveness be improved?

To address these questions, the MEP has made a substantial commitment to evaluation. The program established an overall evaluation system, which standardizes financial and activity reporting and post-service surveying. In
addition, some local centers have invested in additional evaluative activities beyond the national system, as a result of specialized internal capabilities, distinctive state and local stakeholder demands, or other factors.

The MEP has also supported special evaluative efforts to learn about and assess MEP services and activities. Federal and local resources have been allocated to support both quantitative and qualitative MEP studies to provide information for continuous improvement of the program and policy development. Some of these studies concentrate on the end customers, small and mid-sized manufacturers and how the program has affected their behavior. Other studies aim toward the delivery of services. In this vein are examinations of the efficient and effective use of center resources, the responsiveness and quality of center service delivery, and the performance of different modernization approaches.

Operating as both the subjects and end-users of these studies are center and program staff. They seek to make better operating and management decisions. Their attempts to implement recommendations and changes to improve their programs are constrained by limitations imposed by the evaluative system. First the types of results that can be expected from evaluative studies are often characterized by qualifications that make it difficult to link with decision making and staff performance. Most studies have difficulty gathering accurate information from small manufacturers that themselves cannot gauge company impacts. They are affected by the broader business, technological, regional, and policy environments in which the program and its customers operate. And they often cannot adequately account for perhaps larger downstream impacts of assistance on the "customers of MEP customers" and impacts on regional economies. Second, a substantial amount of the effort of evaluation goes toward measuring and documenting program successes for funding sponsors and policy makers, rather than toward guiding efforts to enhance the program (which may involve exposing program weaknesses as well as successes).

What can be learned from evaluation efforts which have tried to address these and other program improvement issues? What are the implications of these studies for MEP program operations and center service mix? And what message do the results of these studies send to policy makers and other stakeholders? To address these and related questions, a workshop was held at Aberdeen Woods in Atlanta, Georgia, in November 1997. The workshop reviewed and discussed findings and results from evaluative studies of industrial modernization and technology deployment. Workshop participants also considered the implications and insights of these studies for program improvement and policy development. Participants addressed these themes through paper presentations and discussions over a one-and-one-half day period. This volume makes the workshop materials and discussions available to a wider audience.

The papers in these proceedings are structured into six major sections. In this first section, there is a keynote paper by Oldsman and Luria on integrating strategy and evaluation in the Manufacturing Extension Partnership. The authors focus on how evaluation can
be made more relevant to MEP stakeholders. This is followed by three contributions that report the results of recent evaluation studies of industrial modernization programs. Jarmin combines national Census Bureau data with data on program impacts to assess the productivity effects of program assistance. Shapira and Youtie report on the evaluation of Georgia’s manufacturing extension program, while Ellis presents the findings from a comprehensive evaluation of the Massachusetts program.

The third section of the proceedings considers organizational issues in the promotion of industrial modernization. Wilkins discusses the preliminary results from a consortium of MEP centers that have engaged in the joint benchmarking of their operations. In this unique effort, the centers pool operational data to determine similarities and differences in program management. Youtie and Shapira examine service partnerships between MEP centers and other business assistance programs, particularly small business development centers. Kingsley and Klein review the findings from their assessment of case studies of industrial networks.

The next section of the proceedings presents a set of comparative insights offered from a transatlantic perspective by Arnold. Through both the paper and subsequent discussion, workshop participants recognized the great value of comparison and mutual learning between the MEP and its European counterparts.

The next section of the proceedings considers issues related to using evaluation in decision making. In separate papers, Davila and Martin discussed their experiences as program managers in using evaluation systems and results. Finally, Sears and Blakerby, in the section on the feedback of evaluation into policy and program design, review the development, current situation, and future aims of the MEP evaluation system. This section also includes Malecki’s overall comments as the workshop rapporteur.

After each major section, the comments of workshop discussants and participants are presented in a summary form.

This volume of papers is the fourth in a series. Three other edited collections of papers from 1993, 1994, and 1996 workshops on evaluating industrial modernization are also available. An index to all available papers produced between 1993 and 1997 is contained in the Appendix. These papers are also available through the world wide web at: <http://www.cherry.gatech/workshop>.

Atlanta
March 1998
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Workshop on Manufacturing Modernization: Implications of Evaluation Results for Program Improvement and Policy Development

November 13-14, 1997
Aberdeen Woods, Atlanta, GA.

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Chris Thompson - Consultant, Baltimore, MD.

Tab Wilkins, Director, Conn/STEP, New Britain, CN.

Jan Youtie, Senior Research Associate, Economic Development Institute, Georgia Institute of Technology, Atlanta, GA.
Part I.

Strategy and Evaluation in the MEP
Introduction
From the outset, the NIST Manufacturing Extension Partnership (MEP) has been committed to evaluation and continuous improvement. This commitment is manifest in a broad range of activities. The MEP requires all affiliated manufacturing extension centers to submit extensive data on program resources and activities on a monthly basis. It also has supported a pilot project involving 17 centers from nine different states to develop a set of measures that can be used by management to monitor internal performance. (See the paper by Wilkins in these proceedings, pp. 83-90.) These efforts are intended to ensure center accountability, chronicle important performance trends, and highlight operating efficiencies. However, like other public programs, the MEP is also being asked to document program effectiveness. Congress, state legislatures and other sponsors are all interested in program results, though different sponsors have different expectations. The very public nature of the MEP program makes it difficult to arrive at a clear and consistent statement of both program objectives and the basic principles under which it should operate. These differences are part of legitimate debate within the political process.

To meet the demands of disparate stakeholders, MEP has taken a broad view of program objectives and associated measures of program outcomes. Unlike many programs, the MEP is making a concerted effort at measuring program outcomes using three different techniques:

- A follow-up survey of participating companies conducted nine months after the completion of major projects\(^1\) asking respondents to indicate impacts with respect to sales, labor costs, material costs,

\(^1\) Major projects are defined as activities requiring eight or more hours of center staff or third-party service provider time.
inventory costs, capital investment, and jobs.

- A series of studies employing quasi-experimental designs in which the performance of participating manufacturers is compared to that of similar, non-participating firms.

- A series of case studies of exemplary engagements based on a conceptual model linking services to program outcomes.2

Finally, the MEP conducts formal reviews of manufacturing extension centers as part of the funding process. These periodic reviews provide feedback on strengths and weaknesses of individual centers based on inputs from the regional manager and panel members, including representatives of other centers.

Preliminary Results and Challenges
The picture that emerges from these evaluation efforts is generally positive. In a relatively short period of time, MEP has been successful in establishing a nationwide program that has already reached tens of thousands of manufacturers. Substantial time and energy has been devoted to establishing new organizations, building necessary partnerships, conducting extensive outreach campaigns, and providing services to companies across the country. Moreover, despite expected growth pains, the MEP has already witnessed a return on its investment. All attempts to measure outcomes to date have reached the same basic conclusion – many companies benefit from participation in the program, some enormously.

The MEP is to be commended for its early success, but it should not rest on its laurels. It needs to grapple with the hard realities of forging a national program dedicated to continually expanding its effectiveness while simultaneously improving operating efficiencies and moving closer to self-sufficiency. For example, centers need to figure out how they can devote a greater share of staff time to project work – based on the initial results of the pilot center benchmarking project, it appears that in a typical center roughly 30 percent of field staff time is spent on project work conducted under a signed written agreements with manufacturing clients. The rest of the time is spent on informal services, client relationship-building, marketing and sales, administration and other necessary functions. All centers need to take a hard look at core business processes with the express purpose of identifying areas for improvement. Similar to the demands facing American manufacturers, manufacturing extension centers need to identify any resources that are not being used as productively as they could and take corrective action. Any waste, if it exists, should be eliminated.

In a related vein, centers need to figure out how to broaden and deepen impacts within the manufacturing community. While the MEP has had an impact on numerous companies, it appears that some manufacturers have benefited substantially more than others – a small percentage of firms account for the bulk of measured impacts. In this regard, the level of effort devoted to firms matters. Manufacturers that receive more assistance from manufacturing extension centers tend to reap the greatest benefit. However, there are probably a host of other factors in terms of both the nature of services and characteristics of firms that contribute to higher performance. Manufacturing extension centers need to identify these factors in order to replicate them in as many companies as possible.

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At the same time, centers are under pressure to serve the broadest market possible. As a result, given finite resources, many small manufacturers receive only limited assistance. The tension between intensive work with a small number of firms and broad outreach is common among public programs, reflecting the competing objectives of program sponsors. Here again, manufacturing extension centers need to identify the best ways to reconcile these conflicting interests.

**Asking Different Questions**

Evaluation can play a role in helping the MEP and affiliate centers address these and other concerns. However, to be most useful, evaluation efforts within the MEP system need to place greater emphasis on learning, focusing more attention on ways to strengthen the program in addition to providing a solid justification for continued funding. The evaluation should provide program managers and staff with information needed to improve performance over time — it should carefully document what works, what doesn’t and why.

In this regard, the evaluation system should be designed to provide answers to the following questions:

- What are the characteristics of high performance companies? Why are some companies more “globally competitive” than others? What manufacturing practices have high performance companies adopted that others have not?

- What specific services are most likely to cause companies to adopt manufacturing practices that lead to higher performance?

- How can centers best reconcile the competing objectives of maximizing impacts and market penetration while achieving self-sufficiency? How can center strike a appropriate balance among conflicting interests of program stakeholders?

Answers to these and other similar questions are central to the continued success of the American manufacturing extension system.

**Specific Recommendations to Improve the Evaluation System**

We propose five specific recommendations to improve the MEP evaluation system.

- **Refine performance measures.**

Current outcome measures — as reflected in the follow-up survey — include changes in sales, labor costs, material costs, inventory costs, and capital investment, as well as job creation and retention. The MEP should review these measures to ensure that they are valid measures of what the program is trying to accomplish. In particular, given its emphasis on competitiveness, the MEP should measure productivity gains within manufacturing firms served by affiliated centers. Increasing productivity underlie improvements in profits and wages and is arguably the most important objective of the program. The current Follow-Up Survey does not capture the data required to calculate measures of productivity such as sales per employee or value-added per employee.

In addition, downstream impacts such as a change in sales may be subject to significant measurement error due to their distance from the actual substance of projects (e.g., nine months later, how could a company make a reasonable estimate of the effect of a 16-hour project on LAN selection on its sales?) Many intermediate impacts with respect to new skills and capabilities and improved manufacturing performance (e.g., scrap, customer rejects, machine run-time, etc.) may be missed — yet, these impacts are much more closely tied to the immediate project objectives.
and may be huge. If implemented, these measures serve as leading indicators of desired policy outcomes and provide program managers with the most useful guidance on directions for service delivery.

- **Help individual centers address questions raised by state legislators.**

  The MEP should devote resources to providing evidence of the extent to which the program contributes to an increase in jobs and regional economic growth - two important issues often raised by legislators. Each center is under pressure to document results, but are hard pressed to collect necessary data and perform credible analyses. The follow-up survey should be revamped to meet this need and greatly simplified in the process.

  For example, the MEP could conduct a straightforward annual survey of all companies that have participated in the program aimed at getting a simple, yet defensible estimate of the economic and fiscal impact of the program. One could go a long way with just two questions: How many people do you currently employ? How many people would you have employed had you not received MEP services? Job impacts can be translated into estimates of changes in gross state product as well as fiscal impacts using standard ratios after adjusting for displacement effects. The MEP should assume responsibility for calculating these impacts and reporting results back to the respective centers.

  The follow-up survey also should be used to obtain direct feedback from clients concerning different elements of the program model. For example, it could include a series of Yes/No questions such as: Have you received information that you otherwise would not have been able to obtain on your own at an affordable cost? Have you changed your operations as a direct result of the assistance provided? Did manufacturing performance at this plant improve as a result of these changes? Is the company more competitive than it otherwise would have been? Is the company more profitable? Has it grown? Would the company have survived in the absence of assistance? Are you satisfied with the services received? Answers to these questions would round out the analysis, providing further evidence of impacts based on the underlying logic of the program. To the extent possible, the results of the survey should be used to test hypotheses concerning the distribution of reported benefits among participating companies.

  The MEP should consider whether a stratified, random sample of participating companies might make more sense than a complete census. All companies served in the previous year would be eligible. Centers should not be allowed to remove companies from the sample frame by using the reporting code "N" in activity data logs submitted to the MEP. Oversampling certain strata would help ensure that companies most likely to have registered large impacts would be included in the sample. A well-designed sampling strategy would allow the MEP to extrapolate results to companies that received assistance, but were not surveyed.

- **Continue to support large-scale quasi-experimental studies as part of summative evaluation.**

  The follow-up survey should be supplemented with more rigorous evaluation methods that provide more definitive assessments of program impacts. The follow-up survey relies on clients to report impacts based on self-assessments without benefit of baseline data. This approach may be open to criticism. It presumes that clients are able to provide an objective and accurate estimate of what would have happened in the absence of assistance. Furthermore, it assumes that this
can be done even though some of the measures are far afield of specific projects and therefore results are subject to a wide range of other contributing factors. In contrast, quasi-experimental studies – like the Census Longitudinal Research Database Study – compare actual changes in performance of participating companies to that of similar, non-participating companies, using statistical techniques to isolate program impacts. The MEP should continue to support large-scale studies that employ this technique to determine the extent to which the program has had a material impact, particularly on plant productivity.

- Undertake comprehensive studies to identify best practices within high performance firms and manufacturing extension centers.

MEP should support studies employing a combination of rigorous quantitative and qualitative techniques to determine the factors contributing to success within manufacturing firms and manufacturing extension centers. All of these studies should be oriented toward explicit recommendations for decision-makers with sufficient detail for implementation. The research agenda should evolve as questions are answered and new issues emerge.

With respect to companies, these studies should pay particular attention to developing a better understanding of the factors that contribute to the highest levels of performance found in the distribution, including the underlying characteristics of firms and the nature of services provided to them. Rigorous case studies should be used in conjunction with broader surveys to provide insights into important causal relationships. Case study work should include cross-case analysis that gets at underlying reasons for different levels of performance.

- Integrate evaluation with ongoing strategic planning and operations.

One of the major challenges facing those involved in evaluation is to make it more useful to decision-makers within the MEP community. Many of the current activities are focused on program justification. Less emphasis has been placed on systematic learning in terms of drawing out clear implications for program improvements from the results of evaluation efforts.

To some extent, people have been unwilling or unable to use information gleaned from evaluation efforts to make decisions about the program. A number of factors contribute to low utilization, including issues related to the relevance of the subject matter, the reliability of data and quality of analysis, and the form in which results have been communicated. To encourage greater utilization, program managers need to be more closely involved in the design of evaluation efforts and better appraised of their results. All evaluation studies should have a clear strategy for disseminating results in a manner that is accessible to program managers and staff throughout the MEP system.

Given resource constraints within affiliated centers, the burden for evaluation should continue to rest primarily with the MEP. However, the MEP should encourage centers to perform their own evaluations as well, focusing on issues of particular concern to center directors and other local stakeholders. The MEP should provide technical assistance for these efforts to help ensure quality and, where appropriate, share findings with the entire MEP community. Simplifying the follow-up survey for administration on an annual basis will free valuable bandwidth that can be used by MEP and affiliated centers to undertake a broader range of evaluation activities.
The MEP has made great headway over the last few years and has established a solid foundation for continued success. As part of this effort, the organization has invested considerable resources in performance measurement and program evaluation. The challenge is now to make evaluation more relevant to the day-to-day activities of program managers, center directors and field staff. In a political environment where resources are tight, the natural tendency is to focus on program impacts. However, continuous improvement requires organizations to examine all aspects of their operations with a critical eye, constantly searching out weaknesses and crafting appropriate responses to effect necessary change.
Discussion

Martin. Regarding the evaluation of centers from a national perspective, what are the implications of a poorly performing center? Will we have private sector implications for a poorly performing center, since we’re basing the program on the private sector model? Will we close down poorly performing centers?

Haines. It would be the intent of the Congress that we do that. We have a capacity problem throughout the country. We have some centers that are under capacity. No center has a growth strategy, but without a growth strategy how will we serve the public? Many centers have the view that center capacity is constrained by lack of public dollars. Congress will expect us to look to the good centers and give more resources to the good centers that are under capacity. It is hard to say that we’ll close a center. With good performance at least the logic is behind you.

Coburn. Ten years ago we closed one Edison center in Ohio. We worked up to it. We worked with the legislature. We worked with the press, indicating that we were running the program like a private sector enterprise. The program’s stature went up dramatically as a result.

Thompson. What is NIST’s expectation? Is it that the state’s strategic plans should correspond to NIST MEP’s funding? Yet, NIST MEP’s funding is declining.

Haines. Yes, but there are few states where the state is the long-term investor.

In most cases, we are the long-term investors. We do have a line of communication with the states. We’re working on it through various projects that will allow us to go back to the states and talk about strategy. My goal is for NIST MEP to at least be recognized in some states’ strategic plans. And with many states going into performance metrics, wouldn’t it be nice for us to lead the states.

Arnold. When we start thinking like an investor and try to get a return, we’re doing what the private sector is doing. But in fact, the reason we have the program is that we’re actually doing something that only the state can do. It’s the idea of market failure and additionality.

Haines. I would agree. That needs to be explicit.

Thompson. How would you do a stratified random sample given that the number of centers is small?

Oldsman. Survey all the small centers but sample from the big centers. Then it really depends on the question. Sales has a lot of variation—you may need to do more surveys to estimate sales impacts.

Jarmin. Another approach is to do a random sample of the whole population and ask, “Were you served by the MEP?”

Martin. There is a problem. A lot of people will be clients but don’t remember they were clients.

Jarmin. Well what does that say?

Martin. You have to know what is going on in the field for you to know how to survey.

Oldsman. Some centers that act as brokers don’t publicize their name. The company may only know the field agent. But I think that’s a bad thing.

Estes. My concern is that the data point on which we rely is provided by the client to the system. And we don’t get even enough responses from the clients—maybe one-third respond. Plus the
respondent may have been in a hurry. We shouldn't rely so heavily on the frame of mind of the person providing the data point.

**Oldsman.** I agree. We are interested in figuring out what works and what doesn't work. We don't care about a number. Why is it that the majority of the companies don't think they have impacts? I'm concerned about that. Not because people should be answering surveys in better ways, but from other evidence as well.

**Shapira.** You have to qualify that. Only a small percentage of firms have an economic impact. But we know that a large percent have impacts in terms of improving their capabilities. If you postulate this as the role of the program you may ask the survey questions differently.

**Oldsman.** But it is really a red herring. You can say the goal of the program is to improve the performance of the firm. So if you don't get good answers on the sales, jobs, etc. you can then say, "Ok I misstated the goal of the program." The results could mean one of three things: (1) the measurements were wrong, (2) the measurement (question wording) was bad, or (3) I believe the results. I personally find it difficult to disbelieve the results.

**Blackerby.** There is a problem of overemphasis on the survey. There's an idea that the survey is an either-or thing. The problem of over sampling means that it is either a census or a sample. But the answer might be an 'and' instead of an 'or'. There could be an underlying census with a sampling overlay to answer specific questions. For example, NIST MEP current has questionnaire variations to deal with additional questions required by the state of Pennsylvania, or additional questions that explore environmental impacts.

**Oldsman.** But the survey is not a census right now. It's a weird thing. Because we give centers the right to "N" out companies, to say, "I don't not want this company surveyed."

**Malecki.** Time is an issue. Companies get skill and know-how, but it may take a longer time to have impacts. Companies may need money or need to hire the right person. This may take a long amount of time.

**Oldsman.** I think it is an empirical question. Scrap reduction programs tend to have a rapid impact. The MEP system provides a fair amount of plant layout as well. Based on the predominance of these types of projects, you ought to see reduction of lead times right away.

**Malecki.** We don't know when implementation took place.

**Oldsman.** Some projects are design-build projects and other programs are rendering advice.

**Korchak.** We're running two evaluation systems. Florida went through a pay-for-performance system i.e. to get your money you have to tell the state what you are doing. Be careful about having an annual survey, which wouldn't work for my state. That's not frequent enough. Considering what states want out of evaluation is an important issue. Is there a way to standardize this?

**Russell.** Even if we were at a point where we asked the right thing and agreed generally about targeting sectors and segments that you served, and even if we faced recognition of increasing the size of the typical project, there remains the problem of translating that into center practice. In a decentralized system, the language used expresses culture where
there is guidance, but not mandatory conformance. Going toward high performance, whatever that means, goes to a community culture where peer pressure matters and everybody feels responsible. That is hard to create.
Part II.

Results and Implications from Program Evaluation Studies
Overview
This paper presents preliminary results from an investigation of the effects of manufacturing extension on the productivity dynamics of client plants. Previous econometric studies of manufacturing extension had very little time series information. This limited what researchers could say about the relative timing of extension services and performance improvements. In turn, this makes it difficult to attribute performance improvements to the receipt of extension services. In this paper, I use a panel of client and nonclient plants to more carefully analyze the dynamics of extension and productivity. Preliminary results suggest that the timing of observed productivity improvements at client plants is consistent with a positive impact of manufacturing extension. Estimated program impacts are within the range of those found in previous studies.

Introduction
In recent years, a consortium of state, local and federal agencies have created a nationwide network of manufacturing extension centers designed to help the nation's 370,000 small and medium sized manufacturing enterprises (SMEs) improve productivity and become more competitive. The premise behind manufacturing extension is that smaller manufacturers have failed to adopt modern production technologies and business practices at same rate as their larger counterparts. Proponents of manufacturing extension argue that this explains the persistent performance gap between small and large manufacturers (see National Research Council, 1993). Because SMEs form an important link in the supply chain, they further argue that this performance gap hinders the global
competitiveness of the entire U.S. manufacturing sector. Manufacturing extension centers are intended to provide SMEs with unbiased information on modern technologies and business practices that the market has failed to deliver.

As the name might suggest, manufacturing extension is modeled loosely on agricultural extension. Locally based manufacturing extension centers perform education and outreach much like county extension agents do. Following an assessment of a plant's needs, a center might then contract with the plant to provide business or technical assistance\(^1\) or may direct the plant to consultants or vendors that can solve the plant's problems. Even though they are part of a nationwide network, the operation of individual centers varies greatly.

Federal support for manufacturing extension is handled through the National Institute of Standards and Technology's (NIST) Manufacturing Extension Partnership (MEP). Several states have operated extension centers for decades. However, the creation of the MEP in 1989 spurred rapid growth in manufacturing extension programs around the country (see Feller, 1997, GAO, 1995 and National Research Council, 1993 for more details about the development of manufacturing extension programs). In 1995, federal support for manufacturing extension was $138.4 million, up from $6.1 million in 1988 (see GAO, 1995). Since federal support must be at least matched by state and local funds, total expenditures on manufacturing exten-

\(^1\)Typical services provided centers include marketing and sales assistance ISO-9000 certification and changes in plant layout. See NIST (1997) for a collection of case studies about individual projects.

sion activities in the U.S. are much larger.

Naturally, in this time of tight budgets, policymakers want to know if the tax dollars spent on programs, such as manufacturing extension, produce the desired benefits. As part of its enabling legislation, NIST/MEP was directed to evaluate its activities and demonstrate its effectiveness. In addition, the Government Performance and Results Act, passed by Congress in 1993, will soon require all federal agencies to more formally demonstrate the effectiveness of their programs. The lessons learned evaluating manufacturing extension and other programs suggest that fulfilling this mandate will be difficult, as there are several data and methodological issues that must be addressed in order to credibly demonstrate that government programs yield the intended benefits.

Despite the efforts of many researchers employing several different data sets and methodologies, we can still not definitively say that manufacturing extension services cause improved performance at client plants.\(^2\) Although several papers (see Jarmin, forthcoming, Shapira and Youtie, 1997, and Nexus Associates, 1996) demonstrate that client status is associated with increases in productivity, none have shown that extension services caused these increases.

The problem is that researchers can never observe what a client plant would have done had it not received assistance from a manufacturing extension center. Thus, researchers are forced to try to imperfectly replicate this experiment by either comparing client per-

formance before and after receiving services or by comparing the performance of client plants to a control group of nonclient plants. Unfortunately, we cannot observe and control for all of the factors that, in addition to manufacturing extension, influence plant performance.

The best way to get around this problem is to randomly assign plants to treatment (i.e., those that receive extension services) and control groups. If this is done, then we can reasonably assume that the only systematic difference between the two groups is client status, and can then conclude that any observed differences in their performance must be attributable to manufacturing extension.

Unfortunately, controlled randomized experiments are not a feasible option for evaluating programs, such as manufacturing extension. Therefore, we must evaluate these programs with non-experimental data. Given this constraint, a researcher wants to specify and estimate an empirical model that mimics a controlled experiment as closely as possible. This requires that we control, to the greatest extent possible, for the unobserved influences that may bias estimates of program impact. The best empirical methodology for accomplishing this is to use panel data to estimate a fixed effects model. Adequately controlling for these unobserved effects requires several time series observations per plant. However, no study of manufacturing extension, to date, has had more the two observations per plant.

This raises two issues concerning the robustness of the results of these studies, which generally find a positive association between manufacturing extension and improved plant performance. Namely, fixed effects estimators are most effective in controlling for unobserved heterogeneity when there are several time series observation per plant.

The current studies do not deal adequately with the issue of the timing of performance improvement relative to the receipt of services. For example, Jarmin (forthcoming) finds evidence that manufacturing extension clients exhibited more productivity growth between 1987 and 1992 than did non-clients controlling for a number of factors including selection bias. What is not known is when the performance improvements occurred. If they happened towards the beginning of the period, before most client plants received assistance, then it is likely that the estimated impact of manufacturing extension services is spurious.

In this paper, I construct a panel data set with annual data for 815 client and 5739 nonclient plants from 1987 to 1993. I use this data set to compare the productivity dynamics of clients and nonclients. The longer panel allows me to more fully control for unobserved differences (e.g., managerial ability) between client and nonclient plants that may bias estimates of program impact. The panel data set also permits a more careful analysis of the relative timing of service provision and performance improvements. The results indicate positive program impacts with estimates that lie within the range of those from previous studies.

Data
As in Jarmin (forthcoming), the data used here are from 2 sources. First plant level production data are taken from the Census Bureau’s Longitudinal Research Database (LRD). The LRD is constructed by linking plant level data from the Censuses and Annual Surveys of
Manufactures. Due to its comprehensive and longitudinal nature, the LRD is, perhaps, the best data set available for evaluating the impact of government programs on manufacturing establishments. Second, manufacturing extension client data come from nine manufacturing extension centers in three states. NIST/MEP arranged to have these centers provide client records on a confidential basis.

All the primary data items used in the analysis below are taken from the LRD. The client records are used to identify which plants in the LRD received extension services and when. To identify extension clients in the LRD, I match client records to the Standard Statistical Establishment List (SSEL) using names, addresses and other information shared across the two data sets. The nine extension centers provided just under 12,000 project level records from 4,185 establishments. I was able to match 2,977 (or 71.1%) of these establishments to the LRD (via the SSEL).

In order to compare the productivity dynamics of extension clients to nonclients, I examine a panel of plants that were in the LRD in 1987 and each year of the 1989 to 1993 ASM panel. In the three states, in which the nine extension centers operate, there are 5739 non-client plants that meet this requirement. There are 815 client plants that meet this and the additional requirement that they had completed at least one project before the end of 1993. Approximately 65% of client and 62% of nonclient plants also appear in the LRD in 1988.

Restricting attention to plants in the LRD with annual data yields a sample that is not representative of either the client or nonclient establishment populations. The plants examined in this paper are considerably larger and more productive the average plant. Thus, one should be careful to note that estimates of program impact obtained from this sample may differ from what would be obtained if we had similar data for the entire manufacturing establishment universe.

**Empirical Model and Results**

The general empirical framework for examining the impact of extension services on the productivity dynamics of client plants is the following Cobb-Douglas production function

\[ Y_{it} = A e^{\lambda t} e^{\delta Ext} K_{it}^{\beta 1} L_{it}^{\eta 1} M_{it}^{\eta 2} e^{c_{it}} \]  

(1)

where \( Y \) is total value of shipments adjusted for changes in inventories and deflated using 4 digit Gray-Bartelsman deflators, \( M \) is material and energy inputs (also deflated by 4 digit deflators), \( K \) is the capital stock constructed using the perpetual inventory method, \( L \) is the total number of employees and \( Ext \) is a measure of extension services. Within this framework, I estimate the impact of

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3The LRD and other micro data sets are housed at the Census Bureau's Center for Economic Studies (CES). These data are confidential and can be accessed only by special sworn employees (not necessarily Census Bureau employees) at CES or at regional data centers in Boston or Pittsburgh.

4For more details on the matching process see Jarmin (forthcoming). The SSEL is used since the LRD does not contain names and addresses for matching. The LRD and the SSEL share common establishment identifiers that facilitate linking the matched client records to the LRD.

5The ASM is a rotating five year panel. All plants with more than 250 employees are included in the ASM with certainty. A probability sample of smaller establishments is also included. However, noncertainty plants can not be selected in to consecutive ASM panels.
extension services on both labor and total factor productivity (TFP). Labor productivity is defined as real value added per worker. TFP is defined in the conventional way as

$$\text{TFP}_{it} = \frac{Y_{it}}{K_{it}^{\beta_i} L_{it}^{\eta_i} M_{it}^{\eta_i}}$$  \hspace{1cm} (2)$$

The weights in the TFP calculation are computed using average cost shares for each plant.\(^7\)

Table 1 provides summary statistics for the main variables used in the analysis below. The plants identified as clients are, on average, larger and more productive than nonclient plants. Simple level comparisons, however, say little about the effectiveness of manufacturing extension programs. To evaluate manufacturing extension we want to follow and compare the performance of client and nonclient plants over time.

Figure 1 shows the timing of the services received by the extension clients examined in this paper. Just over half of the clients received services before 1990 and 90% had been served by 1992 (by definition, all had been served by 1993). Given figure 1, if we were to observe most of the performance improvement at client plants occurring towards the beginning of this period, we would seriously question whether extension services had any role.

Figures 2 and 3 show how the productivity performance of client plants relative to 4 digit SIC industry averages evolved over the period from 1987 to 1993. Figure 2 depicts the relative level and the one and three year growth rates of labor productivity and figure 3 provides the same information for TFP. In both cases we see that client plants move up their industry productivity distributions over this time period. Further, the bulk of this movement occurs after 1990 and, thus, is at least consistent with a positive impact of manufacturing extension services. It also appears that productivity growth rates increase relative to industry averages over this period especially for labor productivity.\(^8\)

To more rigorously test whether extension services had any impact on the improved relative performance of client plants, I estimate several regressions, all of which are variants of the following two models:

$$\Delta \log(\frac{V W}{L}) = \alpha + \delta \text{Ext}_{it} + \beta \Delta \log(\frac{K}{L}) + (\mu - 1) \Delta \log(\frac{L}{V}) + \varepsilon_{it}$$  \hspace{1cm} (3)$$

$$\log(\text{TFP})_{it} = a + \delta \text{Ext}_{it} + \varepsilon_{it}$$  \hspace{1cm} (4)$$

In several cases, dummies for 4 digit industry, year and state are also included. The parameter, \(\delta\), on the extension variable (Ext) measures the impact of extension services on productivity. One of the main concerns in trying estimate the program impact parameter, is that unobserved variables that influence produc-

\(^6\)Real value added is measured as shipments adjusted for changes in inventories and deflated minus deflated materials and energy costs.

\(^7\)Namely

$$n_i = \frac{1}{7} \frac{\sum SW_{it} \varepsilon_i}{TVS_{it}}, \hspace{0.5cm} \eta_i = \frac{1}{7} \frac{\sum M_{it} \varepsilon_i}{TVS_{it}}, \hspace{0.5cm} \beta = 1 - n_i \eta_i$$

where SW is total salaries and wages and TVS is total shipments.

\(^8\)Note that, since a large number of plants are missing from the panel in 1988, the peaks in the one year growth rates (1st differences) and the troughs in the one and three year growth rates at 1989 and 1990, respectively, are outliers.
tivity, such as managerial quality, may be correlated with client status. In this case, estimates of program impact may be biased upwards.

If these unmeasured influences are relatively fixed over time, using difference or within estimators of (3) and (4) will yield unbiased estimates of program impact. Alternatively, if there are instruments available that are correlated with client status but not with the unobserved variables that influence productivity (and are captured in the error term), two stage estimation methods can be employed to obtain unbiased estimates. Luria and Wiarda (1996), Nexus Associates (1996) and Shapira and Youtie (1997) have employed difference estimators, and Jarmin (forthcoming) has used both of these approaches to estimate the impact of manufacturing extension services on client productivity.

However, none of these studies have more than two time series observations per plant. Difference and within estimators are more reliable with longer panels. Further, with only two observations per plant it is not possible to tell if productivity growth rates improve after clients receive services. Rather, it's only possible to determine whether client productivity growth is faster or slower than that for nonclients.

With the longer panel used in this study it is possible to test both whether client growth rates are greater than those for nonclients and whether client growth rates increase after receiving services. To do this I use two measures of client status in the regressions below. First, I define the dummy variable \((\text{Ext A})_i\) to equal 1 if plant \(i\) was ever a client and 0 otherwise. This variable measures the mean difference in the dependent variable between client and nonclient plants and does not vary over time. This is the same measure used in Jarmin (forthcoming) and Shapira and Youtie (1997). Second, I define the dummy variable \((\text{Ext B})_i\) to equal 1 if plant \(i\) is or was a client in period \(t\) or before, and 0 otherwise. That is \((\text{Ext B})\) is 0 before plants receive extension services and 1 afterwards and, thus, measures the mean difference between plant year observations for plants that have not yet received extension services and plant year observations for plants that have.

Tables 2 through 7 provide the results of several regressions based on the models given in equations (3) and (4). Tables 2 and 3 contain estimates of the impact of extension services on labor productivity using the client - nonclient (Ext A) and before - after (Ext B) extension measures, respectively. In both cases, the 3rd difference and within estimates suggest positive and significant program impacts. The level regressions show that, once other factors are controlled for, the clients in this sample are less productive than nonclients (this is also evident in figure 2).

The first difference results suggest that the program has a negative but insignificant effect. However, taking differences tends to increase the noise in the data. Griliches and Hausman, (1986) discuss this and point out that this problem is most severe with 1st differences and can be alleviated somewhat by taking longer differences. The increased noise can be seen in the small and insignificant capital coefficients in the 1st difference regressions in table 2. Notice the capital coefficients improve somewhat when taking longer differences. Thus, the weak 1st difference estimates of program impact are not surprising.
The magnitudes of the 3rd difference and within impact estimates are smaller than those in Jarmin (forthcoming) but larger than those in Shapira and Youtie (1997). However, the plants here are larger than in the other studies and it is likely that extension projects simply do not have as large an impact (on a percentage basis) at large plants as they might at smaller plants. This might be due to both the fact that at larger plants the projects are smaller relative to the scale of the plant’s operations, and that large plants pursue more productivity enhancing activities besides participating in manufacturing extension than do smaller plants.

Many policymakers might be concerned if it was the case that the improvements in labor productivity observed at manufacturing extension client plants were due primarily to reductions in employment. Table 8 provides some descriptive statistics that suggest that this is not the case. In the table, plants are divided into 4 quadrants as in Baily, Bartelsman and Haltiwanger (1994). These are defined by determining whether plants had productivity and employment increases or decreases between 1987 and 1993. The table shows that a larger proportion of client plants were in Quadrant 1, the so-called successful up-sizers, and smaller proportions of clients were in the other three Quadrants. Clients also had a larger proportion in the first two Quadrants (i.e., those that were “successful” by increasing productivity).

Tables 4 and 5 look at the impact of manufacturing extension services on total factor productivity. The results are quite similar to those for labor productivity. Larger and more significant estimates of program impact are obtained from the 3rd difference and within estimators. The estimated impacts on TFP are also smaller than for labor productivity which we might expect after comparing figures 2 and 3 which also suggest that clients experienced more growth in value added per worker than in TFP.

Tables 6 and 7 contain before-after regressions that are estimated using client plants only. Thus, the extension coefficients in these regressions strictly measure changes in client plant performance after receiving extension services. The estimated program impacts on labor productivity in table 7, while following a similar pattern to those in table 3, are smaller and insignificant when dummy controls are included. In table 8, the estimates of impact of TFP show no significant impact.

**Conclusions**

This paper presents preliminary results from an investigation of the effects of manufacturing extension on the productivity dynamics of client plants. These results suggest that the timing of observed productivity improvements at client plants is consistent with a positive impact of manufacturing extension. Estimated program impacts are within the range of those found in previous studies. However, more still needs to be done before we can convincingly argue that manufacturing either does or does not have a significant impact on the performance of client plants. In particular, by examining the timing of extension projects, plant level investment behavior and productivity, we may be able to get closer to a causal story. Work on this is underway.
Acknowledgements
This research is funded by the National Institute of Standards and Technology’s Manufacturing Extension Partnership. I would like to thank Don Siegel for helpful comments. Any findings, opinions or conclusions expressed here are those of the author and do not necessarily reflect the views of the Census Bureau of NIST.

References


Table 1
Descriptive Statistics

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<th>Clients</th>
<th>Nonclients</th>
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<td>Number of Obs</td>
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<td>log(VA/L)</td>
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Table 2
All Plants / Client - Nonclient Comparison
Dependent Variable: \( \log(VA/L) \)

<table>
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<th>Variable</th>
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1 Includes 4 digit industry, state and year dummies.

***Significant at the .01 level; **significant at the .05 level; *significant at the .1 level.

Table 3
All Plants / Before - After Comparison
Dependent Variable: \( \log(VA/L) \)

<table>
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<td></td>
<td></td>
<td>0.025**</td>
<td></td>
</tr>
<tr>
<td>log(K/L)</td>
<td>0.368*</td>
<td>0.263*</td>
<td>-0.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.004)</td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.009</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.019)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.039**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.013)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.025***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.014)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.053*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.009)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.053*</td>
<td></td>
</tr>
<tr>
<td>log(L)</td>
<td>-0.002</td>
<td>-0.010*</td>
<td>-0.329*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.021)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.336*</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>(0.022)</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>-0.199*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.208*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.180*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.011)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.176*</td>
<td></td>
</tr>
<tr>
<td>Dummies</td>
<td>No</td>
<td>Yes*</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>42600</td>
<td>42600</td>
<td>33580</td>
<td></td>
</tr>
<tr>
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<td>23084</td>
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<td></td>
<td>23084</td>
<td>42600</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>42600</td>
<td>42600</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.241</td>
<td>0.098</td>
<td>0.023</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.028</td>
<td>0.020</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.025</td>
<td></td>
</tr>
</tbody>
</table>

1 Includes 4 digit industry, state and year dummies.

2 Includes year dummies.

***Significant at the .01 level; **significant at the .05 level; *significant at the .1 level.
### Table 4

**All Plants / Client - Nonclient Comparison**

Dependent Variable: log(TFP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>First Differences</th>
<th>Third Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext. A</td>
<td>0.125* (0.011)</td>
<td>0.017 (0.010)</td>
<td>0.005 (0.003)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.006 (0.004)</td>
<td>0.009 (0.007)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.015** (0.007)</td>
</tr>
<tr>
<td>Dummies</td>
<td>No</td>
<td>Yes¹</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes¹</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes¹</td>
</tr>
<tr>
<td>N</td>
<td>43060</td>
<td>43060</td>
<td>34081</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34081</td>
<td>23505</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>23505</td>
</tr>
<tr>
<td>R²</td>
<td>0.003</td>
<td>0.003</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.005</td>
</tr>
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<td></td>
<td></td>
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<td>0.004</td>
</tr>
</tbody>
</table>

¹Includes 4 digit industry, state and year dummies.

**Significant at the .05 level; *significant at the .1 level.

### Table 5

**All Plants / Before - After Comparison**

Dependent Variable: log(TFP)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>First Differences</th>
<th>Third Differences</th>
<th>Within</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext. B</td>
<td>0.108* (0.016)</td>
<td>0.005* (0.015)</td>
<td>0.004 (0.005)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.004 (0.005)</td>
<td>0.012 (0.008)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.017** (0.008)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.011 (0.007)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.016** (0.008)</td>
<td></td>
</tr>
<tr>
<td>Dummies</td>
<td>No</td>
<td>Yes¹</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yes¹</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Yes¹</td>
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<tr>
<td>N</td>
<td>43060</td>
<td>43060</td>
<td>34081</td>
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<td></td>
<td></td>
<td>34081</td>
<td>23505</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>23505</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.001</td>
<td>0.003</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.005</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.004</td>
<td></td>
</tr>
</tbody>
</table>

¹Includes 4 digit industry, state and year dummies.

²Includes year dummies.

***Significant at the .01 level; **significant at the .05 level; *significant at the .1 level.

### Table 6

**Clients Only / Before - After Comparison**

Dependent Variable: log(VA/L)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>First Differences</th>
<th>Third Differences</th>
<th>Within</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext. B</td>
<td>-0.010 (0.017)</td>
<td>-0.015 (0.021)</td>
<td>-0.012 (0.018)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.012 (0.019)</td>
<td>0.035** (0.015)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.029 (0.012)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.029** (0.012)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.007 (0.017)</td>
<td></td>
</tr>
<tr>
<td>log(K/L)</td>
<td>0.279* (0.009)</td>
<td>0.214* (0.011)</td>
<td>0.050 (0.047)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.051 (0.048)</td>
<td>0.011 (0.032)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.008 (0.033)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.053** (0.025)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.042*** (0.025)</td>
<td></td>
</tr>
<tr>
<td>log(L)</td>
<td>0.035* (0.008)</td>
<td>0.016*** (0.009)</td>
<td>-0.207 (0.054)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-0.216* (0.055)</td>
<td>-0.177* (0.038)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.188* (0.039)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.127* (0.029)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-0.130* (0.029)</td>
<td></td>
</tr>
<tr>
<td>Dummies</td>
<td>No</td>
<td>Yes¹</td>
<td>No</td>
<td></td>
</tr>
<tr>
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<td></td>
<td>Yes¹</td>
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<td>Yes¹</td>
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</tr>
<tr>
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<td></td>
<td></td>
<td>Yes²</td>
<td></td>
</tr>
<tr>
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<td>5373</td>
<td>4302</td>
<td></td>
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<td></td>
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<td></td>
</tr>
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</tr>
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<td></td>
<td></td>
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<td>5373</td>
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</tr>
<tr>
<td>R²</td>
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<td>0.017</td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td>0.028</td>
<td></td>
</tr>
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<td>0.015</td>
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<td>0.029</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.017</td>
<td></td>
</tr>
</tbody>
</table>

¹Includes 4 digit industry, state and year dummies.

²Includes year dummies.

***Significant at the .01 level; **significant at the .05 level; *significant at the .1 level.
### Table 7
**Client Plants / Before - After Comparison**
Dependent Variable: \( \log(\text{TFP}) \)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>First Differences</th>
<th>Third Differences</th>
<th>Within</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext. B</td>
<td>-0.013 (0.020)</td>
<td>-0.066* (0.025)</td>
<td>-0.001 (0.006)</td>
<td>0.019 (0.009)</td>
</tr>
<tr>
<td>Dummies</td>
<td>No</td>
<td>Yes(^1)</td>
<td>No</td>
<td>Yes(^1)</td>
</tr>
<tr>
<td>N</td>
<td>5420</td>
<td>5420</td>
<td>4345</td>
<td>4345</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.0001</td>
<td>0.005</td>
<td>0.00001</td>
<td>0.011</td>
</tr>
</tbody>
</table>

\(^1\) Includes 4 digit industry, state and year dummies.
\(^2\) Includes year dummies.
*Significant at the .1 level.

### Table 8
**BBH Quadrants by Client Status**

<table>
<thead>
<tr>
<th>Quadrant 1 (LP(\uparrow), TE(\downarrow))</th>
<th>Clients</th>
<th>Nonclients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadrant 2 (LP(\uparrow), TE(\downarrow))</td>
<td>27.2%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Quadrant 3 (LP(\downarrow), TE(\uparrow))</td>
<td>30.1%</td>
<td>32.4%</td>
</tr>
<tr>
<td>Quadrant 4 (LP(\downarrow), TE(\downarrow))</td>
<td>21.6%</td>
<td>22.9%</td>
</tr>
<tr>
<td>N</td>
<td>815</td>
<td>5739</td>
</tr>
</tbody>
</table>
Timing of Extension Services
815 Clients from Balanced Panel

% of Client Plants

Year

% of Clients Active

% of Clients Served to Date

Figure 1

Client Labor Productivity
Relative to 4 digit Industry Mean

% Difference from 4 digit SIC Mean

Year

levels

1st differences

3rd differences

Figure 2
Client Total Factor Productivity
Relative to 4 digit Industry Mean

% Difference from 4 digit SIC Mean

87 88 89 90 91 92 93

Year

levels  1st differences  3rd differences

Figure 3
Evaluating Industrial Modernization: Methods, Results, and Insights from the Georgia Manufacturing Extension Alliance

Philip Shapira and Jan Youtie

Overview
This paper examines the experience of the Georgia Manufacturing Extension Alliance (GMEA) in implementing an evaluation of its industrial extension services. As part of the U.S. Manufacturing Extension partnership, GMEA provides assistance to manufacturers to resolve industrial and business problems and upgrade technology, training, and business performance, focusing primarily on firms within the state of Georgia. The program has established an evaluation component along with other assessment and review mechanisms. Several evaluation methods are employed, including customer surveys, economic analyses of benefits and costs, controlled studies, and logic-based case studies. The paper examines the strengths and weaknesses of these different approaches, reviews the insights each method offers, and discusses how the resulting evaluative information is used.

Introduction
A variety of methods are used to evaluate the impacts and net benefits of industrial modernization programs and to develop insights that can enhance program performance. Perhaps most frequently, follow-up surveys with users are implemented to ask firms about their experience with a particular industrial modernization program or project. Longer-term controlled studies, cost-benefit analyses, case studies, external reviews, focus groups, and fiscal impact studies are also among the evaluative techniques that are pursued (Shapira, Youtie and Roessner 1996). Judgements about the utility and value of the results obtained from any particular method have to be made in the context of underlying evaluation objectives and aims, the robustness of implementation, and the ability to prompt learning and program improvement. Consideration
should also be given to such factors as resource costs, the timeliness of findings, and, of course, usefulness to decision-makers and the questions they want answered.

This paper reflects upon the experience of the Georgia Manufacturing Extension Alliance, an industrial extension program that has implemented a series of diverse methods as part of its evaluation strategy. The paper examines the findings, strengths and weaknesses of these different approaches, reviews the insights each method offers, and discusses how the resulting evaluative information is used.

The Georgia Manufacturing Extension Alliance

The Georgia Manufacturing Extension Alliance (GMEA) is an affiliate of the U.S. Manufacturing Extension Partnership (MEP) providing industrial extension and technology deployment services to manufacturing companies in the state of Georgia. GMEA's lead organization is the Georgia Institute of Technology (Georgia Tech) which first began running formal programs of industrial extension and technology transfer services in the early 1960s (Clifton et. al., 1989). Through Georgia Tech's Economic Development Institute, GMEA deploys a cadre of industrially experienced engineers and business professionals to assist firms through a network of 18 regional offices. These field office services are supported by program skill centers in areas such as quality, manufacturing information technology, human resource development, strategic management assistance, energy, and environmental services. GMEA has sought to establish an integrated delivery system involving the services and technology of Georgia Tech, the state's small business development centers, Georgia Power's Technology Assistance Center, technical education institutes, and other federal labs and agencies.

From February 1994 to December 1996, GMEA served over 2,100 companies, equivalent to 21 percent of all manufacturers in the state. Included here were 39 percent of Georgia manufacturers with 20 to 499 employees. GMEA customers were served through 2,647 informal engagements, technical projects and assessments; 11 network group service projects (usually involving quality or labor force development); and 240 workshops and seminars. Roughly 36 percent of closed projects involved referrals to other organizations or private-sector consultants and vendors.

GMEA first received funding from the national MEP through the National Institute of Standards and Technology (NIST) in 1994. Over a two-year period, $6.6 million through the federal government's Technology Reinvestment Project (an initiative to strengthen the U.S. industrial base using Defense Department funds) was committed to GMEA, matched by an equivalent amount of state, in-kind and other funds. In 1996, GMEA was "rolled over" (after an external review) into civilian-side funding from NIST, with about $2.3 million in federal funds, again matched by state monies and revenues. After 1997, federal funding is scheduled to "ramp down" to zero by Fiscal Year 2001. However, legislation currently under consideration in the U.S. Congress would abolish this "sunset clause" and allow ongoing federal support of MEP centers like GMEA - probably at one-third of core funding (Shapira 1998).

Evaluation Approach

Georgia Tech did not formally evaluate its predecessor industrial extension services, but – with the development of GMEA in 1994 – an explicit evaluation element was built into the program. The program's
evaluation activities are designed to provide consistent feedback about the effectiveness, targeting and impacts of GMEA’s services; support systematic learning about what services and approaches work best and why, so as to assist the ongoing improvement and management of program services; and furnish evaluative information to GMEA’s major stakeholders and sponsors, including the state of Georgia and NIST.

GMEA’s evaluation element is under the direction of the authors of this article. By design, the evaluation combines an “external” faculty member (from a separate academic unit who is not employed or supervised by the program) and an “internal” senior researcher (within the program’s home institute, who does not provide direct services to firms but who has access to direct service data).

To develop evaluative procedures, we established a program logic model which delineated program inputs, work processes, and expected intermediate and final business and economic development outcomes (Shapira and Youtie, 1994). We then developed a series of tools and procedures to obtain information and measurements on the various components of the program logic model that, in turn, would provide the foundation for subsequent evaluation analyses. The tools and procedures employed included the following:

- **Customer Profile.** This assembles basic information and is administered (as unobtrusively as possible) by program personnel at the point of initial contact with a customer. The profile records information on logistical items (company name, address, phone, etc), contact name, employment, and industry type. Customer profile data is tracked in ProTrac - GMEA’s management information system.

- **Activity Reporting.** This tracks field agent activities and customer interactions, to provide a record of program interventions. Items recorded include project opening and closing information, activity or services provided, personnel involved, and staff time committed. Each project is assigned to a unique record and is tracked in ProTrac.

- **Client Valuation.** Client valuation surveys are administered to each customer upon completion of all major GMEA engagements, including formal assessments, technical assistance projects, and referred technical assistance projects. The customer valuation procedure checks logistical and service information, obtains customer satisfaction ratings of the quality and delivery of services, asks whether the customer will take any action (if yes, what kind; if no, why not), and prompts the customer to provide initial expectations of impact (e.g. sales, employment, use of new technology). The customer valuation survey is administered centrally by mail, supported by telephone follow-up.

- **Customer Progress, Longitudinal Benchmarking, and Non-Customer Controls.** GMEA maintains a progress tracking system. In 1994, a benchmark survey was conducted of manufacturers in the state with 10 or more employees (Youtie and Shapira 1995). In 1995, a one-year follow-up survey of GMEA customers was conducted to track changes in customer business performance outcomes (e.g., sales, cost savings, investment, employment) one year after project closure. In 1996, a second benchmark survey was undertaken of manufacturers (with 10 or more employees) in the state (Youtie and Shapira 1997). A third benchmark
survey is planned for 1998. This design allows tracking of customers, industries, and technology use over time. Since the benchmark surveys also go to non-customers, we can also compare customers and non-customers along a variety of parameters.

- **Case Studies and Special Studies.** The evaluation team has conducted a series of case studies to provide an in-depth examination of the linkages between GMEA services and impacts on firm operations and profitability. These case studies helped to understand how GMEA's services are received by firms and what factors influence how customers respond to these services. Special studies have also been undertaken, on such topics as defense dependency and diffusion of ISO 9000 practices.

- **Organizational Assessments and External Reviews.** The evaluation team, along with GMEA management, has coordinated responses to MEP first, second, and third year review panels to provide feedback regarding program operations and impacts.

The findings from these procedures have been used to produce a series of analytical and evaluative studies which are distributed or used in briefings to program management, field staff, program sponsors, industry advisors, and customers. A Worldwide Web site is maintained (http://www.cherry.gatech.edu/mod) that provides access to GMEA evaluation studies. The following sections examine the results and insights from several of the main elements of the GMEA evaluation system.

### Customer Surveys

Customer surveys are used to obtain feedback from customers on the quality and impact of GMEA services. We use three types of surveys: post-project valuations, customer follow-ups, and longer-term controlled instruments. The first customer survey – the post-project valuation – is sent to the company manager responsible for the project for manufacturers with closed projects receiving eight or more hours of assistance from GMEA staff. Shorter program interactions with companies, such as initial visits or informal consultations, are not formally evaluated through this procedure. In 1994, about 55 percent of the program’s interactions with customers were for 8 hours or more (by 1996, these more lengthy interactions had grown to represent two-thirds of program interventions). The time required for information reporting and mailing means that customers usually receive the post-project questionnaire about 30-45 days from the completion of the project. As necessary, the first questionnaire is followed by a second mailing and telephone contact. The response rate to the post-project survey procedure is relatively high—about 70 percent. A particularly useful feature of the customer surveys is the space for written comments; customers often use this to provide valuable additional comments on a project, their experience, or the program.

Roughly 540 surveys were received and processed up to December 31, 1996. The surveys show an overall mean customer satisfaction rating of 4.47 on a five-point scale (with one being poor and five being excellent). Timeliness and staff knowledge and experience received particularly high ratings from customers. Program managers receive copies of the completed surveys very soon after they are received. While customers generally report high levels of satisfaction with GMEA direct services, in
some cases problems or dissatisfaction are noted. In such cases, program managers are able to respond to these problems, to correct them if possible or take measures to avoid difficulties happening again. Systematic issues are also observed. For example, referrals to other organization have received lower customer satisfaction ratings (mean=3.67). GMEA managers and staff have recognized this issue and now try to better screen and monitor outside service providers.

In the post-project survey, more than 80 percent of GMEA customers report that they have taken or expected to take action as a result of the assistance and services received. Companies that have taken or anticipate taking action tend to have higher satisfaction ratings than those not anticipating taking action. They also tend to have received more hours of service from GMEA staff.

The post-project customer survey procedure was the first element introduced by the GMEA evaluators. However, to check customer progress after a longer period of time had elapsed, we subsequently conducted a one-year follow-up survey by telephone after the first year to further estimate actual (not anticipated) outcomes. The one-year follow-up survey was conducted by telephone in July and August of 1995, tracking the first wave of 113 completed 1994 GMEA projects (Youtie and Shapira 1997a). Customer contacts for 75 of the 113 projects were reached during the one-year follow-up survey administration period. Using survey data for the same firms collected at two points in time—immediately after program participation and one-year later—we are able to examine the reported economic effects of the program and explore the relationships between customer reports of impact and the timing of data collection.

The follow-up survey indicated that, one year after project completion, 68 percent of firms had actually taken action on the program's recommendations (another 17 percent of the projects were on hold with the firm still considering whether to implement project recommendations). We also find that close to the point of service delivery, customers receiving assistance tend to over-estimate the benefits of program participation and under-estimate the commitment and resources necessary to achieve the benefits. Subsequent measurement, at about a year after program participation, suggests that customers can provide a more realistic assessment of benefits and costs, although with some drop-off in response rates. The one-year survey shows that program participants still receive net benefits, but at a lower level than anticipated immediately after the close of the project. For example, companies report median added sales of $80,000 at the one-year mark, compared with the $100,000 anticipated just after the project closed; for operating savings, the one-year reported median is $20,000, as against $50,000 at project closure; while the median capital expenditure was $87,500 in the one-year report, compared with an estimate of $25,000 at the end of the project. However, for a relatively small number of cases where program participation results in very large positive impacts, we find some evidence that immediate post-project measurement underestimate the scale of the ensuing benefits (see Youtie and Shapira 1997a).

As part of the 1996 Georgia Manufacturing Survey, we obtained a further round of information on longer-run project impacts. In this survey, we asked a broader set of questions, to include both economic and non-economic factors. Customers who had completed projects 12 or more months prior to the survey point reported that involvement with GMEA had
resulted in significant effects in areas that are hard to quantify, including existing process improvement (60 percent), improved management skills (over 55 percent), and greater attention to quality (about 45 percent). (Youtie and Shapira, 1997b.)

Project Impact Analysis
A further analysis of customer evaluation surveys allows us to provide information on the differential impacts that certain types of projects have. Drawing on aggregated customer reports of whether or not an impact is expected in particular categories, we can estimate the likelihood of an impact by project type. Table 1 shows that product development and marketing projects are 60 percent more likely to increase sales than is the average project. Energy projects are most likely to lead to cost savings, and plant layout and environmental projects tend to help companies avoid capital spending. Marketing projects have the strongest link to job creation, and management and human resources projects have the strongest link to job retention. Quality projects do not rate highly in any impact area, although they do require the largest manufacturing customer staff time commitment.

Cost-Benefit Analysis
As manufacturing extension and related technology transfer programs have increased in scale, there has been increased interest in trying to assess not only the outcomes for individual firms, but also the economic and regional impacts and returns on the public resources invested. In related fields of technology policy, efforts have been made to assess the range of benefits and costs over time associated with program intervention using benefit cost analysis (Feller and Anderson, 1994; Roessner, et. al., 1996). These efforts, as Feller and Anderson (1994) note, “must be done explicitly, with full specification of benefits and costs actually estimated, and theoretical and empirical context provided for each estimate.” To date, few benefit-cost estimations of industrial extension programs have been undertaken with such a systematic and explicit exposition. First, different types of impacts are often not properly accounted for. For example, increased capital investment is often treated as a benefit when, in fact, from the view of a company, it is a cost (the company, of course, hopes there will be a positive payback over time). Second, the existing measures do not consider all of the private costs involved when a company participates in an industrial extension program, such as the often considerable level of private staff time which has to be committed to extension projects. Third, in some assessments, private company benefits are compared with the public costs of the program. This comparison is incomplete in that private costs are not included nor, for that matter, are public returns (Feller, 1995). Furthermore, compounding the problem of comparing public costs with only private benefits, there are instances where just the federal cost of the program is identified (and not the matching state funds expended) or vice-versa (where only state expenses are counted and federal revenues are excluded).1

The GMEA evaluation team has attempted to develop a fuller and more complete assessment framework of the costs and benefits derived from industrial modernization and extension programs. The framework compares private business and public returns with private and public

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1 For 610 firms responding to MEP center surveys in 1994, NIST translated reported benefits of “$8 on each $1 that the federal government invested in MEP.” National Institute of Standards and Technology, Manufacturing Extension Partnership, Making a Difference For America's Manufacturers, <http://www.mep.nist.gov/about/makediff.html>.
This calculation excludes state and local costs.
investments. Private business returns from project involvement include increases in sales, savings in labor, materials, energy, or other costs, reductions in the amount of inventory carried, and the avoidance of capital spending. Private investment includes estimates of the value of customer staff time commitment, increased capital spending, and fees paid. Public investment includes federal, state and local program expenditures. Public returns are measured by federal, state, and local taxes paid by companies and their employees, estimated from sales increases or job creation/retention. To operationalize this framework, we used post-project survey data from 129 projects completed by GMEA between February 1994 and December 1994.

Benefit-cost analysis is, of course, sensitive to the particular assumptions used in calculation. We identified a number of critical elements where careful consideration of how they should be incorporated into the model was necessary. In general, we took a conservative approach, making assumptions that erred towards under-estimating net program effects. For example, it is apparent that added sales that accrue to a firm due to program intervention may be shifted from another firm, resulting in possible zero-sum outcomes. Drawing on data from the 1994 Georgia Manufacturing Technology Survey and other studies, we estimated the potential shifting effect and subsequently use an adjusted sales number that includes only about 30 percent of the reported sales in the benefit-cost model. (For a detailed discussion of our treatment of benefit-cost elements, see Shapira and Youtie 1996.)

Results from the cost benefit model indicate that GMEA's industrial modernization resources are leveraging relatively high levels of private investment which, in turn, are likely to lead to favorable and positive public and private returns over time. The estimated net public and private sector benefits from GMEA's first year services - scaled up to represent the 532 projects actually completed by GMEA during this year - ranged between $10 million and $26 million. The ratio of private and public returns to private and public investment ranges was between 1.2 and 2.7. Most significantly, the program's public investment was found to have a substantial leveraging effect on private investment. Companies invested from $3 to $13.3 for every dollar of public expenditures. For a typical company, the estimated private payback period for this private investment ranged from six to 22 months.

Case Studies

Case studies are among the most common evaluation methods, and viewed by program managers to be the most effective method to communicate successes to constituencies. However, much of what is referred to as "case studies" often lacks the rigor of quantitative evaluation practices. These "case studies" tend largely to be anecdotal success stories that emphasize the positive aspects of engagements for promotional purposes (Shapira, Youtie and Roessner, 1996). At the federal level, the MEP has incorporated this qualitative element into its reporting structure: the MEP's reporting system requires that its center affiliates prepare and submit periodic qualitative success stories of the best engagements.

However, the MEP has also sought to improve how these qualitative accounts of successful engagements are chosen, documented, and disseminated, by developing system-wide procedures to select key issues for study, provide training in case study techniques, and establish methods for review (Yin 1995). This more extensive case study effort is designed to "document exemplary client engagements for internal and external marketing purposes" and to "build capacity within the Centers to
document and disseminate exemplary engagements.” (Cosmos Corporation, 1996) A structured method is used to examine how specific services are delivered and received, the service inputs and outcomes, company actions, and counter-factual explanations for observed results. Using this MEP case study framework, GMEA has conducted case studies of successful projects to understand the linkages between program assistance and customer outcomes (for an example, see Youtie 1996). These studies show significant impacts from the GMEA cases. For example:

- A product development project yielded $2 million in bookings over two years and 10 new jobs.
- A plant layout project generated an $8 million sales increase (in which the CAD layout was used as a sales tool), as well as $50,000+ in operating savings, $750,000 in inventory savings, a 40 percent increase in direct labor productivity, and 16 new jobs.
- An ISO 9000 pre-assessment audit yielded $1.6 million in total savings and $800,000 in sales retained.
- A product design and manufacturing layout project generated $36,000 to $104,000 in cost savings and $625,000 to $700,000 in increased sales.
- A manufacturing cost model project led to $100,000 in labor savings, $500,000 in new sales, and a 5 percent increase in profitability (the highest increase in the company’s history). The companies learned about the value of adopting new technologies and processes, upgrading employee skills, and seeking outside assistance.

**Controlled Studies**

Although Georgia Tech-assisted manufacturers report benefits, this does not necessarily "prove" that the results are attributable to Georgia Tech assistance. For example, unassisted firms could also have experienced these same benefits during the 1994-1996 time period, suggesting that the results may be due to general economic or industrial conditions rather than program intervention. Differences between client firms and non-client firms may also be explained by differences in the underlying facility employment size and industry mix. Furthermore, simply comparing clients and non-clients fails to account for the influence of non-extension services (for example, offered by vendors and consultants), and subsequent information flows from other manufacturing firms. Thus, it is important to not only to compare performance measures of Georgia Tech clients and non-clients, but also to control for other company characteristics and interactions.

To address these problems, the GMEA evaluation team used a controlled survey designed to assess longer-term impacts of the program. The controlled survey allows for a comparison of the performance of clients and non-client manufacturers. This survey, conducted in the winter of 1996-1997, examines business performance for the period 1994 to 1996 (the survey also asks about companies' problems, needs, and technology plans for the period through to 1998). The survey went to all Georgia manufacturing firms with 10 or more employees. More than 1,000 responses were received (a 16 percent response rate) and weighted to reflect the actual distribution of manufacturers by industry and employment size (Youtie and Shapira 1997b).

The evaluation team used survey responses to develop a model which estimates the impact of GMEA/Georgia Tech project-related extension services on client productivity (value added per employee). Drawing on Jarmin (1997a) and
Oldsman and Heye (1997)², we examine the growth rate in the standard value-added production function from 1994 to 1996 (logged), as a function of receiving GMEA/Georgia Tech services (in the form of projects) and an array of plant, industry and regional characteristics. This model was estimated using ordinary least squares. Table 2 presents the results, which indicate that GMEA/Georgia Tech assistance can be linked to productivity growth. Over the study period, GMEA/Georgia Tech clients experience a 0.3 percent growth rate in value-added per employee over non-clients for the period 1994-1996. In terms of productivity, this is significant and is equivalent to a value-added increase of $366,000 to $440,000 for the average client plant, backing out what the model estimates value-added per worker for the average client plant would have been had it not been a client.³

² We employ a similar model to that used in Jarmin’s study which estimates the logged change in value-added per employee as a function of changes in labor and capital (logged), along with control variables representing manufacturing characteristics (e.g., employment size, industry, location, and status as a branch plant.) We estimate capital in the form of computer capital as in Oldsman and Heye’s study. The independent variables used in our regression include the facility employment growth rate 1994-96 (logged); percentage growth in employees using computers or programmable machine control on a weekly basis 1994-96 (logged); whether the plant is the only facility in the company (dummy variable); two-digit industry classification (dummy variables); level of employment (dummy variables); location in a metropolitan statistical area (dummy variable); location in a county with a Georgia Tech extension office (dummy variable); use of private consultants (dummy variable); use of non-Georgia Tech public service provider (dummy variable); and participation in a cooperative activity with other firms involving design or new product development, manufacturing, training, quality assurance, or marketing (dummy variable).

³ The range is based on 90 percent confidence intervals. For comparison, see Jarmin 1997b.

Organizational Assessments and External Reviews

GMEA has been subject to organizational assessments and external reviews, as part of which GMEA evaluation analyses have been used to provide information on program performance. There have been several assessments by expert panels and oversight agencies of MEP program centers including GMEA. MEP has conducted reviews of GMEA operations and results annually for the first three years of GMEA’s joining the MEP program. The reviews required GMEA and other centers to prepare written materials and reports and respond to questions by panel members. The panels examined center results, planning and vision, staff quality, management of resources and budgets, continuous improvement program, performance in meeting program goals, and made a recommendation about whether federal funding should be continued for a further three years. Overall, GMEA has been reviewed favorably and continued funding has been approved. But there have been recommendations to strengthen strategic planning, the role of an advisory board in providing industry input, coordination with public and private organizations and quality of referrals, budgeting and financial planning in response to reduced levels of federal funding, and marketing (Table 3).

Issues in the Use of Evaluative Information and Analysis

We have discussed the methods and results of several different approaches used to provide evaluative information about GMEA program performance and impacts. While the various approaches indicate that, generally, the program appears to have favorable impacts, there are significant contrasts in terms of detailed findings, the reliability of estimates, the availability of controls, and time horizons.
In the GMEA evaluation, a mix of quantitative and qualitative methods is used, but there is no clear superiority on this dimension. While it is important to quantify program impacts and we take care to qualify and verify numerical estimates, it is apparent that companies usually find it rather difficult to estimate the dollar value of program services. Some technology deployment and industrial extension services (such as reducing energy use or materials wastage) have immediate and quantifiable benefits. But other services, including inter-firm networking, quality assistance, and labor force training, have impacts that accrue over the longer term upon which it is hard to place a dollar value. Requests for dollar-denominated impacts are rarely answered completely by firms (we note that in our post-project survey, many more customers check the “yes” box than subsequently fill in a dollar value, suggesting that firms believe there is an economic impact — even though they cannot provide a number). As our one-year follow-up demonstrated, the elapsed time since project completion affects how companies report benefits and costs and, where estimates can be made, there is frequently have a wide margin of error. Although when aggregated together, “bottom-line” numbers can be derived, care needs to be taken in associating these numbers with a higher degree of accuracy than the underlying data collection realities allow.4

There are also differences in the usefulness of different evaluation approaches to program managers, federal and state sponsors, and other interested parties. Among professional evaluators, the sine qua non is usually the sophisticated controlled study (preferably with random assignment, although that is often hard to achieve). However, for other audiences, we have observed that there is no direct correlation between the usefulness of an evaluation method with that method’s degree of sophistication or even use of controls. Whether as professional evaluators we like it or not, simple methods are often influential. This is evident at the state policymaking and funding level, where the demand for complex evaluation techniques is relatively weak. It is also true at the federal level, where business testimonials and case examples (coupled with targeted lobbying) can go a long way in securing funding. Business testimonials are more easily understood, of course — although, arguably to their credit, there is at least some “street wisdom” among decision makers which recognizes the difficulties of quantifying the impacts of technology deployment programs. Similarly, although program managers like to receive studies that give bottom-line figures (especially if the results shown are positive), those results are not always easily translated into management actions.

In understanding these issues, it is helpful to highlight the two essential purposes for which evaluation analyses can be used. The first is program justification and rationalization. Here, the aim is to analyze the effectiveness of a program and to provide information to guide resource allocation, including resource choices among different policies and programs and whether to allocate any resources at all to particular programs or services. The targets of attention are usually funding sponsors and policy makers, including elected officials. Efforts to demonstrate that a program works are also targeted to customers, particularly potential new customers. The second purpose is program improvement, where evaluative information helps to guide

4 The problem of missing responses is not unique to GMEA. For example, even national follow-up surveys conducted of MEP customers by the U.S. Census Bureau, relatively few companies are able to report dollar impact figures.
attempts to improve program quality, responsiveness and effectiveness relative to resources and needs. For program justification, evaluation tends to focus on such questions as: Does this program produce results and are these results worthy of continued funding? On the other hand, for program improvement, the key questions for evaluation are somewhat different, asking: How does this program produce results? What practices will lead to further gains in results? And, how can those practices be implemented?

Looking across the array of GMEA evaluation methods, we find that each method has a somewhat different degree of utility in meeting these two contrasting evaluation purposes. Although not strictly an evaluation method, we should first mention the program’s management information system, which is used to provide reports of program activities and allows counts to be made of services, the types of firms served, the unit cost of different services, and fee revenues obtained. This information is requested by federal sponsors and state sponsors and is used to assess the program’s degree of market penetration, performance against objectives, and spread of services by project type, industry, and geography. These factors have weight in funding decisions, arguably a little more so at the state level than at the federal level (although, increasingly, federal sponsors are using this management information data to “benchmark” programs against one another). Moreover, for program managers seeking to improve performance, the management information system provides data critical to understanding what the program is doing and to maintaining its timeliness and quality.

From the view of the federal sponsor, GMEA’s surveys of customers are significantly discounted as a program justification device. Measurements of satisfaction are deemed to be a program level concern, with funding decisions being made on the basis of demonstrated economic impacts, as opposed to whether the customer firms are happy. This is reasonable, since the MEP service is subsidized, which means that firms may be more easily satisfied than if they had to bear the full market cost (a cost which many firms would be unwilling or unable to afford in that event). The federal sponsor also discounts “expected” (as opposed to “actual”) impacts. The lack of a control group is a further concern (although NIST’s own 8-10 month follow-up survey, conducted by the Census Bureau, does not have a control group). At the same time, client surveys have proven to be useful at the state level. Program managers report showing completed forms to elected officials. That the survey forms are completed in a customer’s own handwriting (or typing) gives them greater weight than aggregated numbers in a table, we are told. For program management and improvement, the post-project customer surveys are also valued. Program managers want to keep a “real-time” track of customer satisfaction. In particular, they want to know when and where there are problems, so that these can be addressed.

The analysis of relative program impacts, by different project types, is generally too specific to be used in discussions of program justification, whether at federal or state levels. However, it has attracted considerable attention from program management and field staff in the context of how to better manage the program and improve its net impacts. Within GMEA, it has prompted discussion about allocating more resources to project types, such as product development, that may generate larger effects on new sales and thereby jobs. At the national level, within the MEP, this analysis has been coupled with other evidence about the effects of
more substantive and strategic interventions (versus quick, easy to do, but not necessarily fundamental projects) to argue for major shifts in the allocation of extension resources and priorities (see, for example, Luria 1997).

The benefit-cost analysis of GMEA exhibits utility characteristics that are the reverse of those of the relative program impact analysis. We believe this analysis has had useful educational effect in helping program management understand the full framework of benefits and costs associated with project interventions, particularly in pointing out that the program often imposes costs and expenditures on firms before streams of benefits accrue. However, the aggregated nature of the bottom-line results does not lend itself to specific improvement actions. On the other hand, these bottom-line results have been used in program justification discussions and materials, although we suspect that all officials are jaded by such studies and recognize that the results are sensitive to the assumptions used as much as the performance of the underlying program. In theory, benefit-cost analysis should allow elected officials to make rational decisions about where to allocate resources among different programs (or chose not to raise those tax-supported resources). In practice, this does not occur, as it is almost impossible to apply standardized procedures across different programs or even to units within the same program.

The longitudinal controlled studies are valued at federal and, perhaps to a slightly lesser extent, state levels particularly for purposes of program justification. Controlled studies help to raise and answer important questions about whether programs make a difference and whether firms might have achieved the same results without program intervention. Controlled studies with a longitudinal dimension also help to address and control for issues about the kinds of firms that enter the program - for example, is the program attracting a "biased" set of firms that are already receptive to intervention and thus more likely to be successful (we have not yet conducted this element of analysis, although we now have the data to do so for GMEA). At the same time, we have found that controlled studies are generally less useful for program management and improvement. The variables used are often highly aggregated (e.g. was or was not a program customer) or not amenable to program action. There are also issues of timeliness (these studies tend to take a while to complete and may use old secondary data sources), survey response bias, and interpretation. Since controlled studies tend to focus on economic variables, they usually say little about non-economic effects (for example, impacts on know-how, relationships, trust or mutual business confidence) or about organization variables (for instance, how particular services are delivered affects results) that can be important for program management and improvement purposes.

Case studies seek to focus on evaluation issues that cannot be easily quantified and to highlight the ways in which program interventions lead to program outcomes. We have helped to prepare both short descriptive cases and more elaborate cases employing logic models. We find that case studies have a mixed reception in terms of program justification. We have already noted the power of simple verbal or descriptive written testimonials by businesses or, on their behalf, program managers. More formal case studies do not appear to have any greater impact in this realm. Interestingly, while we have found that some previously reported impacts did not hold up to the scrutiny of a formal case
study, in other instances we have identified customer impacts not otherwise reported or captured. From the view of program improvement, well-implemented case studies have the potential to identify good practices that may be more likely to stimulate impacts in subsequent projects (Youtie 1997).

External reviews have proved to be a major instrument from the view of the federal sponsor in managing the MEP program, recommending improvements in center operations, and promoting revisions in management, organization or strategy where deemed necessary. In this sense, external reviews are critical elements in program improvement and have been used to prompt managers, even in a program like GMEA which is generally recognized to be well-run, to make changes. External reviews have also validated the GMEA evaluation process itself as an effective and robust. The point that individual MEP centers are subject to external review is helpful in program justification, particularly with federal funders who are concerned that subsidies not be given to ineffective centers (this becomes more important now that the “sunset clause” on federal funding beyond six years may be lifted). However, the value of external review may be limited from an oversight perspective because panel reports are closely held and not widely released (although in the past, summaries and general reviews have been issued of the first manufacturing technology centers). Additionally, state program sponsors, in general, do not require external reviews: in the case of Georgia, the established reputation of Georgia Tech appears to assure state officials that the program is competent. Independently, however, some units of the program have secured external validation, for example by being certified to ISO 9000 quality management standards (as in the case of GMEA’s skill center for quality and international standards).

Conclusions

GMEA’s experience with an array of evaluation methodologies highlights many of the tensions that are evident in implementing evaluations of technology deployment programs like the MEP. The issues include those of reconciling the varying evaluative needs of program sponsors, program managers, service providers, and customers; accounting for the differential impacts of particular kinds of services; and trying to measure improvements that are not only often difficult to quantify or estimate, but which may be attributable to other factors besides program intervention. There are very practical problems of conducting evaluations with limited resources and concerns about over-burdening customers with information requests. And, in the context of frequently uncertain federal and state funding environments, there are also challenges of incorporating methods that can support program learning and improvement as well as address issues of program justification.

While we have shown that some methods are clearly better than others for particular purposes, there is no one single method that by itself is adequate to the task of evaluating all aspects of a large and complex program like GMEA. Particularly in an environment where reliable econometric data is hard to come by, our approach has been to use a variety of sources to understand what the program is doing, what its impacts are, and where there may be opportunities for defining good practice and improving program performance. We have sought to implement evaluation methods that address questions of program justification. The early evidence from our surveys, case studies, and control group comparisons suggests that the
program is leading to positive results. However, we would be among the first to recognize that further rigorous long-term studies are needed to conclusively demonstrate this. At the same time, we have also tried to implement evaluation approaches that promote program learning and dialogue about how program performance can be enhanced. Again, this process is still in its early stages, but we are beginning to see that some services and strategies are more likely to generate different, if not greater, results than others. This is information that program managers, sponsors, and customers find relevant. While we hope that state and national debates about program justification can begin to raise issues about how to strategically aid firms (rather than whether to continue to fund programs), other dissemination avenues are available. The decentralized nature of the MEP allows individual programs to alter their service mix and try innovative approaches. Opportunities for comparison, through forums, workshops, personnel exchanges, reviews, best practice case studies, and (hopefully) econometric studies (including controlled ones) can allow successful program innovations to become widely known and adopted throughout the system. It is probably in this way that evaluative studies to aid program improvement can become most widely utilized.

Note
The views expressed in this paper are the authors’ and not necessarily those of the Georgia Manufacturing Extension Alliance or its sponsoring organizations.

References


Yin, R. “Use of the case study method for evaluating the MEP program: Discussion paper in support of MEP National Evaluation Strategic Planning Processes.”


Table 1. GMEA Project Types by Relative Impact

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Sales Increase</th>
<th>Capital Spending Increased</th>
<th>Capital Spending Avoided</th>
<th>Inventory Savings</th>
<th>Cost Savings</th>
<th>New jobs Created</th>
<th>Jobs Saved</th>
<th>Mean Customer Time (days)</th>
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<td>1.24</td>
<td>0.35</td>
<td>0.73</td>
<td>1.18</td>
<td>0.67</td>
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<td>Quality</td>
<td>1.09</td>
<td>0.67</td>
<td>0.65</td>
<td>1.09</td>
<td>1.05</td>
<td>1.07</td>
<td>0.87</td>
<td>1.99</td>
</tr>
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</table>

*Index: 1.00=Impact (actual and anticipated) by project type as a ratio of average impact by project type (column). A ratio of greater than one means above average impact. A ratio of less than one means below average impact.

Table 2. Ordinary least squares analysis of growth rate of value-added per employee, Georgia manufacturers 1994-96 (facilities with 10-499 employees).

| Variables                                      |        
|-----------------------------------------------|--------
| % Change in labor inputs (employees)          | -0.1008 ***
| % Change in computer capital (computers, PLCs per employee) | -0.0003  
| GMEA/Georgia Tech client                      | 0.0026 *   
| Located in an urban county                    | 0.0051 ***
| Located in a county with a GMEA/Georgia Tech regional office | -0.0016  
| Used a private consultant                     | -0.0033 ***
| Used a public service provider                | -0.0008  
| Participates in inter-firm collaboration      | -0.0003  
| The only facility in the company              | -0.0041 ***
| Food                                          | 0.0058   
| Textile                                       | 0.0071 ***
| Lumber                                        | -0.0065 **
| Furniture                                     | -0.0074 **
| Chemicals                                     | 0.0036 *  
| Fabricated Metals                             | 0.0061 ***
| Electronics                                   | 0.0058 *  
| Instruments                                   | 0.0089 **
| 1994 Employees 10-19                          | 0.0025   
| 1994 Employees 20-49                          | 0.0036 **
| 1994 Employees 50-99                          | -0.0001  
| 1994 Employees 100-249                        | 0.0053 ***
| Constant                                      | 1.1091 ***
| Adjusted R-squared                            | 0.2043 ***
| N                                             | 409     

Notes
The dependent variable is growth rate of value-added per employee, 1994-96. All growth rates denote logged values for period. Preliminary analysis, subject to revision.

***Clients vs. Non-Clients: differences significant at less than the 1%; **Clients vs. Non-Clients: differences significant at the 5%; *Clients vs. Non-Clients: differences significant at the 10%

Source
1996 Georgia Manufacturing Survey, weighted responses of 1,002 manufacturers.
Table 3. External Reviews of GMEA, 1994-1997

<table>
<thead>
<tr>
<th>Review</th>
<th>Panel composition</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review of TRP proposal 1994</td>
<td>External agency review</td>
<td>Two Year Funding of GMEA approved</td>
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<tr>
<td>First Year Review 1995</td>
<td>NIST internal staff review</td>
<td>Recommends TRP funding be continued</td>
</tr>
<tr>
<td>Second Year/Rollover Review 1996</td>
<td>NIST panel, with external reviewers</td>
<td>Recommends rollover into MEP status. Recommends strengthening of GMEA advisory board</td>
</tr>
<tr>
<td>Third Year Review 1997</td>
<td>NIST panel, with external reviewers</td>
<td>Recommends continuation of funding, three additional years. Recommends attention to strategic planning, financial planning</td>
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</table>
Evaluation of the Massachusetts Manufacturing Partnership: Selected Findings

Introduction
The purpose of this paper is to share a subset of findings generated through the ongoing program evaluation of the Massachusetts Manufacturing Partnership (MMP), at the Corporation for Business, Work and Learning. MMP is a Manufacturing Extension Program of the National Institute of Standards and Technology (NIST/MEP). The findings described herein were derived through an examination of data related to MMP customers and services, and to the outcomes reported by customers as a result of those services.

This paper is also intended to be responsive to the need for increased knowledge transfer throughout the national network of NIST/MEP centers. To facilitate this program evaluation-based knowledge transfer, a meaningful context will be developed within this paper, allowing others committed to the improvement of manufacturing extension services to assess the applicability of research techniques and findings to manufacturing extension centers across the country.

In order to clarify the conditions leading to reported findings, this paper will include the following:

- an overview of the mission and objectives of MMP;
- documentation of MMP’s service delivery model;
- insight into the purpose and approach of MMP’s evaluation plan;
- profiles of MMP customer and project characteristics;
- selected findings regarding project development and project results. These findings will be included and expanded upon in the MMP Year

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Mission and Objectives of MMP
The mission of the Massachusetts Manufacturing Partnership (MMP) is to improve the competitiveness of small and medium-size manufacturers (SMEs)\(^1\) in Massachusetts. This purpose is responsive to widespread interest in the maintenance and expansion of the vital, yet declining, manufacturing sector of the Commonwealth’s economy. MMP addresses the needs of manufacturers, manufacturing supply chains, local communities and the Commonwealth through its ongoing pursuit of this mission.

The importance of small and medium-size manufacturers to the Commonwealth and its citizens is profound. Manufacturing jobs account for approximately 17% of all non-governmental state employment, and manufacturing output comprises approximately 16% of the total gross state product.\(^2\) While attention is often focused on the state’s largest employers, the Massachusetts economy is also highly dependent on the 81% of its manufacturers that employ fewer than 50 workers.\(^3\) MMP’s mission to increase the competitiveness and the survival prospects of these SMEs is, therefore, a vital element in the Commonwealth’s overall economic development strategy.

Guiding MMP’s pursuit of this mission to improve the competitiveness of SMEs is a set of critical objectives. These include:

- Accelerate the awareness and acceptance by Massachusetts SMEs of world-class manufacturing business and training processes, and practices.
- Provide cost-effective services that yield bottom-line results for SMEs and their workforce, as well as a measurable economic impact.
- Develop, through industry leadership and involvement, a cohesive statewide manufacturing partnership to increase the competitive manufacturing base in the Commonwealth and attract more manufacturing business to the state.

Furthermore, MMP’s success in increasing SME competitiveness is believed to rely upon its ability to introduce greater flexibility to the manufacturing process, product, and workforce of companies. In order to effect a higher degree of flexibility and competitiveness among manufacturers, MMP will help SMEs:

- Evaluate, purchase and utilize existing manufacturing and business products and processes that increase quality \((Better)\), increase productivity \((Faster)\) and decrease costs \((Cheaper)\);
- Access education and training for management and workers to increase the benefits of these new manufacturing and business practices; and,
- Pursue new technologies or new products, and develop upgrades for

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\(^1\) The National Institute of Standards and Technologies, Manufacturing Extension Partnership (NIST/MEP) defines an SME as a small or medium-size manufacturing establishment with fewer than 500 employees.

\(^2\) Massachusetts Division of Employment and Training, Employment and Wages State Summary 1995.

\(^3\) Massachusetts Division of Employment and Training, Distribution of Establishments and Employment by Size Groups, March 1996.
current products. And, for contract or service manufacturers, expand and market new technology-based services.

Service Delivery
The MMP service delivery model is designed to maximize service flexibility and the utilization of existing consulting resources within the Commonwealth. Over the past four years, this model has demonstrated the fluidity that is characteristic of young, evolving systems. However, the two predominant modes of service delivery - direct and brokered services - reflect a generally consistent set of characteristics (see Model 1) that may be organized into five phases: initial contact; project development; internal/external resource identification; project management; and, follow up.

Phase 1: Initial Contact
MMP conducts outreach to potential customers through a variety of means. Initial contact with an SME may be the result of direct sales by the project manager; participation in an event sponsored by MMP or an MMP partner; or a referral from another company or organization. Following the initial contact, an MMP project manager arranges to meet with key company staff in order to learn about the company and to assess whether it could benefit from MMP services.

Phase 2: Needs Assessment and Project Development
The first meeting between MMP and the company provides an opportunity for the project manager to gather basic descriptive data regarding the company, including its products and processes, business performance and goals. This discussion may form the basis for an informal needs assessment by the project manager. A plant tour is usually conducted which allows the project manager to observe the company’s manufacturing layout and equipment utilization.

As a result of this meeting, the project manager and the company may immediately begin to discuss technical assistance project (TAP) opportunities in response to identified company needs. Another possible outcome is an agreement to have a follow-up meeting to conduct a formal needs assessment to clarify company performance and needs. This follow up meeting may lead to a TAP or, alternatively, the company may decide not to take advantage of MMP services.

Phase 3: Resource Identification
When a company decides to contract for a TAP the project manager’s role shifts from assessment and development to resource identification. The project manager identifies the most suitable internal MMP or external consulting resources available and presents the findings to the company. External, or “outside,” resources may include private consultants, college or university faculty, or staff of other organizations. In most cases, the company entertains a proposal from each resource and selects from among them, with the input of the project manager. In some instances, MMP may serve as the technical resource to the project, if suitable skills are available within the organization.

4 Technical Assistance Projects (TAPs) are MMP activities that involve >8 hours of project manager time and for which a formal contract for services has been agreed to.
The use of outside resources for project implementation is a key element of MMP's service delivery strategy. This strategy allows MMP to offer a wide range of services to a large number of SMEs, because project development is not limited by MMP's internal expertise and because a project manager can manage several TAPs in the time it takes to implement one.

Phase 4: Project Management and Implementation

Once the project is defined and a resource is selected, the project is formalized through the TAP contracting process. A statement of work, financial arrangements and timetables for completion of milestones are agreed upon in this contract. Contract development is a critical aspect of the project manager’s job. MMP has documented through case studies that some of its most successful projects began with a project manager's insistence that a statement of work be revised until it fully met the company's needs.

With the contract finalized, the company and outside resource begin the project. In this stage, the project manager is responsible for oversight and ensures the requirements of the contract are met. When the TAP is completed, the project manager reviews all work and, if satisfied that all contractual obligations have been met, closes the project.

Phase 5: Follow Up

The project manager will, in most cases, follow up with the company after the project is completed. This is both to ensure that the company remains satisfied with MMP's services and, when appropriate, to allow the project manager to assume an ongoing role in the company's improvement strategy. In some cases, the first project will lead to a second, which may or may not require different expertise and, therefore, a different resource. In this case, the cycle of project development will repeat itself.

Direct v. Brokered Services

Earlier in this section, it was mentioned that MMP’s service delivery model is dynamic and evolving. There is no more significant trend in service delivery than the recent shift toward the provision of direct services, utilizing internal MMP resources. Through September 30, 1996, over 95% of all MMP technical assistance projects were delivered using a brokered service strategy. But since that time, 25% of all completed projects have utilized internal resources. This reflects an increased emphasis within MMP on retention of project revenues and the implications of this trend will be studied extensively in the MMP Year Four Evaluation Report, scheduled to be published early in 1998.

The MMP Evaluation Plan

MMP has, since its inception, made a strong commitment to program evaluation and data driven program management. Dating back to the earliest stages of center development, MMP collaborated with the Donahue Institute, University of Massachusetts in the design and implementation of a comprehensive evaluation plan. The plan, which has evolved with MMP over the past three years, is designed to achieve certain specific objectives. These objectives define the plan's original design and continue to guide its ongoing implementation. On a fundamental level, the purpose of the MMP evaluation plan is to support:
- Internal (MMP) management decision making;
- Program monitoring and reporting; and,
- NIST/MEP and other external research and evaluation efforts.

**Evaluation Methodology**
Underlying the MMP evaluation plan is a conceptual model that illustrates the relationship between MMP customers, the technical assistance services they receive and the outcomes of those services (see Model 2). The MMP evaluation plan is designed to document and clarify elements contained in this conceptual model. Through this process, the purpose and objectives of the evaluation plan can be realized, and many of the program management and policy concerns of MMP, its investors and the nationwide NIST/MEP network may be addressed.

This evaluation logic model articulates the complex chain of events leading from MMP technical assistance services to business and economic outcomes. It relies on the assumption that services prescribed by MMP project managers and subsequently implemented by outside or internal MMP resources, lead to changes that affect the manufacturing performance of companies. These changes result in longer-term business impacts which, in turn, result in changes in the larger state and national economies. It is also assumed that the specific characteristics of the company, the project and the current economy may influence the effectiveness of actions and changes throughout the course of these events.

**Profile of MMP Customers**
MMP serves the Commonwealth and its citizens through the provision of technical assistance projects to SMEs. This section briefly describes two principle attributes (company industry and company size as indicated by number of employees) of the companies served by MMP since initiation of services in August 1994. For the purpose of this study, service is defined as, and limited to, a completed TAP (project). All company data were collected through the MMP “Customer Profile” form, except where otherwise indicated. As of August 31, 1997, MMP had completed 1,074 projects with 650 different companies.

**Key Industry Sectors**
Among the companies served by MMP are representatives of 32 different two-digit standard industrial classification (SIC) codes, including all of the manufacturing SICs (numbers 20-39). This wide coverage of industries reflects MMP’s strategy and ability to serve the broadest possible range of manufacturers. However, MMP has also pursued a policy that focuses resources on four two-digit SIC Codes that it considers particularly critical constituencies. These four SICs account for 49.5% of all companies served by MMP. In the Massachusetts economy, these SICs comprise $9.89B (55%) of the $18.12B in total manufacturing payroll. 5 These SICs include:

- Fabricated metal products (SIC 34)
- Industrial and commercial machinery (SIC 35)
- Electronics (SIC 36)

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5 Massachusetts Division of Employment and Training, Employment and Wages State Summary 1995
Measuring and analyzing instruments (SIC 38)

Companies from five other SICs (see light shading in Table 1 below) represent an additional 28% of all companies served through MMP projects. These companies also account for 18% ($3.14B) of all manufacturing employment wages in the Commonwealth.6

Company Size (Employment)

Among Massachusetts’s manufacturers, approximately 81 percent employ 50 or fewer employees and less than one percent employ 500 or more.7 This means that almost all of the Commonwealth’s manufacturers are MMP service-eligible by company size criteria and, further, that the vast majority of these manufacturers are very small companies (<50 FTE). Figure 1 displays the distribution of MMP customers, by size of company workforce.

This chart reveals that 55% of companies served by MMP projects employ 50 or fewer employees and 74% employ 100 or fewer. While the distribution of companies receiving services is not proportional to the overall population of manufacturers in the Commonwealth, it nonetheless demonstrates an emphasis on small and very small manufacturers. MMP has engaged in considerable discussion regarding the most effective strategies that may be employed in order to maintain and enhance its focus on very small manufacturers.

Profile of MMP Technical Assistance Projects

MMP strives to improve the competitiveness of SMEs by helping them evaluate, purchase and utilize products and processes that will increase product quality (better), increase productivity (faster) and decrease costs (cheaper). This section provides a brief review of two critical project characteristics including: project type, a chief indicator of the substance of a project; and, project cost, an indicator of the level of effort expended on the project. Further, it briefly examines the relationship between these two characteristics. This review encompasses the 1,074 projects completed by MMP as of August 31, 1997.

Project Types

NIST/MEP has defined thirteen distinct project types (and “other”) that, while sufficiently specific to be meaningful categorizations, may contain a range of projects with diverse characteristics. MMP does not utilize the “other” type category and includes an additional type, “technical training” in its internal tracking. Project type is the foundation for this examination of project characteristics, as it reflects the essence of the project activity. All project characteristics reported in this section rely on data collected through MMP’s “TAP Contract” form.

Figure 2 displays the distribution of MMP projects, by project type. Three types of projects predominate, representing 59% of the MMP project portfolio: quality/inspection/ISO- E (26%); human resources- M (19%); and, process improvement- K (14%). Market development-I (10%), EDI/ communications/ LAN- B (7%), plant layout- K (5%) and business systems/
management- C (5%) are other commonly conducted project types.

Project Cost

Cost is an essential project characteristic that can be used as a rudimentary measure of project intensity. It also has obvious implications for a center’s strategy with respect to the generation of project-based revenues. Due to the limitations of data collected by MMP, the most accurate representation of project cost that can be applied to the 1,074 projects reviewed in this section is the sum of money identified in the contract for services between MMP, a company and any outside consulting resource.

Any money that is transferred as a result of the contract agreement, including both direct payments and any MMP project subsidy, is factored into this calculation of cost. This cost formula does not include any other labor costs that may have been incurred by the customer (i.e. staff time, line shutdown), outside resource or MMP during the development and implementation of the project.

As Figure 3 displays, MMP has pursued a strategy to offer low cost services to SMEs. Of the 1,054 projects reviewed by this analysis, 48% cost less than $2,500 and 75% cost less than $10,001. Data show that very expensive projects (> $20,000) are not a major segment of the project portfolio. It should be noted, however, that MMP does not include project-related capital investments as part of project cost. Company business investments that result from projects are discussed in greater detail in the section Evaluation.

Findings: Company Investment Behavior.

Relationship Between Cost and Type

Table 2, below, provides detail relating to the mean cost of different project types. This detail is further clarified by the line plot analysis in Figure 4. The error bars in Figure 4 show the expected cost values associated with different types of projects. Wherever these error bars fail to overlap, there is a statistically significant difference in the mean cost of the project types being compared, within one standard error.

Based upon this data, it can be inferred that MMP project cost is, to a limited extent, a function of project type. Of projects with 50 or more observations, human service (M) and market development (I) projects are particularly inexpensive. Whereas, quality/inspection/ISO (E), process improvement (K) and new product design or development (L) are relatively expensive.

An limitation of this finding is that MMP’s mean project costs may also reflect an unstated approach-to-service strategy. That is, MMP conducts a relatively large number of human resource projects in seminar formats, which keeps costs very low. If MMP emphasized larger scale, on-site human resource projects, then cost data may show different results. For this reason, this finding may not be broadly applicable to other NIST/MEP centers. However, within the context of MMP’s historical project profile, project type does appear to influence project cost.

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8 MMP no longer provides cash subsidies to customers as of February 9, 1997.
Findings: Project Development

- Understanding of Company Needs

One of the presumed benefits to companies of working with MMP is the objectivity and manufacturing experience of the MMP project manager. In the eyes of many customers, these attributes make MMP a credible source for manufacturing or business needs assessments. While it is assumed that project managers conduct an informal needs assessment for all projects, in some cases, formal assessments\(^9\) may be conducted to more systematically clarify priorities for company improvement. As of August 31, 1997, MMP had conducted 386\(^10\) formal assessments.

MMP collects data relative to the company’s perception of the project manager’s assessment of their needs. The question “how would you rate the project manager’s understanding of your particular problems or needs?” is asked as part of a customer feedback survey administered immediately after project completion. Answers are given on a five point scale with “1” meaning “poor” and “5” indicating “excellent.” As of August 31, 1997, 260 customer feedback surveys were completed for MMP projects.

Data show that clients have reacted very positively when asked to assess the project manager’s understanding of company needs. Table 3 details the mean score on this question for all project types. The mean for all projects is 4.4 of 5 possible points and no project type has a mean score of less than four. This would seem to indicate that MMP is providing services that are appropriate to the needs of SMEs.

- MMP Influence on Company Actions

It is reasonable to follow this discussion of the assessment of company needs with some consideration of the extent to which MMP has influenced the business actions of companies. This information is also collected through MMP’s customer feedback survey. The question “Would you have undertaken this project or made any of the resulting changes without the assistance of MMP?” is intended to address this specific point of interest.

As shown in Figure 5, a majority (61%) of survey respondents indicated “yes” the company would have undertaken the project or pursued similar actions without the assistance of MMP. As many as 39% may not have pursued these actions with services. It is reasonable to conclude that the business actions of companies that indicated “no” or “maybe” in response to this question were probably influenced by MMP. What remains unexamined is whether the companies that would have made changes without MMP assistance were influenced by the program.

Figure 6 shows further detail regarding the responses of those companies that would have undertaken the project without MMP assistance. In particular, it shows that 43% of those companies would have pursued the project in the same time frame. However, for no less than 34% and as many as 57% of these companies, MMP did influence actions, causing or

\(^9\) Examples of formal assessments commonly used by NIST/MEP centers include Performance Benchmarking, QuickView, and SITE.
enabling them to undertake changes sooner than they otherwise would have. For those companies that reported no MMP influence on actions, the likely appeal of working with MMP would include cost sharing, technical support, resource location, contract management or overall cost effectiveness.

**Findings: Project Results**

Ultimately, MMP’s performance is viewed in light of project results. Concerned interests want to know whether MMP is positively influencing the business behavior and competitiveness of SMEs. For this reason, a variety of results-focused data are routinely collected for MMP through two basic tools: a customer feedback survey and a follow-up impact survey. MMP contracts with a third-party consultant, the Donahue Institute, University of Massachusetts, to conduct these telephone-based surveys. As of August 31, 1997, 260 customer feedback surveys and 384 Eight Month Follow-up Impact Surveys had been administered. All companies with surveyable projects are contacted and overall response rates for these surveys are 78% and 75% respectively.

Specific business or manufacturing changes that result from MMP projects are summarized by six categories: sales; cost savings; intermediate manufacturing outcomes; employment; investments; and, “other”.

- **Did the project lead to change within the company?**

Eight Month Follow-up Impact Survey data, collected approximately eight months after a project is completed, indicate that 80% of surveyed projects resulted in changes within the company by the time of survey (Figure 7). An additional 11% of companies had not yet implemented changes as a result of the project, but expected to in the future, while 9% of companies did not intend to take action as a result of the project. A review of data suggests that neither project type nor cost is a reliable determinant of whether changes will be implemented.

- Did reported changes lead to business impacts?

While changes may have been implemented, this does not necessarily mean the company experienced a business impact, as captured by MMP’s Eight Month Follow-up Impact Survey. Analysis reveals that 81% of projects that led to changes resulted in some impact on company sales, cost savings, intermediate manufacturing outcomes, employment, investments or “other”.

**Frequency of Impact by Project Type**

The frequencies of projects with “some reported impact” are listed in Table 4, by selected project type (those with 12 or more observations)\(^{11}\). Data indicate that the substance (type) of a project may be an indicator of the likelihood that a project will lead to a business or manufacturing impact. As Figure 8 demonstrates, these findings are statistically significant within one standard error. Specifically, it can be inferred that customers with projects that are quality/inspection/ISO, plant layout, process improvements, or product or design development most frequently experience a business impact as a result

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\(^{11}\) The activity-type profile of projects contained in the survey sample is very similar to the profile of all completed projects, as reported in the section Profile of MMP Technical Assistance Projects.
of MMP services. Companies that engage in EDI/communications/ LAN, business systems/management, human resource or market development projects appear less likely to report impacts as a result of an MMP project.

Frequency of Impact by Project Cost

Data in Table 5 suggest that project cost is also a factor in the frequency of reported project impact. Specifically, projects that cost less than or equal to $2,500 are less likely to result in a project impact than are projects of higher cost. Furthermore, the likelihood of project impact increases as costs rise, up to the $5,000-$10,000 level. Above this cost level, the frequency of impact shows little variation. These findings, depicted in Figure 9, are significant within one standard error.

Frequency of Impact by Company Size

Data in Table 6 indicate that the size of the company that engages in a project may also influence the frequency of project impact. Figure 10 illustrates that companies that employ one to ten employees appear less likely to experience project impacts than larger companies. This finding is statistically significant to one standard error.

Frequency of Impact by Industry

Data in Table 7 indicate that the industry classification of the company

that engages in a project may also influence the frequency of project impact. The most prominent aspect of Figure 11 is the very high likelihood of impact associated with SIC 38, "Measuring and analyzing instruments." Also noteworthy is the less frequent impact associated with SIC 34, "Fabricated metal products," and SIC 35, "Industrial and Commercial Machinery." Again, the error bars associated with these observations reflect significance within one standard error.

Summary

Data show that project characteristics such as substance type and contract cost may influence the likelihood of project impact being realized by MMP customers. However, attributes of the customer, including industry and number of employees, also appear to influence the likelihood of impact. This understood, what remains to be known is which of these factors is most responsible for project results. Unfortunately, MMP results data sets are still relatively small and therefore attempts to conduct this type of analysis have shown inconclusive results.

What types of impacts are attributed to projects?

Knowing whether impact occurred as a result of a project is only the first step in understanding the results of MMP services and their effects on SMEs. A logical next step is to determine the types of impacts that are likely to occur.

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12 The cost profile of projects contained in the survey sample is similar to the profile of all completed projects as reported in the section Profile of MMP Technical Assistance Projects. However, projects costing <$2,500 are slightly under-represented and projects costing between $5,001 and $20,000 are slightly over-represented.

13 The employment levels of companies engaging in projects contained in the survey sample is very similar to the profile of all completed projects as reported in the section Profile of MMP Customers.

14 The SIC Code profile of companies engaging in projects contained in the survey sample is similar to the profile of all completed projects as reported in the section Profile of MMP Customers. The one noticeable exception is that SIC Code 38 is slightly over-represented.
as a result of projects with different attributes. In the examination of this question, project substance (type) is assumed to be the primary determinant of the kinds of changes a company is likely to experience as a result of the project. Specific business or manufacturing changes that result from MMP projects are summarized by six categories: sales; manufacturing efficiencies; cost savings; employment; investments; and, "other."

Data pertaining to these impact areas are captured through the Eight Month Follow-up Impact Survey, which requests both qualitative and quantitative data. In this survey protocol, the respondent is first asked whether a change in sales occurred. If the response is "yes," they are asked whether sales have "increased" or "decreased," and finally, they are asked what the dollar value of the change in sales has been, to date. Respondents are far more likely to offer qualitative data than quantitative. The following analyses rely upon those qualitative responses.

Frequency of Change in Sales

Revenue generation is a primary consideration for many small and medium sized manufacturers. Data contained in Figure 12 demonstrate the frequency of reported impact on company sales resulting from MMP projects. From this figure, it is clear that certain types of projects are more likely than other types to generate new sales. In particular, plant layout (F), market development (I), and new product design/development (L) appear most likely to result in this type of impact.

A particularly interesting aspect of this finding is that previous analyses indicated that market development projects had a relatively low likelihood of any impact. Two other project types that showed a relatively low frequency of any project impact, business systems/development (C) and human resources (M), demonstrate a very low frequency of impact on sales. So, for a company with revenue generation needs, market development projects may be more helpful than frequency of impact statistics may suggest.

Frequency of Manufacturing Efficiencies

In some cases, companies have issues pertaining to manufacturing production that require immediate resolution. Areas of concern may include: production lead time; set-up time; material handling; scrap rate, rework rate, quality and overall production output. As shown in Figure 13, certain types of project services provided by MMP appear very likely to affect change on one or more of these measures of manufacturing efficiency. In particular, quality/inspection/ISO (E), plant layout (F), process improvement (K) and new product design/development (L) appear likely to result in these types of intermediate manufacturing outcomes.

Frequency of Manufacturing Cost Savings

Positive intermediate manufacturing efficiencies should, ultimately, begin to show bottom line results to companies, in terms of cost savings in labor or materials, as a percent of sales. It should be noted that other, non-manufacturing, business changes may result in cost savings as well. Figure 14 describes the frequency of reported cost savings and significant differences are in evidence among the various project types. Two clusters are apparent. EDI/communications/LAN (B), market development (I) and human resources
(M) projects are least likely to result in cost savings for the company, while the other identified project types demonstrate a higher frequency of these types of impacts.

**Frequency of Change in Employment**

In many instances, MMP projects may result in the retention of jobs that would otherwise have been eliminated. In other cases, MMP customer employment changes may occur based on the needs of the company, whether those needs are to reduce or augment existing staffing levels. Figure 15 displays data related to the frequency with which some change in employment is reported as a result of a project, by project type. Data indicate that new product design/development (L) projects are most likely to result in an employment impact, while business systems/management (C) and human resources (M) projects are least likely result in changed employment.

**Frequency of Business Investments**

One of MMP’s objectives is to “help SMEs evaluate, purchase and utilize... manufacturing and business products that increase quality, increase productivity and decrease costs.” This would indicate, based upon MMP’s assessment of company needs and subsequent evaluation of existing technologies or methods that may address those needs, that many companies will make some investment as a result of MMP services. While these investments may be considered costs to the company, they also represent a modernization of the company’s equipment, process or management approach that may improve the company’s long term competitiveness.

MMP tracks “capital investments in plant and equipment”; “investment to support process improvement (i.e. software, material flow charts)”; investment in product enhancement or new product development (i.e. new material, R&D)”; and, “investment in training.” As figure 16 shows, certain types of projects are more likely to result in at least one of these investments than are others, with new product design/development (L) projects standing out in this regard. Market development (I) and human resources (M) projects demonstrate the lowest frequency of reported impact on company investment.

**Frequency of “Other” Impacts**

Companies frequently report impacts that do not correspond to a specific question on MMP’s impact survey. “Other” impacts reported by MMP customers include: improved morale; greater awareness of new practices and processes; better corporate image; increased work skills; increased flexibility; and increased capacity for change. In some instances, respondents said that these impacts were the greatest benefit of the project.

The project types that appear most likely to result in some impact on a measure not included on MMP’s impact survey are (see Figure 17) EDI/communications/LAN (B), quality/inspection/ISO (E) and process improvements (K). Business systems/management (C) projects, on the other hand, appear least likely to result in “other” impact.
What is the magnitude of reported project impacts?

There is an understandable interest among program managers, program stakeholders and the larger research community in assessing the magnitude of impacts experienced by companies and the larger economy as a result of MMP services. In particular, it would be helpful to know which types of projects result in the greatest and most positive outcomes.

Unfortunately, MMP's follow-up project impact data set contains too few observations to support this type of analysis. This limitation is exacerbated by two factors: (1) the low frequency of reported impacts that are quantified (44%) and (2) the enormous range of values amongst those quantified responses. Because conclusions that might be drawn from such an analysis of MMP data could be misleading, they are not pursued in this report.

This said, MMP does utilize an alternative, qualitative measure of the magnitude of project impact. The mission of MMP is to improve the overall competitiveness of small and medium size manufacturers. In order to measure the effectiveness of its services upon companies, MMP asks each company to indicate "to what extent did this project improve your competitiveness?" This question is asked on the customer feedback survey and responses may be influenced by the subjective perceptions of the respondent. Response options are on a five-point scale corresponding to the values listed below:

- no change 1 point
- slight improvement 2 points
- moderate improvement 3 points
- substantial improvement 4 points
- very substantial improvement 5 points

Responses and other detail for this question are shown below in Table 8. All project types with more than 10 responses to this question were included in this analysis, as well as new project development (L), for which there are only five observations. This project type was included for consistency with previous analyses.

The overall mean score for improvement of competitiveness across all project types was 2.5, which would place the mean response between a "slight" improvement and a "moderate" one. As Figure 18 illustrates, respondents tend to rate the results of environmental (D), plant layout (F) and market development (I) projects upon company competitiveness lower than other project types. Among those types that showed higher ratings of improved competitiveness, quality/inspection/ISO project outcomes stand out. These projects have a higher customer rating of improved competitiveness than all other types and this result is based upon the largest number (75) of responses associated with any project type.

Figure 19 offers another perspective on responses to this question, showing the distribution of responses. It shows that 71% of MMP projects result in some improvement of company competitiveness. Additionally, 34% of companies report that projects led to "substantial" or "very substantial" improvements in competitiveness. However, a substantial portion of respondents (29%) indicated that the project resulted in no change in competitiveness.
Conclusions
The preceding analyses provide new insight into the development and results of MMP projects. This section offers a summation of key learning points resulting from those analyses.

- Companies Needs are Understood

Data indicate that MMP project managers demonstrate a clear understanding of company needs during the project development process. In fact, mean scores of project manager “understanding of needs,” by project type, range from 4.0 to 4.8, on a balanced scale of 1 to 5, with 1 indicating “poor” and five indicating “excellent.” This finding suggests that MMP is functioning effectively in its role as an objective resource, listening to and helping to clarify the needs of SMEs. Any concern that any particular type of project is being forced on customers may be dispelled by these findings.

- MMP Influences Company Actions

Data show that as many as 29% of MMP customers may not have undertaken the changes resulting from services without MMP assistance. Furthermore, in the absence of MMP services, at least 34% of those companies that planned to make the changes without MMP would have delayed implementation of those changes for some period of time.

At the same time, it is also clear that many companies (61%) already have clear ideas about how to improve their business and that MMP helps them implement these ideas. Apparently, some companies work with MMP to help identify appropriate solutions to business issues, but a sizeable number of companies work with MMP for other reasons, such as to acquire outside perspective on problems, to make use of consultant resource identification services or for MMP project and contract management expertise.

- MMP Projects Lead to Change

Survey data indicate that no less than 80% of MMP projects resulted in business changes within the companies that conducted those projects. Companies also report that an additional 9% of projects that did not result in change by the time of MMP’s Eight Month Follow-up Impact Survey may still lead to some change. Among the explanations provided by companies that report they will not make changes as a result of MMP services, personnel changes, lack of time or financial resources, or a decision to change business strategy were the most common reasons for failure to implement changes.

- Companies Report Impacts for a Vast Majority of Projects

Of those MMP projects that resulted in some change within the company, 81% were reported to result in an impact on one or more of the following measures: sales, manufacturing efficiency, cost savings, employment levels, investments or “other.” Four distinct analyses were performed in order to clarify the variables that may influence the likelihood of reported project impact: company SIC; company size (FTE); project cost; and, project type (substance).
Data are inconclusive as to whether any one particular project or customer attribute is uniquely important as a determinant of project effectiveness. However, data showed that each of the aforementioned characteristics might have some influence upon results.

Impact and Company SIC
Companies from seven different two-digit SIC codes were analyzed for possible correlation between industry and the likelihood of reported project impact. Among these industries, those companies from SIC 38, "measuring and analyzing instruments," demonstrated a significantly higher frequency of reported impacts (within one standard error) than companies from other sectors. It is possible that other characteristics of either the companies or the projects conducted with this sector may have influenced this result, but data sample sizes are insufficient to say this definitively.

Impact and Company Size (FTE)
MMP provides services to companies with workforces ranging from a handful to 500 employees. However, MMP's client portfolio generally reflects the Commonwealth's distribution of manufacturers and is largely comprised of companies with 50 employees or fewer (55%). Data indicate that companies with between 11 and 250 employees (76% of all customers) have similar frequencies of reported impact as a result of services, with means running from 74% to 88%. Companies with a workforce of one to ten employees demonstrated a significantly lower likelihood of impact (67%) than did companies of other sizes (within one standard error).

Impact and Project Cost
The services provided to SMEs by MMP tend to be very low in cost, as 75% of projects cost $10,000 or less. Of particular note, 48% of all MMP projects cost $2,500 or less, with a substantial number of these being human resource and market development projects. Interestingly, the frequency (66%) of impact attributed to an MMP project is lowest for this large subset of very low cost projects.

Frequency of reported impact for projects that cost between $2,501 and $5,000 climbs slightly to 81% and projects of $5,001 or more demonstrate very high frequency of reported impact, ranging between 90% and 100%. The differences in mean impact scores associated with these three broad cost levels are significant within one standard error.

Impact and Project Type
MMP services may be most clearly defined by the "substance type" that is associated with them. Among the fourteen identified project types listed by MMP, eight have sufficient survey data to allow analysis. Data show two distinct groups within these types with respect to the likelihood of reported impact. Quality/inspection/ISO (94%), plant layout (93%), product or design development (92%) and process improvement (87%) projects show significantly higher mean frequencies (within one standard error) of reported impact than do projects in a second grouping. In this second grouping that includes business systems/management, EDI/communications/LAN, market development and human resources projects, mean frequency of impact ranges from 69% to 72%.
MMP Projects Improve Competitiveness

Data show that 71% of surveyed companies that utilized MMP services reported some improvement in competitiveness. The distribution of responses shows that 34% of companies report that projects led to “substantial” or “very substantial” improvements in competitiveness. However, a substantial portion of respondents (29%) indicated that the project resulted in no change in competitiveness at all.

The mean score in response to this question is 2.5, which falls midway between “slight improvement” and “moderate improvement” on the question’s response scale. Project types with the highest and most reliable mean scores include EDI/communications/LAN, quality/inspection/ISO and process improvements. Mean scores for environmental, plant layout and market development projects were relatively low on this measure.

Acknowledgments
Production of this study would not have been possible without the ongoing support and assistance of many people.

It is wholly appropriate to recognize the efforts of the many staff of the Massachusetts Manufacturing Partnership (MMP) with whom the Donahue Institute has collaborated in the last three years. Particular thanks are due to: Fred Ritzau, Statewide Director, MMP; and, Paul Cotnoir, Jerry Rubin, Jim Chapman, Fran Eagle, and Stephen Andrade, Directors of MMP’s regional offices. Thanks must also be directed to Rob Biela for his tireless attention to the collection of data that were instrumental to production of this report.

Additionally, the author would like to thank staff of the Donahue Institute, University of Massachusetts, including: Dr. Eric Heller, Director of Research and Evaluation; Michael Doherty, Research Analyst; and, Stacey Hamwey and Matthew Allen, Research Assistants; for their ongoing assistance in the evaluation of MMP.
Model 1: MMP Service Delivery Model

Phase 1: Initial Contact

Phase 2: Needs Assessment & Project Development

Phase 3: Internal/External Resource Identification

Phase 4: Project Management and Implementation

Phase 5: Project Follow-Up, Define Next Steps

Exit Services

Model 2: Evaluation Logic Model

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Objectives</th>
<th>Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Assistance</td>
<td>Actions Within</td>
<td>Company Business</td>
</tr>
<tr>
<td>Services</td>
<td>Company</td>
<td>Economic Impacts</td>
</tr>
<tr>
<td></td>
<td>Mfg. Changes (Company)</td>
<td>Impacts</td>
</tr>
</tbody>
</table>
Table 1: Most Served Companies by SIC Code

<table>
<thead>
<tr>
<th>SIC</th>
<th>Sector</th>
<th># Served</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Apparel and other finished products</td>
<td>33</td>
<td>5%</td>
</tr>
<tr>
<td>26</td>
<td>Paper &amp; allied products</td>
<td>29</td>
<td>4%</td>
</tr>
<tr>
<td>27</td>
<td>Printing, publishing and allied industries</td>
<td>38</td>
<td>6%</td>
</tr>
<tr>
<td>28</td>
<td>Chemicals and allied industries</td>
<td>23</td>
<td>4%</td>
</tr>
<tr>
<td>30</td>
<td>Rubber &amp; miscellaneous plastics</td>
<td>59</td>
<td>9%</td>
</tr>
<tr>
<td>34</td>
<td>Fabricated metal products</td>
<td>93</td>
<td>14%</td>
</tr>
<tr>
<td>35</td>
<td>Industrial &amp; commercial machinery</td>
<td>107</td>
<td>16%</td>
</tr>
<tr>
<td>36</td>
<td>Electronics</td>
<td>72</td>
<td>11%</td>
</tr>
<tr>
<td>38</td>
<td>Measuring and analyzing instruments</td>
<td>50</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td><strong>Totals:</strong></td>
<td><strong>504</strong></td>
<td><strong>78%</strong></td>
</tr>
</tbody>
</table>

Figure 1

Number of Employees in Companies Served by MMP

- 251-499: 5%
- 500+: 1%
- 1-10: 14%
- 11-25: 19%
- 51-100: 19%
- 26-50: 22%
- 101-250: 16%
Figure 2

Completed Projects by Type

A: CAD/CAM
B: EDI/communications/LAN
C: business systems/management
D: environmental
E: quality/inspection/ISO
F: plant layout/manufacturing cells
G: automation robotics
H: control system integration
I: market development
J: material engineering
K: process improvements
L: product or design development
M: human resources
N: technical training
Table 2: Mean Cost by Project Type

<table>
<thead>
<tr>
<th>Project Type</th>
<th>n</th>
<th>Mean Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Training</td>
<td>36</td>
<td>$1,719</td>
</tr>
<tr>
<td>Material Engineering</td>
<td>4</td>
<td>$3,281</td>
</tr>
<tr>
<td>Human Resources</td>
<td>209</td>
<td>$3,502</td>
</tr>
<tr>
<td>CAD/CAM</td>
<td>24</td>
<td>$3,757</td>
</tr>
<tr>
<td>Market Development</td>
<td>107</td>
<td>$4,030</td>
</tr>
<tr>
<td>Environmental</td>
<td>35</td>
<td>$6,456</td>
</tr>
<tr>
<td>Business Systems/Management</td>
<td>56</td>
<td>$8,074</td>
</tr>
<tr>
<td>Plant Layout/Mfg. Cells</td>
<td>50</td>
<td>$8,913</td>
</tr>
<tr>
<td>EDI/Communications/LAN</td>
<td>70</td>
<td>$9,217</td>
</tr>
<tr>
<td>Control Systems/Integration</td>
<td>27</td>
<td>$9,870</td>
</tr>
<tr>
<td>Process Improvements</td>
<td>145</td>
<td>$10,550</td>
</tr>
<tr>
<td>Quality/Inspection/ISO</td>
<td>270</td>
<td>$11,511</td>
</tr>
<tr>
<td>Product or Design Development</td>
<td>37</td>
<td>$15,663</td>
</tr>
<tr>
<td>Automation/Robotics</td>
<td>4</td>
<td>$15,813</td>
</tr>
</tbody>
</table>
Figure 4

Interaction Line Plot for Project Cost
Error Bars: 95% Confidence Interval

Table 3: MMP Understanding of Needs, Mean Scores by Type

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Mean Score</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automation/Robotics</td>
<td>4.0</td>
<td>1</td>
</tr>
<tr>
<td>Business Systems/Management</td>
<td>4.8</td>
<td>12</td>
</tr>
<tr>
<td>CAD/CAM</td>
<td>4.4</td>
<td>5</td>
</tr>
<tr>
<td>Control Systems/Integration</td>
<td>4.6</td>
<td>8</td>
</tr>
<tr>
<td>EDI/Communications/LAN</td>
<td>4.4</td>
<td>22</td>
</tr>
<tr>
<td>Environmental</td>
<td>4.8</td>
<td>13</td>
</tr>
<tr>
<td>Human Resources</td>
<td>4.4</td>
<td>31</td>
</tr>
<tr>
<td>Market Development</td>
<td>4.5</td>
<td>28</td>
</tr>
<tr>
<td>Material Engineering</td>
<td>4.0</td>
<td>2</td>
</tr>
<tr>
<td>Plant Layout/Mfg. Cells</td>
<td>4.6</td>
<td>14</td>
</tr>
<tr>
<td>Process Improvements</td>
<td>4.5</td>
<td>31</td>
</tr>
<tr>
<td>Product or Design Development</td>
<td>4.7</td>
<td>6</td>
</tr>
<tr>
<td>Quality/Inspections/ISO</td>
<td>4.4</td>
<td>80</td>
</tr>
<tr>
<td>Technical Training</td>
<td>4.3</td>
<td>7</td>
</tr>
<tr>
<td><strong>All Types</strong></td>
<td><strong>4.4</strong></td>
<td><strong>260</strong></td>
</tr>
</tbody>
</table>
Figure 5

Would Company Have Undertaken Without MMP

- Yes 61%
- No 27%
- Maybe 12%

Figure 6

If Yes, When Would You Have Taken Action On This Project?

- Uncertain 23%
- Delayed Uncertain 23%
- Delayed more than 1 year 8%
- Same Time Frame 43%
- Delayed 6-12 months 8%
- Delayed more than 1 year 3%
Figure 7

Survey Outcomes for All Surveyed Projects

<table>
<thead>
<tr>
<th>Will Not Implement Changes</th>
<th>Not Yet Implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Changes Implemented</td>
<td>80%</td>
</tr>
</tbody>
</table>

Table 4: Frequency of Reported Impact

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Mean</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>E Quality/Inspection/ISO</td>
<td>.94</td>
<td>108</td>
</tr>
<tr>
<td>F Plant Layout/Mfg.</td>
<td>.93</td>
<td>14</td>
</tr>
<tr>
<td>L Product or Design Development</td>
<td>.92</td>
<td>12</td>
</tr>
<tr>
<td>K Process</td>
<td>.87</td>
<td>30</td>
</tr>
<tr>
<td>M Human Resources</td>
<td>.72</td>
<td>74</td>
</tr>
<tr>
<td>C Business</td>
<td>.71</td>
<td>17</td>
</tr>
<tr>
<td>B EDI/Communications/LAN</td>
<td>.69</td>
<td>16</td>
</tr>
<tr>
<td>I Market</td>
<td>.69</td>
<td>36</td>
</tr>
<tr>
<td>All Types</td>
<td>.81</td>
<td>342</td>
</tr>
</tbody>
</table>
Figure 8

Table 5: Frequency of Reported Impact

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Mean</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; $2,500</td>
<td>.66</td>
<td>126</td>
</tr>
<tr>
<td>$2,501-</td>
<td>.81</td>
<td>43</td>
</tr>
<tr>
<td>$5,001</td>
<td>.93</td>
<td>74</td>
</tr>
<tr>
<td>$10,001-</td>
<td>.90</td>
<td>71</td>
</tr>
<tr>
<td>$20,001-</td>
<td>.92</td>
<td>24</td>
</tr>
<tr>
<td>$40,001</td>
<td>1.00</td>
<td>4</td>
</tr>
<tr>
<td>All Types</td>
<td>.81</td>
<td>342</td>
</tr>
</tbody>
</table>
Figure 9

Cell Line Chart Grouping Variable(s): Cost Level
Error Bars: ± 1 Standard Error(s)

Cell Mean for Any Impact

A $<2,501
B $2,501-$5k
C $5,001-$10k
D $10,001-$20k
E $20,001-$40k
F $40,000+
Table 6: Frequency of Reported Impact

<table>
<thead>
<tr>
<th>Company Size</th>
<th>Mean</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 10</td>
<td>0.67</td>
<td>28</td>
</tr>
<tr>
<td>11 - 25</td>
<td>0.81</td>
<td>50</td>
</tr>
<tr>
<td>26 - 50</td>
<td>0.82</td>
<td>74</td>
</tr>
<tr>
<td>51 - 100</td>
<td>0.85</td>
<td>50</td>
</tr>
<tr>
<td>101 - 250</td>
<td>0.88</td>
<td>56</td>
</tr>
<tr>
<td>251 - 499</td>
<td>0.74</td>
<td>14</td>
</tr>
<tr>
<td>500 +</td>
<td>0.50</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>0.81</td>
<td>273</td>
</tr>
</tbody>
</table>

Figure 10

Table 7: Frequency of Reported Impact

<table>
<thead>
<tr>
<th>SIC</th>
<th>Sector</th>
<th>Mean</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Printing, publishing and allied</td>
<td>0.80</td>
<td>15</td>
</tr>
<tr>
<td>28</td>
<td>Chemicals and allied</td>
<td>0.85</td>
<td>13</td>
</tr>
<tr>
<td>30</td>
<td>Rubber &amp; miscellaneous</td>
<td>0.85</td>
<td>34</td>
</tr>
<tr>
<td>34</td>
<td>Fabricated metal</td>
<td>0.78</td>
<td>51</td>
</tr>
<tr>
<td>35</td>
<td>Industrial &amp; commercial</td>
<td>0.78</td>
<td>50</td>
</tr>
<tr>
<td>36</td>
<td>Electronics</td>
<td>0.88</td>
<td>40</td>
</tr>
<tr>
<td>38</td>
<td>Measuring and analyzing</td>
<td>0.97</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0.84</td>
<td>238</td>
</tr>
</tbody>
</table>

Figure 11
Figure 12

Cell Line Chart Grouping Variable(s): type
Error Bars: ± 1 Standard Error(s)

Figure 13

Cell Line Chart Grouping Variable(s): type
Error Bars: ± 1 Standard Error(s)

Key: Figure 12 - Figure 14
B: EDI/Communications/LAN
C: Business Systems/Mgmt.
E: Quality/Inspection/ISO
F: Plant Layout/Mfg Cells
I: Market Devt.
K: Process Imprmnts.
L: Product or Design Dev’t
M: Human Resources

Figure 14
Figure 15

Cell Line Chart  Grouping Variable(s): type
Error Bars: ± 1 Standard Error(s)

Figure 16

Cell Line Chart  Grouping Variable(s): type
Error Bars: ± 1 Standard Error(s)

Figure 17

Cell Line Chart  Grouping Variable(s): type
Error Bars: ± 1 Standard Error(s)

Key: Figure 15 - Figure 17
B: EDI/Communications/LAN
C: Business Systems/Mgmt.
E: Quality/Inspection/ISO
F: Plant Layout/Mfg Cells
I: Market Devt.
K: Process Improts.
L: Product or Design Dev't
M: Human Resources
Table 8

Means Table for Change in Competitive Effect: project type

<table>
<thead>
<tr>
<th>Count</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Std. Err.</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>22</td>
<td>2.773</td>
<td>1.232</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>2.700</td>
<td>1.567</td>
</tr>
<tr>
<td>D</td>
<td>12</td>
<td>2.250</td>
<td>1.357</td>
</tr>
<tr>
<td>E</td>
<td>75</td>
<td>3.080</td>
<td>1.302</td>
</tr>
<tr>
<td>F</td>
<td>13</td>
<td>2.154</td>
<td>1.405</td>
</tr>
<tr>
<td>I</td>
<td>27</td>
<td>2.037</td>
<td>1.427</td>
</tr>
<tr>
<td>K</td>
<td>30</td>
<td>2.933</td>
<td>1.461</td>
</tr>
<tr>
<td>L</td>
<td>5</td>
<td>2.800</td>
<td>1.643</td>
</tr>
<tr>
<td>M</td>
<td>28</td>
<td>2.643</td>
<td>1.393</td>
</tr>
</tbody>
</table>

Figure 18

Figure 19

Distribution of Responses
"To What Extent was Competitiveness Improved?"
- Substantial Imp. 24%
- Very Substantial Imp. 10%
- Moderate Imp. 27%
- Slight Imp. 10%
- No Change 2%
Estes. On the two-year survey, Phil and Jan do benchmarking that goes back to the client to get the customer to respond.

Shapira. We recently tried to get the two-year survey results all on one page, so that the field staff could understand what the benchmarks were, and also could also understand what types of firms have what types of performance metrics. We’ve done the same thing with the benefits.

Oldsman. Where are the areas your evaluation plan is missing?

Alford. Phil hit on the main one. We do a lot of training and workshops, but we don’t know whether or not our courses produce changes in companies, which then result in impacts. A preliminary analysis of training/workshop customers shows that most of our training/workshop customers were already customers of projects, rather than brand new customers. At the same time, we do get additional project leads from training programs.

Coburn. Sessions like this promote broader thinking. My perspective is as a practitioner. Ohio was the first state investor in the MEP program, but I haven’t been very involved in the program since then. The most interesting thing I’ve heard here is the use of the census data when you look at this from a practitioner’s perspective (e.g. interfacing with elected officials), self-reporting is a problem. If you can deliver 10 successful customers to the legislature, that will strip it away, but really you’re delivering idiosyncrasies. If you were able to do program analysis from the perspective of the overall regional economy, that is powerful. That represents a fundamental breakthrough. There are some other questions, though.

The core values of the MEP regarding private sector values—what does that mean? What is the reality of the MEP at $100 million? The MEP began as an idea. Today it is not an idea—it’s a big system. What kind of system is it? It is basically a consulting business. How are we different from a consulting business? Why does the MEP warrant public support? The point is that MEP needs to be focused on the firms that couldn’t pay for consultants any other way. If they could afford it, they should use the private sector consultants. At the same time, if the MEP is a consulting business, how are consulting businesses evaluated? In the business there are two ways: (1) Are you able to making continuing sales? and (2) Are you efficient/profitable? If you were to apply those rules to the MEP, regarding continuing sales, MEP is very effective. Congress continues to buy. The private-sector rule is—were you able to keep your firm in business and grow? Now the profitability measure is more difficult, but Eric’s work touches on that. That is a phenomenon where quantitative and qualitative measures are few and far between. In any case, that leads to the question of what the true public goal is here? Is it to be the poor man’s Anderson Consulting? In a way it is. But I also think it is to effect a change in the American manufacturing culture, however, that is very difficult to evaluate. You’re talking about bringing a message to firms operating in an individualistic American culture, they can look outside and to other firms to improve themselves. Regarding issues of efficiency of the system, Eric Oldsman says that 30 percent of the time a field agent is out in the field. I would ask, what is the appropriate level? What do you benchmark against? How do you know what the effective level is?
would look at other public activities and look at their ratios of fieldwork vs. in-house work. You hear about private consultants spending 75% of their time on a project, but what does that mean and how does that compare with Eric's 30%? Even while in-house, private consultants work on projects. Also this is a system. SAP is becoming popular for system work within companies. It's a rigorous tool to try to integrate disparate operations within organizations. Along those lines, how do you get the kind of efficiencies built in the system from that standpoint, because it relates to getting continuous support from sponsors, but also to get continuous improvement. There are two more points. One is the need to get results out quicker. Why don't results go out on a home page? This promotes analysis of results. It's interesting that the MEP growth resulted from a program that is defunct (TRP), but creative people used that program to produce the MEP. Also, in terms of rewarding effective behavior, the Baldrige award is very good. MEP should have awards for the most effective center and have awards for the most effective manager, even dollar awards. In addition, maybe we should have an award for the most creative approach that didn't work. You benefit from acknowledging failure and acting on it. You benefit from risk-taking. This practice didn't work, so we pulled it. This center didn't work so we closed it.
Part III.

Organizational Arrangements to Promote Industrial Modernization
Overview

This is a discussion about an ongoing effort among Manufacturing Extension Centers (MECs) to track a set of operating measures for benchmarking themselves compared to one another. The development of the effort has been funded by the National Institute of Standards and Technology (NIST) and has been center directed and led, with staffing and operational support provided by Nexus Associates. The general findings indicate that for project activity, center field staff are meeting, on average, eight new prospects per year, developing ten-twelve new projects per year, "carrying" eighteen per year, and closing eight per year. The benchmarking suggests that centers should view their operations, from a cost perspective, as consulting-type organization for the purposes of cost management, while recognizing each centers unique operating approach and regional goals.

Background on Project Initiation

The genesis of the project was 1995 when the Northeast Directors began discussing the idea of sharing standardized operating information among themselves with the purpose of learning about one another, and developing a basis for self-improvement activities.

The group applied for NIST funding in the fall of 1995 under a competition to support MEC-based evaluation activities, with the Connecticut State Technology Extension Program, (CONN/STEP), Connecticut’s MEC, as the lead MEC. The proposal included all of the Northeast MECs as well as four centers from outside the region. Centers from other regions increased the number of MEC “business models”, and incorporated one center who had already achieved ISO 9000 registration.

Word was received in the summer of 1996 that the project was funded. Work began with the first meeting of the group held in conjunction with the Northeast
Regional Director’s meeting in September of 1996.

**Benchmarking Among MEPs**

Several of the underlying reasons for benchmarking among MEC's were to:
- Establish some shared operating parameters;
- Help focus improvement efforts using “baseline” data;
- Examine the impact of changed operating procedures on various operating parameters;
- Compare measures against other centers leading to learning what others are doing; and
- Observe what might be reasonable operating metric goals based on center experience;

Benchmarking under this project excluded comparing impact results. Since so much of the NIST effort was already directed to measuring MEC impact results, it made no sense to compete with these efforts.

**Other Benchmarking Approaches**

A similar effort was started by MAMTC and Paul Clay in a roughly concurrent timeframe, which is taking a straight accounting perspective on MEC metrics. In particular that group is looking at centers which use a similar operating approach, which are about the same size, and will look at issues like cash flow, balance sheets and income statements. The analogy one can draw is that the use of financial data, like the MAMTC approach, is similar to audited financial statements - while the MEC Benchmarking project is like looking at internal operating measures, such as Performance Benchmarking or High Impact Assessments do with manufacturers.

At the same time as well, NIST was rolling out their standardized monthly reporting system and semi-annual reporting system which captured data that could be used for benchmarking by centers. However, many of the centers viewed this data as suspect since data is often submitted to make an individual center look favorable. Others have commented on a number of definitional problems. And third, if the benchmarks desired were different from reporting methods, then the NIST data would be limiting.

**First Steps in the Project**

At the first meeting, the 14 participating centers began by defining the types of activities or processes that were most important to measure and improve. The question posed was “Without discussing actual metrics please identify the 5 major processes within your center that you would like to measure”?

The centers were broken into separate groups of 3-5 members, and asked to come up with their top five processes. The larger group re-convened and almost using the same words, the different groups proposed focusing on the same five processes: Client Development; Project Development; Project Management; Customer Impact; and, Building Customer Relations. The Customer Impact was set aside since NIST was focusing on that. The other four processes were organized in a flow diagram fashion as indicated in Diagram I.

**Definition of the Four Major Processes**

**Develop Prospects:** This is the process of meeting with manufacturers. “Manufacturers that have received an initial site visit or undertaken a project. Once a prospect, always a prospect.” Prospects are eventually presented with project proposals, becoming customers. “Customers are prospects that have initiated one project with the MEC. Once a customer, always a customer.”

**Projects:** Is work undertaken for a manufacturer according to a signed, written agreement between the customer and the MEC and/or a third-party service provider that describes the services to be delivered and any associated budget. The project may
be carried out by MEC staff and/or a third-party service provider. In either case, MEC staff must provide project management.

Manage Projects: Is the time and effort undertaken during the project under contract, this may be project support, or it may be direct contract work.

Build Customer Relations: Is looking to measure the level of repeat customers, size of project activity, and coverage in the marketplace.

One change from the original concept occurred at this point. Rather than looking at many different activities, the project focused on processes related to project development. Activities like marketing, seminars, group projects, etc. were recognized as valuable activities by MECs, however the group felt that the need to focus and achieve consensus would only be possible with one set of activities at a time.

First Conclusion

Despite the best efforts of the MEC’s involved, it was recognized that all of the participating MEC’s operated in a similar enough fashion that this project could be accomplished. While many of the participating centers declared their uniqueness, it was eventually agreed that by working together at a higher level of process analysis, all centers are “uniquely similar”. There are some differences, but not enough to prevent comparisons.

Second Conclusion

Many of the measures used would be related in both inverse and converse fashions (i.e. high on one would typically result in being lower on another, or the reverse) and a specific value is related not to the performance of center’s, but rather to a level that matches an individual center’s philosophy or “business model”. Thus the participants began to agree on processes with the recognition that no single measure could designate a high performing or low performing center, nor that “high” or “low” was a judgement possible independent of an individual center’s expectations.

Next Steps

The project moved into the stage of developing specific metrics that could be associated with each of the processes. Each center was visited in the fall of 1996 to discuss what measures they currently use, what measures they might use, and how they might approach measuring any of the processes. In each case, the Director, field personnel and administrative and support people were interviewed. In addition, 21 private consulting organizations were contacted to examine their metrics for the same processes.

At a second meeting in December of 1996 proposed measures were presented and discussed in detail. This conversation resulted in numerous changes in the specific definitions, but also began to identify the concept of an MEP “Costing Rate”. This thought is that if one takes all the operating costs, and divide by just the number of hours spent in project activity with companies (i.e. billable activities that you could charge for) what would the actual cost per hour be? A graphical presentation of this concept is presented as Diagram II.

In essence the processes follow a “consulting model” practice from a cost perspective. If all cost outside of the time spent with manufacturers are included in an hourly cost rate, MECs at this point “cost” $200-$400 per hour of time spent with clients. This is the same thought process which drives larger consulting groups to actually bill out at $400 per hour.

Third Conclusion

What became evident early on is that many of the efficiency measures would be based on tracking time, particularly a break out between time spent on projects, compared to all other time. In at least 50% of the centers, this was not already being done to the level necessary for benchmarking purposes. Most centers
tracked time on a weekly basis, several centers tracked time across publicly supported programs or contracts, but very few tracked time or differentiated time spent on companies or company projects versus other activities.

For several centers the issue of further participation in the project centered around whether they were willing to begin tracking the field staff time by hours against individual companies and company projects. In several cases, the centers were moving in that direction already, and this became a driver for helping the center to see more rationale for instituting a clear policy, and provided guidance for a reasonable approach.

Pilot Testing
A pilot test was run during the month of January, 1997 using the agreed to measures. A third meeting was held in Boston in February, 1997 resulting in revised measures, data definitions and collection approaches to be put in place for the full quarter.

The First and Second Report
The first full report was generated based on the first quarter of 1997, January to March. Reports were returned to centers by early summer. The report is a confidential release of information for every center, with a code key established for individual centers - they know who they are, but not anyone else. Yet everyone has access to everyone else's data. Each of the centers were then visited in July, as they were completing the submission of their second quarter data, and debriefed on the first report.

One lesson learned from the visits was that centers were particularly interested in tracking their quarterly performance. The original idea was to compare benchmark data every six months. Yet quarterly data for self analysis turned out to be of most interest. A quarter is a short enough period that problems could be responded to, yet long enough that "noise" evident from monthly data would not be confusing. Centers commented that comparison would be helpful computed once a year.

A second report was produced in August 1997, and a meeting held in Boston in early September 1997 where the participating centers together reviewed the results of the two quarters of data. At this meeting each of the centers began to share their "coding" so that everyone was identifiable to everyone else. A very healthy discussion occurred among centers based on these results, particularly those centers that had "outlier" metrics on the scales. Also discussed was how the data was being used by the center for planning, base-lining and performance improvements.

Measurements Selected
The following measures were recommended by the group for use by MEPs in gauging their business processes:

Overall
- Percent of total "available hours" charged to projects;
- Total operating costs per project hour;

Prospect Development
- New Prospects per Field Staff
- "Conversion Rate" of Prospects to Customers

Project Development
- Number of new Customers per Field Staff
- Number of new Projects per Field Staff

Project Management
- Percent of Field Staff "available hours" charged to projects
- Active projects per Field Staff
- Average Hours spent per project in period
- Number of completed projects
- Number of open projects
Financial

- Total operating costs per Field Staff
- Gross Cash received from clients per Field Staff
- Payments to outside parties per Field Staff
- Net Cash received from clients per Field Staff

Numerical Findings

There are several preliminary findings regarding the level of activities through the first two quarters of the project:

Average New Customers

The average number of new customers per field staff person is typically around 2-3 per quarter. However, the range of number of prospects visited by field staff ranges from 2 to about 10, with the median or mean approximately 7. The conversion rate ranges from just under 0.1 to just over 0.6, in almost an inverse relationship to the number of prospects visited. Thus, centers who have visited 11 prospects, have a conversion rate of 0.2 (this a new customer rate of 2) and centers who have visited 3 prospects, have a conversion rate of 0.6 (thus a new customer rate of just under 2). This represents various marketing strategies, and represents that there are trade-offs among these strategies.

Project Development and Management

The rate of project development, management and closure is fairly similar across the participating centers. On average, field staff are developing 8 new customers per year, 12-14 new projects per year, “carrying” 18-20 as active through various parts of the year, closing 8-10 per year. Thus, most field staff are developing more projects than they are closing at this point.

Financial Measures

Most centers, 75%, have moved from a position of subsidizing services to one of generating positive cash flow on a project basis. This may in fact be due to billing and collecting methods versus true cash flow, which would become evident through future quarters.

Additional Lessons Learned

Fourth Conclusion

Getting buy-in at a level which results in true participation is difficult. First the center director needs to agree, then you need 1-2 other champions within the center to ensure real follow through and support on the operating level. During the project, approximately 70% of the centers changed directors, yet there was strong continuity in the project since most of the data collection and understanding was developing at the next “level” down. In several cases, the new director benefited from the reports as means of getting good, quick operating information about the center, and what a center is!

Fifth Conclusion

It was easy to get participation from centers for the initial pilot test, and for the first full quarter program. It is much harder to build a sustained commitment and understanding for something like this that: requires data input by a center (i.e. time and effort); happens only four times a year; does not represent a requirement by a funding agency; and, doesn’t affect the field staff directly.

The main way this was overcome, was to build into the process several meetings on-site at the centers to reach out for their input, and to meet with the directors and other staff members so that the results and their use were made clearer to the participants. A significant training
activity will be an imperative for any new center interested in participating.

Sixth Conclusion
What might be termed the “process of discovery” was particularly important to the centers in the project. As opposed to simply being given the data collection requirement, and the measures to review, the whole process of getting together on a regular basis (perhaps twice a year as a group) to discuss the consulting model perspective, to discuss the use of particular measures, and to discuss how the results of these projects or programs are used, was as important as the numbers. Several centers gained a true perspective on how to begin viewing, managing and supporting their operations from this activity.

Seventh Conclusion
Of particular importance to the group was the role that NIST played, and didn’t play during the project. NIST provided the funding, and was involved in helping to set up the initial measures. NIST wanted to use any currently collected data if possible, to help limit the amount of extra data collection. Second, NIST has a tremendous amount of experience from the quarterly and semi-annual report process about issues and dilemmas in the collection and use of data and measures.

There was a tremendous amount of concern about whether NIST would be involved in holding or reviewing the actual center data and measures. NIST was very supportive in letting the project be directed by the Centers, letting the project information reside with a third party (Nexus Associates) and not requiring access to the center codes. This, in spite of what one NIST Regional Manager pointed out, that based on information already at NIST they could see many of the same things that Centers might discover on their own. However, the fact that NIST does not hold the data, or know who the data is about seems to have allowed for a fuller exchange between the centers.

Final Perspectives
The project continues with the original group focused on reviewing a full year of data, and looking at ways to expand the project to other centers. Several centers have begun to use the results in discussion with their boards, with their staff and with their state sponsors. In addition to creating a descriptive “model” to share, the actual data is being used to establish baseline data for leading improvement efforts.

It is clear that the way centers can improve the cost of their efficiencies follows some of the typical consulting strategies. These include using “lower cost” staff, strengthen external marketing efforts to maximize field staff time in projects, etc. Also, several “trade off”s that are intuitive have been clarified: the affect of client work versus meeting with prospects; leading indicators for projects that can be tracked; the difference in many metrics or measures among “business models” is there, but not as dramatic as might be expected.

Based on the project several centers have established much stronger data collection and management systems, particularly focusing on client relations and time worked with clients. While the study or results didn’t always uncover unknown information for an individual center, it helped to verify and clarify problems, and show the impact that a problem might have on other operating factors.
Diagram I

Staff spend time on direct and indirect activities ... but only billed time generates revenue

Total Time

Available time

Charged time on projects

Billable time on projects

Diagram II

Hours spent

- holidays, vacations and leaves
- undertaking other processes
- building customer relationships
- developing prospects
- developing projects
- managing projects ... but not billed
- managing projects ... and billed to customers

Reserve

Total Operating Costs
Overview
This paper examines the relationship between MEP centers and the SBDC program. It begins with an overview of relationships that MEP centers have across the system with various public and private organizations that provide services to small and mid-sized manufacturers. More in-depth case studies of three MEP centers and their relationships with SBDCs are profiled. Preliminary conclusions are provided based on the study's findings.

Context for Service Coordination
A key element of the Manufacturing Extension Partnership, managed by the National Institute of Standards and Technology (NIST) at the U.S. Department of Commerce, is the development of coordinated local networks of service providers in the public and private sector to serve the needs of small and mid-sized manufacturing enterprises. Across the country, MEP centers have increasingly established and maintained relationships with third party service providers. As of June 1997, the MEP reporting system indicates that more than 2,600 organizations are associated in some way with 68 MEP centers. This number understates the actual amount of organizations involved in the MEP, however. Some centers do not report information about organizations that various center staff informally use to provide assistance to manufacturers. In addition, data from the remaining seven relatively newer centers which describes the system of 75 MEP centers is not included in this analysis. But certainly this number is more than three times the size of the 750 affiliated organizations reported by 40 centers as of at the end of 1995. Moreover, the average center reported 38 organizational affiliates, compared to 19 such relationships at the end
of 1995. These numbers suggest that MEP center affiliation with third party service providers has continued to grow.

Many of these relationships are with small business development centers (SBDC). As of June 1997, 59 percent of MEP centers report having relationships with SBDCs. In comparison, more than 90 percent of centers have relationships with universities and economic development organizations. The next most common type of organizational relationship, for 66 percent of the centers, is with community colleges and technical institutes. Fifty-nine percent of centers have relationships with industry associations, 57 percent with other non-profits, and 48 percent with consulting companies. (See Table 1.)

Table 1. Affiliated Organizations

<table>
<thead>
<tr>
<th>Type of Organization</th>
<th>% of centers reporting affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic development organization</td>
<td>97%</td>
</tr>
<tr>
<td>University, 4-year college</td>
<td>95%</td>
</tr>
<tr>
<td>Community/vocational College</td>
<td>66%</td>
</tr>
<tr>
<td>Industry association</td>
<td>59%</td>
</tr>
<tr>
<td>SBDC</td>
<td>59%</td>
</tr>
<tr>
<td>Other non-profit</td>
<td>57%</td>
</tr>
<tr>
<td>Consulting company</td>
<td>48%</td>
</tr>
<tr>
<td>Other government</td>
<td>38%</td>
</tr>
<tr>
<td>Federal laboratory</td>
<td>38%</td>
</tr>
<tr>
<td>Extension services (cooperative, manufacturing, engineering)</td>
<td>31%</td>
</tr>
<tr>
<td>Large company</td>
<td>31%</td>
</tr>
<tr>
<td>Electric, power utility</td>
<td>31%</td>
</tr>
<tr>
<td>Training organization</td>
<td>29%</td>
</tr>
<tr>
<td>Other for-profit</td>
<td>26%</td>
</tr>
<tr>
<td>Vendor</td>
<td>10%</td>
</tr>
</tbody>
</table>

Base number of centers reporting is 68. The 10 New York centers reporting results have been treated as one center because they reported in aggregate. Source: MEP semi-annual report, June 1997.

In our earlier (Phase I) study *Coordinating Industrial Modernization Services*, we examined the development, operation, and effects of efforts to promote local service coordination in the MEP system. The study found that MEP sponsorship has led to increased service coordination not readily obtained through individual center efforts alone or through demands of state governmental funders. Increased service coordination, in turn, has mostly improved the assistance delivered to firms. The study noted that there were drawbacks to coordinating service delivery with third party organizations including increased costs (e.g., identifying service providers, lost learning within the organization, information sharing, contract management and monitoring projects), difficulties in maintaining quality across partner organizations, delays in timely service delivery, and inter-organizational tensions. At the same time, many benefits associated with service coordination emerged, including avoiding the duplication of services, tapping specialized skills, spreading development costs of new tools, broader marketing to new industrial customers, improving access to particular industries and areas, flexibility in staffing and the delivery of services, improving service quality, enhancing visibility in the locality, and strengthening state and local support.

Phase II of this study probes changes and developments in how MEP centers coordinate services with partner organizations, assessing the impacts of service coordination on centers and firms, and refining and disseminating recommendations for best practices in service coordination. Among the data sources are case studies from MEP centers, including several MEP centers examined in Phase I of the study. The centers examined in Phase I of the study included: Chicago

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Manufacturing Center (Chicago, Illinois) area, Georgia Manufacturing Extension Alliance (state of Georgia), Great Lakes Manufacturing Technology Center (Cleveland, Ohio area), Manufacturing Extension Partnership of Southwest Pennsylvania (Pittsburgh, PA area), Minnesota Manufacturing Technology Center (state of Minnesota), Oklahoma Alliance for Manufacturing Excellence (state of Oklahoma). The design of Phase II calls for revisiting four of these centers—Chicago Manufacturing Center, Georgia Manufacturing Extension Alliance, Great Lakes Manufacturing Technology Center, and Manufacturing Extension Partnership of Southwest Pennsylvania—and adding two new centers—Florida Manufacturing Technology Center and Industry Network Corporation—as case study subjects.

Three of these centers—Great Lakes Manufacturing Technology Center, Georgia Manufacturing Extension Alliance, and Manufacturing Extension Partnership of Southwest Pennsylvania—have had relationships with SBDCs are some time in the history of the center. The paragraphs below summarize the experiences of these centers with respect to their SBDC relationships.

**Great Lakes Manufacturing Technology Center**

The Great Lakes Manufacturing Technology Center (GLMTC) is one of the first three centers in the NIST Manufacturing Extension Partnership, established in 1989 through its host organization the Cleveland Advanced Manufacturing Program (CAMP). GLMTC is one of seven Edison Technology Centers in Ohio. GLMTC’s initial formation included affiliations with several local educational institutions, including Cleveland State University’s Advanced Manufacturing Learning Center (AMLC), Cuyahoga Community College’s Unified Technologies Center (UTC), Case Western Reserve University’s Edison Sensor Technology Center (ESTC) and the Center for Automation and Intelligent Systems Research (CAISR). These initial affiliations remain, though at various levels of activity—the Advanced Manufacturing Learning Center being the most active. The 1998 budget for GLMTC totals $8.88 million including $1.30 million in state support, $2.98 million in federal support, and $4.59 million in industrial support. (See Table 2.) GLMTC employs 47 full-time equivalent in-house staff. The number of initial visits in fiscal year 1997 was 220, resulting in three assessments and 35 projects. In total, 253 projects were booked in fiscal year 1997. Sixty-three percent of the projects were done in house and 37 percent were subcontracted to third-party providers. Project revenue exceeded $3.1 million with the average value of a project at $15,000. This revenue was split about 50:50 between GLMTC and third-party providers.

In the spring of 1994, CAMP received $250,000 in federal funds a year for three years from NIST to create a manufacturing-focused Small Business Development Center (SBDC) called the Northern Ohio Manufacturing (NOM) SBDC. CAMP originally saw the pilot program as a way to more fully serve manufacturers that needed financial and marketing services in the course of implementing technically-oriented changes. However, CAMP found that manufacturers did not want traditional SBDC business planning services, and the core SBDCs in Ohio did not have the skills and experience to work with manufacturers. As a result, CAMP/GLMTC used the funds to set up industrial marketing, planning, and finance capabilities and hired corporate finance, marketing, and commercial banking professionals from outside the SBDC system. The NOM-SBDC staff served about
22 percent of GLMTC’s manufacturers (about half of which were new to GLMTC) and generated 13 percent of GLMTC’s industrial revenue.

When the three-year pilot project ended, NOM-SBDC was brought in-house, without an association with the “SBDC” name. The industrial marketing function was most often demanded by clients, so GLMTC maintained it as part of the in-house consulting services group. The other former NOM-SBDC staff members have been reassigned. Grassroots relationships with the local SBDC organizations were maintained, with CAMP/GLMTC staff referring requests from companies in financial difficulties unable to pay for services to the SBDC and other public organizations. At the statewide level, however, the state SBDC program simultaneously set up a parallel network of “manufacturing SBDCs” to link Ohio’s SBDCs and MEP, including a planned manufacturing SBDC in Kent in the Cleveland metropolitan area.

Georgia Manufacturing Extension Alliance

The Georgia Manufacturing Extension Alliance (GMEA) provides industrial extension and technology deployment services to the state’s 10,000+ small and mid-sized manufacturers. The lead organization in GMEA is Georgia Institute of Technology (Georgia Tech) Economic Development Institute, which has a 35-year history of industrial extension service provision focused on rural Georgia. To expand the capacity of the state-sponsored service a proposal was submitted to the competitively-reviewed federal Technology Reinvestment Project (TRP) in 1993. Georgia Tech proposed a new structure, the Georgia Manufacturing Extension Alliance, that would partner Georgia Tech with the University of Georgia Small Business Development Centers (SBDC), the state Department of Technical and Adult Education’s (DTAE) Quick Start program, and Georgia Power Company Technology Applications Center (TAC). Over a two-year period, federal funding of $6.6 million was committed to GMEA, matched by an equivalent amount of state, in-kind and other funds. In 1996, GMEA was “rolled over” (after an external review) into civilian-side funding from NIST, with about $2.3 million in federal funds, again matched by state monies and revenues. In Year 4, GMEA’s federal funding is reduced from 50 percent to 40 percent of the operating budget. Client fees are expected to make up this difference. From Year 2 to Year 4 client fees are budgeted at more than three times the levels as in Year 2.

GMEA now operates a network of 18 regional offices (compared to 13 offices at the end of 1993), staffed with industrially-experienced engineers and business professionals. Field office services are supported by program skill centers in areas such as quality, manufacturing information technology, human resource development, strategic management assistance, energy, and environmental services. From February 1994 to December 1996, GMEA staff of 62 full-time equivalent field engineers and specialists served over 2,100 companies, equivalent to 21 percent of all manufacturers in the state. Included here were 39 percent of Georgia manufacturers with 20 to 499 employees. GMEA customers were served through 2,647 informal engagements, technical projects and assessments; 11 network group service projects; and 240 workshops and seminars. Thirteen percent of GMEA’s informal engagements, technical projects, and assessments involved industrial marketing and business services. Roughly 36 percent of closed projects involved referrals to other organizations or private-sector consultants and vendors.
Since GMEA’s original design, relationships with the three original partners have changed and relationships with other partners have become more prominent. The University of Georgia SBDC—now called Business Outreach Services (BOS)—provides pre-venture business planning, financial consultation, capital acquisition primarily through SBA loans, and marketing assistance through a network of 19 regional offices and 60 employees. The SBDC works with a large volume of clients in a year—at least 125 per staff member. Most clients have 10 or fewer employees, and most are in the retail industry. Only 7 percent of SBDC/BOS clients are manufacturers. Initially, the SBDC/BOS received about $175,000 a year in the first two-year period (February 2, 1994 to June 30, 1996), and $95,000 in the third year (July 1, 1996 to April 30, 1997), matched by an equivalent amount of cash resources. This money primarily went to support an SBDC/BOS counselor (with an engineering background) on-staff at the EDI main office on Georgia Tech’s campus. This counselor was to help develop an assessment tool with a financial analysis component, and to serve as a point of contact for field engineers with problems for which SBDC expertise was relevant. This counselor served only 37 manufacturers through 43 assessments and technical assistance projects during GMEA’s first three years of operation. In addition, GMEA co-located with the SBDC/BOS at eight sites around the state.

In year four, there was no formal contract with the SBDC/BOS. The SBDC/BOS program in fact spent only 60 percent of their year three grant. Further, the SBDC/BOS system desired to bring back into (and fund) the counselor previously supported by GMEA. Nevertheless GMEA management has characterized the relationship between Georgia Tech’s GMEA management and the University of Georgia SBDC/BOS leadership “as the best it has ever been.” The statewide SBDC/BOS leadership recently stressed the importance of serving small manufacturers at its annual meeting. However, much of the inter-organizational activity occurs informally at the grassroots level rather than as a result of formal top-down policies. In the GMEA Norcross office (one of the seven GMEA/SBDC co-locations), the two organizations split a suite. The two share administrative training expenses, telephone calling systems, a local area network and printers, and connection to the Internet through Georgia Tech’s system. The SBDC’s regional director reports that thanks to Georgia Tech’s connection, the SBDC’s staff can obtain information much more quickly than when they used to have to wait for responses from the University’s main campus. The two groups participate in a monthly brown bag lunch and staff meeting. They jointly hold training programs (most recently for loan offices from the local banks), and, for programs not jointly-sponsored, for example, Georgia Tech’s courses on simulation and product development, SBDC/BOS staff were invited to and did participate in these training programs. They have taken out advertisements together and have jointly visited manufacturing clients. Georgia Tech staff both receive referrals from and provide referrals to SBDC/BOS staff. Georgia Tech staff tend to refer small start-up businesses to the SBDC/BOS. They also use the SBDC/BOS’s for applications involving Geographic Information Systems (GIS).

Both organizations report improvements in the appropriateness of the referrals to one another as a result of improved understanding of organizational capabilities. GMEA’s director estimates that GMEA/SBDC co-locations save approximately $20,000 per office. The partnership has also generated new funding.
In the fall of 1997, GMEA’s Augusta office and BOS/SBDC were jointly awarded $80,000 from the Savannah River Regional Diversification Initiative to form a product and technology support center.

**Manufacturing Extension Partnership of Southwest Pennsylvania**

The Manufacturing Extension Partnership of Southwest Pennsylvania (MEP-SWPA) was established in March 1994 as part the national Manufacturing Extension Partnership (MEP) program of the U.S. Department of Commerce, National Institute of Standards and Technology. The core organization of MEP-SWPA is Southwest Pennsylvania Industrial Resource Center (SPIRC)—one of eight Industrial Resource Centers (IRC) sponsored in 1988 by the Commonwealth of Pennsylvania to assist small and medium-sized manufacturers in the state. As part of the expanded MEP-SWPA, SPIRC has now developed a service partnership with three other organizations covering a 13-county area of Southwestern Pennsylvania (including the Pittsburgh metropolitan region) with some 4,000 small and mid-size manufacturing enterprises (SMEs).

The new program started in March 1994, with an allocation of federal funds of $3.25m over two years matched by an equivalent amount of state funds. In Year 1, about $0.8 million goes to the partners, who also have to provide a 1:1 match. The total program budget is about $4.06 million a year ($8.13 million over the two year period).

In its first three years, MEP-SWPA was a partnership of 16 organizations, with SPIRC being the lead organization. The origins of this arrangement lied in the response to the announcement in 1993 of the federal government’s Technology Reinvestment Project (TRP). The TRP announcement stimulated attempted responses from both SPIRC and the Ben Franklin Technology Center (BFTC), each with their own proposals with different groups of service providers. After NIST—the manager of the TRP’s technology deployment programs—indicated that only one proposal from the area would be viable, SPIRC and BFTC merged their partner groups together. The merged group included three SBDCs based at area universities and colleges as well as state-sponsored non-profit organizations, technology centers, university centers, community colleges, and non-profit economic development groups. Although SPIRC management knew upfront that the size of the merged group would be unmanageable, the result was an enlarged group of more than 16 organizations involving technology centers, universities, community colleges, small business development centers, and economic development groups, with SPIRC as the lead organization.

With the implementation of the MEP, marketing and outreach to potential new customers was conducted through the larger service provider network, resulting in more manufacturers being contacted, visited, and served. In 1993—the last full year before MEP funding, SPIRC conducted about 200 initial meetings and implemented around 80-100 projects. Most of these projects were operations reviews involving a formal multi-day assessment with recommendations. A further 40-50 projects were referred to outside consultants. In the first year of the MEP (3/94-3/95), with additional resources and partners, the program conducted over 650 initial meetings and implemented more than 160 projects. At the same time, MEP management reported a tendency of affiliates to “keep” manufacturing clients rather than referring them to another affiliated organization. The
development of the MEP-SWPA service network was a complex process, involving many meetings and negotiations between SPIRC and the other service providers. Concerns about what each partner could and would contribute had to be addressed, while fears about clients of one program being "stolen away" by other programs had to be allayed. In the end, all but one of the service partners was able to come up with matching resources (in cash or in-kind). The exception was CTC, which could not use its other federal funds as match. However, SPIRC was able to cover this through its own resources. Of the additional federal funds ($1.625 million) in the first year, just over 50 percent was budgeted either to SPIRC or to BTFC. Of the balance, universities were budgeted 16 percent, technology centers 10 percent, community colleges 9 percent, and economic development organizations 6 percent. Among the partners, the most productive in delivering projects included BTFC (which in year 1 completed 40 projects - mainly in technology development assessments and product development assistance) and the Center for Hazardous Materials Research (which conducted about 30 environmental compliance audits). One of the Small Business Development Centers (at Dusquesne University) was particularly active in business management assistance (14 projects), while the University of Pittsburgh's Manufacturing Assistance Center conducted 11 informal engagements and 8 projects in varied areas of manufacturing and computer-controlled technology. One of the community colleges (CCAC) initiated 16 training assessments and events, while a second (Waynesburg) conducted 9 training assessments and events. On the admittedly very crude measure of delivered activities for allocated budget, the best performers were the SBDCs, BTFC, non-profit technology centers, and community colleges. The universities as a group were slightly behind. The economic development groups delivered the fewest activities per allocated budget.

The major change in the MEP-SWPA affiliations has been a reduction in the number of affiliated organizations from 16 to three. Following its third year review and Year 4 reduction in NIST MEP funding from $1.625 million to $1.213 million, SPIRC reduced its affiliate relationships. The process involved assessing affiliate relationships based on several factors: whether the relationship added value, e.g. complemented SPIRC's service offerings, enhanced its fee income, the performance of the organizations in delivering quality services; the importance of the NIST MEP funding to the organization; and its relationship with SPIRC.

SPIRC designed three organizations as full MEP affiliates: Concurrent Technologies Corporation (CTC), formerly the Center for Hazardous Material Research (CHMR; Duquesne University's Institute for Economic Transformation (IET); and the Steel Valley Authority. In severing partnerships with the other former MEP affiliates, SPIRC found that some organizations themselves chose to withdraw. Relationships with other former affiliate organizations were strained at the management level. At the service delivery level, SPIRC has maintained ongoing relationships with many of these organizations—particularly the SBDC at St. Vincent's College, by referring potential clients to one another.

**Preliminary Conclusions**

The second phase of our work on the coordination of industrial modernization services is still in process, so the observations and conclusions offered here are preliminary. However, from what we
have learned so far, we can make the following points:

- The need and opportunity to better coordinate manufacturing extension services with SBDCs is being recognized at state and local levels by MEP affiliates. It is clear that there are important mutual benefits for MEP and SBDC service providers and business customers when services are coordinated, effective referral systems are in place, information is shared, and joint planning occurs.

- To be most effective, MEP and SBDC coordination has to occur at the local program level, with strong relationships and mutual trust built between staff and their respective centers. Co-location is one way of facilitating these relationships, although other forms of coordination are possible and necessary too. In each locality, MEP and SBDC coordination takes different forms, depending on local conditions and institutional arrangements and capabilities.

- Federal policy should encourage local MEP’s and SBDC’s to better coordinate, but federal policymakers should avoid developing standardized models (which do not take into account local differences). Moreover, SBDCs should not be exempt from requirements applied to all service providers that they offer services that are effective, responsive and of high quality as a precondition for continued MEP affiliation. As our case research indicated, MEP’s centers facing new budget situations or changes in customer requirements need to have the flexibility to adjust their partner arrangements and to benefit from learning about partner capabilities in relationship to customer needs so as to optimize MEP service delivery.
Overview
Inter-firm collaboration (IFC) has been explored by organizations seeking a vehicle for the industrial modernization of small and medium-sized manufacturers. This paper offers five models of the impacts of IFC networks based on a survey of 123 case studies. The models examine the association between impacts of IFC with variables describing the origins, activities, and structures of networks. Impacts are measured through aggregate assessments of business expansion, bottom line savings, increases in projects, increases in membership, and increases in other benefits. We find that business expansion is associated most strongly with factors related to the origins of projects. Increases in membership and other benefits are most strongly associated with structural factors. Finally, bottom line savings and increases in projects are most closely associated with both origin and structural factors.

Introduction
Networks of inter-firm collaboration (IFC) have grown in number and economic importance in recent decades. Following studies of their contribution to economic growth in Italy and other regional economies in the 1980s, public policies stimulating IFC networks became an accepted strategy for industrial modernization throughout the industrialized countries (Lichtenstein, 1992; O'Doherty, 1990; Pyke, 1994). By the mid-1990s hundreds of new networks had been launched around the world and their experiences documented in a growing body of case literature.

Much of the research to date has attempted to identify factors associated with the successful creation of IFC networks. This paper offers five models of the impacts of IFC networks based on data from over one hundred case studies. The models relate a variety of causal variables to an array of
impacts. In so doing, we explore the different kinds of impacts that networks can have on business activity and the factors that shape these impacts.

**Inter-firm Collaboration and Modernization**

Inter-firm collaboration has been explored by organizations seeking a vehicle for the industrial modernization of small and medium-sized manufacturers. Interest in IFC has come from both public and private sector organizations who share an underlying impetus — enhancing the competitiveness of the manufacturing enterprise through networking. The variety of IFC networks that have emerged over the past decade is impressive, covering all phases of business operations. Small manufacturers have used IFC networks to 1) acquire equipment, training, and consulting services; 2) gain access to new markets through the creation of new products or product lines; 3) improve business practices by sharing lessons learned among participating firms; and, 4) improve awareness of both market opportunities and business assistance resources within a region or industry. It is difficult to assess the number of IFC networks that have been created. However, a cursory review of the literature hints that there may be hundreds, if not thousands, of these networks worldwide. It is known that interest in IFC networks has not been limited to any one country, sector, industry. Furthermore, IFC networks have become a major tool used by business and technology assistance providers in both the public and private sectors.

A variety of approaches to IFC networks are being implemented today. Indergaard (1996) suggests that networks are being established following either a resource mobilization strategy or social mobilization strategy. The resource mobilization model brings together small grants, small firms and professionals trained at facilitating networks (usually drawn from the private sector). The goal is to create a collaborative business opportunity. The social mobilization model uses grants to trade associations and regional service organizations targeted at specific industries to stimulate collaborative activity.

Both models share the fundamental assumption that co-operation among small manufacturers needs to be stimulated in some fashion. They argue that in most instances small firms do not have the capital (human or otherwise) to be able to forge an IFC network without assistance. Both models also agree on the catalysts for change: small incentive grants, expert advice on modernization, expert assistance on the social and business dimensions of networking, and trust among firms. Recent evaluations tend to indicate that both approaches to networking have produced successes (Indergaard, 1996; Rosenfeld, 1996; Shapira, et al., 1996; Sommers and Heg, 1995)

**Case Studies of Inter-firm Collaboration**

Not only is IFC unfamiliar to businesses and service providers; it is a relatively new field of study. As a consequence, our understanding of the factors that cause IFC's to be born, thrive or fail is nascent (Indergaard, 1996; Rosenfeld, 1996; Sommers and Heg, 1995). The development of indicators that measure events and outcomes is an emergent art. Under such circumstances, case studies offer the type of rich qualitative information so important to the development of theory and effective program evaluation.

Over time, agencies and not-for-profit organizations that use IFC networks to promote economic development have sponsored large numbers of case studies. They have been an important tool for the
promotion, education and evaluation of IFC networks (Kingsley, 1996). Most small firms have little or no experience conducting business through networks and are wary of committing precious resources to an endeavor so fraught with uncertainty. Similarly, most service providers, whether from the public, private or not-for-profit sectors, have little experience in either working with or forming networks of small firms. Case studies are proving to be the best, and sometimes only, means of demonstrating the mechanics and advantages of IFC.

Typically these studies have a very short life as a management tool, after which they receive little further attention. However, in large numbers they can become the data for another research methodology, the case survey method (described below). This study is based on 123 such case studies.

We analyze case studies written by authors with four types of institutional affiliations: universities, consulting organizations, state agencies, and USNet/Regional Technology Strategies, Inc. (USNet/RTS).1 Case studies were evenly distributed across the different types of authors. USNet/RTS is separated from other types of consulting organizations because they account for a large block of the cases that typically provide the richest details about networks.

There are distinct differences among the authors. State agencies were by far the quickest to begin writing about networks. The typical state case was written less than two years after the network was created. It also tends to be very short (one or two pages in length) and designed for promoting networks to small manufacturers. The other types of authors (academics, consultants and USNet/RTS) were more likely to begin writing after a longer interval. However, each had a distinctive approach. USNet/RTS was the most likely to write longer, detailed cases. Only 19 of the cases in the survey are over five pages in length. However, USNet/RTS accounted for 63% of these. Academic authors were likely to highlight several short cases in a single research article. While consultants have the longest time interval between initiation and case write-up, this reflects a bi-modal distribution. The median difference is three years. Consultants, like state agencies, are more likely to produce very short case studies (one to three pages in length).

The data suggests that there have been three significant periods in the recent history of IFC’s and case writing. First, few case studies have been written about networks initiated before 1989. Then from 1989 through 1991 the pace of case writing and, perhaps, IFC network creation increased significantly. These years each saw ten documented network initiations, on average. Finally, 1992 experienced a sharp peak at thirty-one documented initiations, and subsequent years remained at about eight per year before tapering back down again in 1995.

To some degree the dates of case initiation reflect trends in public policy and the economy. In the 1970s, and into the 1980s, the US economy faced increasing economic competitiveness pressures. As awareness rose of the potential that IFC held for competitiveness, network initiation began. This growing awareness is manifested in the data up to 1989 which shows a small number of networks being created. Then in 1989 federal and state programs to support inter-firm networks

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1 USNet is a consortium of several state economic development organizations, co-sponsored with the National Institute on Standards and Technology, designed to promote inter-firm collaboration. Regional Technology Strategies is the primary contractor responsible for the administration of USNet. Over the past several years many case studies have been developed as a part of this initiative.
began to have an affect. This marks the beginning of a period when government policy joined with on-going economic trends to yield the sharp increase in network initiations that lasts through 1992. However, the distribution of initiation dates also reflects when different case authors are writing. For example, the majority of cases from state agencies were written in 1993. The majority of academic cases are written in 1991 and again in 1996. Consultants and USNet/RTS authors are steadier, consistently producing case studies over the 1992 to 1997 time period.

There are limitations to this collection of cases. Almost uniformly the studies we examine employ a process model, charting a flow of activities from the initiation of the network to an impact. However, with a few notable exceptions, the cases are quite narrow and rely upon a single voice in providing evidence concerning the network. The focus is almost exclusively upon the attributes of network. Despite these limitations the case studies are nonetheless sufficiently rich in detail to allow for extraction of data for the case survey method.

Surveying Case Studies of IFC Networks

The case survey method mixes two methods, survey and case study. Instead of conducting a survey directly in the field, investigators apply their survey questionnaire to a collection of case studies. The method has proven particularly useful under conditions where (Larsson, 1993; Yin & Heald 1975): (a) case studies are a major method of research and evaluation; (b) the unit of analysis is an organization or group of organizations; and (c) a broad range of variables and contexts are of interest. All of these conditions are common to studies of IFC networks.

The four basic procedures for case survey analysis include:
1. Selection of a group of existing case studies relevant to the evaluation question.
2. Designing a coding scheme for systematic conversion of qualitative case descriptions into quantified variables.
3. Use of multiple raters to code the cases and measure their inter-rater reliability
4. Statistical analysis of the coded data.

Each of these steps was applied to the case studies of IFC networks. Five case selection criteria were employed. The first criterion was that the networks had to be defined by participating small manufacturing firms as inter-firm collaborations. This distinguishes IFC networks from the more general network studies where the researcher imposes a definition of the network. Second, the network had to be designed for some commercial or competitive purpose to benefit the firm. Thus, case studies of both soft and hard networks were included in the survey. Third, the case had to describe in sufficient detail the structure of the network and an outcome of the network either in terms of material benefits (or lack thereof) or changes in organization learning and behavior. Fourth, case selection was not limited to networks formed at the impetus of, or in association with, a public program. Fifth, case selection was limited geographically to those found in the heavily industrialized countries of Europe, North America, and Asia. No systematic exploration was made of case studies in languages other than English. To do so would introduce an unwarranted cost to the development of the case survey. These criteria do not specify whether the unit of analysis in the case must be a firm in the network, the network, or a region in which several networks are described. In fact, all
three types of cases were included in this study.\footnote{Another concern is deciding what to do if there is more than one case study describing an IFC network. This was an issue with roughly 10% of the cases surveyed. The rule used in this study was to survey the case with the greatest amount of information. This position is consistent with most case study surveys that attempt to summarize the different cases into a single observation.}

The second step in the case survey method involves the design of the coding scheme for the survey. Five types of variables were defined. All quantitative variables were nominal measures indicating whether a particular attribute was evident in the case. There are four types of quantitative variables examining the origins of the network, the collaborative activities of the firms, the organizational structure of the network, and the impacts of collaboration (see \textbf{Table 1} for a list of these variables). The fifth type of variable assessed the major factors that contributed to the network’s success, as well as the factors that hindered operations. Each coder provided a brief narrative description of success and hindrance factors for each case.

The case survey method requires the use of multiple coders who proceed in parallel to apply the survey to the case studies. Three coders each scored all 123 IFC network cases. Their completed surveys were then compared for agreement. The coders were in agreement 89 percent of the time across all variables. For general questions the agreement was slightly higher at 92 percent. Questions about specific traits registered 87 percent agreement. These scores are sufficiently high to indicate that the data is a reliable representation of the case studies.

The final step in this method consists of analysis of the resulting data. The IFC network data were analyzed using descriptive statistics and measurements of association. Frequency distributions and cross tabulations were also analyzed for each of the different types of variables. Chi-square statistics were used to relate impacts to the origins, activities and structures found in IFC networks. Lambda statistics were used in conjunction with cross tabulations to determine the direction of the influence.

The next sections report the findings of this research. For purposes of clarity we \textit{italicize} the names of the variables.

\section*{Modeling Impacts}

The model used in this analysis reflects the causal assertions put forth in the literature and in policy regarding the launching of IFC networks. One consistent theme is that there are significant barriers to the initiation of networks among small manufacturers. It is argued that firms require common stimuli and traits to successfully develop a network (Lichtenstein, 1992; Pyke, 1994). But they also need an honest broker to help them develop trust among one another and identify the resources critical to a network operation (Hatch, 1988; Rosenfeld, 1995). The ways in which a network navigates the initial stages of operation can have a profound consequence on its success. A second theme is that networks are organized for different purposes. In particular, a distinction is drawn between “hard” networks designed for a specific business endeavor and “soft” networks oriented towards information sharing and human resource development (Cragg and Vargo, 1995). The type of impacts a network can produce varies according to these goals and activities. Finally, it is argued that the outcomes of networks are shaped by how they are organized (Hausler, Hohn, Lutz, 1994; Malecki and Tootle, 1996).

What is not well specified is the variety of impacts that may be produced by a network. We employ two types of measures of impact: business activity by the IFC network, or growth in the IFC network.
These variables are nominal measures through which the coder makes an aggregate assessment of the type of impacts found in a case. Impacts are recorded in 97 of the 123 cases. Table 2 lists the number of cases achieving each kind of impact.

Two variables measure business activity. Bottom line savings measured whether or not a network had any effect on firm's profitability. In one-third of the cases, networks produced such contributions for the bottom line of participating firms. Business expansion measured whether or not the network generated some new line of revenue-generating activity for the members (e.g., new products or services.) In 46 percent of the cases a new business was launched.

Four variables measured network growth. Networks could experience an increase in projects, indicating that the initial project was followed by additional projects. They could also experience increase in membership if the number of participants in the network increases over time. Other benefits were recorded if there was an expansion in the benefits that participants derived from the network. Finally, they could experience growth in investment if members contribute additional resources beyond those agreed to in the foundation of the network.

Impacts are sensitive to the author of the case. For example, USNet/RTS cases were much more likely to report the impacts produced by a network, whereas studies authored by state agencies were the least likely to report impacts. This is largely due to the different purposes for which the narrative was written. USNet/RTS cases were longer and more detailed as befits the needs of training and evaluation. State agencies produced case studies designed for the promotion of networking.

There is a relationship between these impacts. Bottom line savings were strongly associated with each of the growth impacts. However, business expansion was associated solely with a growth in the number of projects a network pursues. Project increases played a pivotal role in the success of a network. This impact was associated with all other types of impacts. While it was important, the direction of influence between project increases and other impacts was statistically ambiguous.

The Factors of IFC Networking: Findings

We examine five models relating IFC networks and impacts. However, there are similarities among these models that make them amenable to clustering into three distinct groups. The models of network impacts are suggestive of several strategies for the effective operation of IFC networks. Not surprisingly, these strategies differ according the impact that is being pursued. The following are lessons that are drawn from both the statistically significant factors and the hindrance and success factors described in the previous section.

Business expansion presents distinctive managerial challenges to an IFC network. The factors associated with this impact differ from those found in the other impact models. Table 3 summarizes these factors.

In expanding a business the network must be focused on the commercial endeavor and organized as a for profit operation. There must be a clear market opportunity that brings the partners together. Strong private sector leadership is critical. But what is even better is a strong commitment from each of the participants. Preferably the partnership should be forged among the chief executive officers of the respective organizations. Great attention should be paid at the front end of the project to whether partners have comparable and complementary skills. Procedures for
qualifying network members are helpful in the expansion of a new business and should be applied ruthlessly. Similarly, there must be a clear understanding of each organization's responsibility in the network. It helps if partners already have customers in common.

However, there is less need to spend a great deal of time on the structure of the network. Legal standing as a for-profit enterprise seems to be more important than formalizing the network organization. It is best if the source of on-going monies is from the private sector. However, a mix of on-going funds from the public and private sectors also has a positive, if somewhat less effective, association with business expansion.

In contrast, for growth impacts such as other benefits and increase in membership, structural variables are critical. Tables 4 and 5 provide a summary of these findings. The pursuit of these goals requires the creation of a central organization that has a dedicated staff. Networks that employ a flat organizational structure will likely fail to achieve the desired growth. Strong administrative leadership is required to coordinate the efforts of network members. Greater ambiguity can be tolerated in the creation of the network as the members negotiate the extent of activities in which they will engage. However, clear responsibilities and goals need to be specified early on so that the network can cohere.

These impacts tend to be associated with "soft" activities of information sharing, human resource development, and responding to community needs. Requiring members to "buy-in" to the network has been found to create a stronger commitment towards working with each other. Impacts are more likely to be achieved when the on-going funds for the network come from the private sector or foundations. Public funding is almost never the sole source of on-going funds. Rather they are used as leverage for private sector funds.

Bottom line savings and project increases are affected by a wider range of factors and appear to be a hybrid between these two extremes. Origin and structural factors influence both as is seen in Table 6 and 7. Networks seeking these impacts tend to be striving for sustained collaboration. To achieve this end it is important to have positive experiences early in the life of the network. The leadership of a trained broker has been found to be of particular help in networks seeking bottom line and/or project growth impacts. However, it is best that this individual be drawn from the private sector. Public sector initiation by a state agency is more often associated with cases that result in failure. Interestingly, both are associated with previous collaborations, but not in the anticipated direction. For both impacts, previous collaboration does not increase the likelihood of success. Both impacts are helped when there is a strong central organization running network activities and when the sources of on-going funding are from the private sector.

The two types of aggregate impacts - business activity and network growth - also differ in some significant ways. Networks seeking a bottom line impact are, in most cases, trying to reduce and control their costs. They are similar to networks expanding a business in a preference for being organized on a for-profit basis. These impacts are more likely to be associated with seed funding that comes from the private sector or foundations. Like other growth impact, project growth is more likely to be facilitated by the presence of a staff dedicated to network activities.

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Lessons About the Promotion of Networks

A mixed message emerges from these case studies regarding the role of the public sector in promoting IFC networks. On the one hand, the fact that so many networks have been formed is an indicator of success. The strategy of using small grants to link small firms together through the efforts of network experts seems to produce the desired result. A few of these networks are even beginning to sustain themselves as evidenced by the growth in the number of projects they pursue collectively. Further, there is strong evidence that public sector organizations effectively disengage from the network once it is up and running.

On the other hand, the evidence from the cases indicates that public agencies should avoid being the primary initiator of networks. In such cases, the likelihood of achieving a successful impact is low.

On the surface, the findings appear to suggest that public agencies should avoid initiating networks at all. In most cases, networks built through such efforts fail to record any impact. However, this negative relationship reflects a bias in the case studies themselves: the cases authored by state agencies as a rule do not provide detail on impacts. State agencies write case studies within a year and a half of the initiation of the network and so are less likely to be in a position to report results.

This study is less ambiguous in recommendations regarding the management strategies for promoting IFC networks. Perhaps most importantly, this study finds that the factors that produce successful networks vary with the type of impacts being sought. This argues for flexibility in the implementation of programs to account for these different objectives.

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Table 2. The Number of Cases Reporting Impacts and Their Authors

<table>
<thead>
<tr>
<th>Cases reporting Impacts</th>
<th>Business Expansion</th>
<th>Bottom Savings</th>
<th>Line Project Increase</th>
<th>Membership Increase</th>
<th>Other Benefits</th>
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<tr>
<td>% USNet/RTS</td>
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<td>46%</td>
<td>36%</td>
<td>33%</td>
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<tr>
<td>% State Agency</td>
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<td>5%</td>
<td>10%</td>
<td>11%</td>
<td>18%</td>
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<tr>
<td>% Consultants</td>
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<td>24%</td>
<td>33%</td>
<td>37%</td>
<td>24%</td>
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<tr>
<td>% University</td>
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<td>25%</td>
<td>21%</td>
<td>19%</td>
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Table 3. Business Expansion Model

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<th>Factors</th>
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<th>Direction of Influence</th>
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<td>Origin Factors</td>
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<td>Shared Customers</td>
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<td>Private Firm Initiation</td>
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<td>+</td>
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<td>Activity Factors</td>
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<tr>
<td>Information Sharing</td>
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<td>.003</td>
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<td>Marketing and Sales</td>
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<td>Structural Factors</td>
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<td>Sources of Funds</td>
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<td>+ Private Sector</td>
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<td>Legal Status</td>
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Table 4. Increase in Membership Model

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<td>State Agency Initiation</td>
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<td>.004</td>
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<td>Activity Factors</td>
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<td>Human Resource Activities</td>
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<tr>
<td>Network Structure</td>
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Table 5. Other Benefits Model

<table>
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<tr>
<th>Structural Factors</th>
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<td>Network Staff</td>
<td>9.044</td>
<td>.011</td>
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<td>Network Structure</td>
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Table 6. Bottom Line Savings Model

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<tr>
<td>Shared Suppliers</td>
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<td>Direct Cost Reduction</td>
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<tr>
<td>On-Going Funding</td>
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<td>Legal Structure</td>
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Table 7. Project Increase Model

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<td>Origin Factors</td>
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<td>Network Structure</td>
<td>24.716</td>
<td>.000</td>
<td>+ Central Organization</td>
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</table>
Discussion

Coburn. Would the system used in the MEC benchmarking study allow you to show a break-even point?

Oldsman. Yes. The operating cost per hour, which is what you have to recover, is the break-even point.

Redivo. How are you defining new prospects?

Wilkins. Initial site visits.

Martin. That relates to having the capacity to do the work.

Oldsman. That relates to what Ruth says. Whether the center’s strategy is to think about growth vs. whether the center’s strategy is to manage against a budget. Most centers manage against a budget.

Haines. Do you know what direction is good?

Oldsman. I think the group felt that the first two measures—the percentage of available time spent on projects and the cost per project hour—were unambiguous. The other measures relate to the center’s business model. Then it became an issue about strategically thinking where do we think we should be, noting that there are tradeoffs. A center director may say that the center wants to reach a lot of companies prospecting, but allocating more resources to prospecting is going to drive down other measures. Now centers are thinking through this, deciding where they want to be on the various measures, so that drives other decisions. Also centers are using this as a management tool. If a center’s prospects are down and projects are closing, then the center in trouble.

Wilkins. This has focused our center to think about how we want to look and what we want our model to be.

Martin. In the partnership study, wouldn’t your definition of partner depend on the model that the center adopts? For example, how would your study define partners in the case of centers that employ the broker model?

Youtie. Even though the broker model employs few core staff in the host organization and mostly relies on partner organizations for service delivery, we still consider those partner organizations to be third party affiliates. For example, when interviewed, the core staff in the host organization of the center refer to themselves as “we” and refers to the staff that the center funds in the affiliated organizations as “them”.

Oldsman. In the cross-case analysis of network case studies, how did the coders determine that a network had an impact? When the coders saw something in the case that said sales impact, did they coded it yes?

Kingsley. Yes. These were considered to be the outcomes from the network.

Jarmin. Could you have a sales impact from a network with human resource development as its primary purpose?

Kingsley. Yes. Our cross-case analysis found that the type of activity/purpose of the network was not related to the type of impact.

Oldsman. What do you do when your three coders disagree about whether a sales impact really was mentioned in a case.

Kingsley. We code that as inter-item disagreement.

Oldsman. If somebody didn’t write about an impact, did you assume the impact didn’t happen?

Kingsley. Yes. We assumed that. But the cases had to have some language
about impacts or they were thrown out prior to the formal cross-case analysis.

Jarmin. If you only select ones that report about impacts, aren’t you biasing your results?

Kingsley. The set of evaluative questions we were addressing had to do with impacts. Also, this technique is designed as a data reduction technique.

Oldsman. You found that the networks that were legally established as a for-profit status were more likely to have cost savings and business expansion than were those receiving strictly public support. Isn’t that what you would expect anyway?

Thompson. Everybody thinks they’ve rediscovered inter-firm collaboration, but that’s been in existence for years in agriculture. Are you finding parallels? Second, you are reporting benefits from inter-firm collaboration, but doesn’t that run counter to the American industrial tradition of inter-company competition? How is U.S. industry supposed to deal with your findings in light of this competitive tradition?

Kingsley. One woman said that if we would have implemented an inter-firm network 20 years ago we would have been thrown in jail.

Thompson. We have a set of rules that make it legally difficult to set up networks even though it may be appropriate to do so.

Jarmin. Another way to think about the issue of inter-firm collaboration is that one way to network is to buy up/merge with other companies. Maybe this is a poor-man’s network.

Kingsley. These results show that there are positive benefits.

Oldsman. As a point in studies, there’s a difference between statistical significance and policy significance. Statistical significance doesn’t say anything about the size of the relationship and whether or not we should care. You have to take care to call it statistical significance rather than just calling significance.

Malecki. It frequently is difficult to measure outcomes of center activities and projects. Many of these change firms’ capabilities but have no immediate effect on firm performance. In addition, one of the more important changes in behavior concerns network behavior. Relatively few firms form local networks on their own. Those that do we can label extroverts. Only extrovert firms routinely seek out external information from such sources as trade shows, trade journals and other publications, Web sites, and new suppliers. Taken together, these information sources lead to more frequent product changes and new customers. This behavior could be among the characteristics of high-performing companies.

Concerning networks, some firms "the extroverts" naturally join networks. These extroverts also willingly answer surveys. Other firms "the introverts" need the gatekeeper role played by network coordinators and field agents. Larger firms have resources (people and time) to network, but many of their networks are of the tight supplier-customer (input-output) links, not local links with nearby firms.

Networks represent a long-term change in behavior. This behavior incorporates several elements:

- improved skills and know-how
- expected future increases in productivity and wages
- actual increases among firms that have been network members longer
It is interesting to note that networks in the 1992 NIST compilation by Gregg Lichtenstein marketing was the most common objective of networks. In the 1997 work by the Georgia Tech team, the most frequent objective was information sharing. In a sense, this is a downgrading of expectations. To share information is much easier to accomplish than demonstrable marketing effects.

Concerning Manufacturing Technology Center partners, to what extent do Centers play a gatekeeper role? The evidence is that there is a great deal of duplication of expertise: Centers are referring to partners and third parties the same sorts of projects in which they have in-house expertise. This may be important to do politically, but one must ask: Is it effective in improving small manufacturers? Is learning taking place in Centers in new areas of expertise? Is outsourcing increasing or decreasing over time?

The more successful networks -- and Centers -- marshal resources from many sources: public, private, and non-profit. This gatekeeper role is an important one and, to be effective, requires that continual learning be ongoing. The network coordinator and field agent serves as a link from outside (possibly global) sources of information and best practices to local firms and their needs. The gatekeeper role also involves links to state/regional/local support institutions (formal and informal). To some degree, a network and an MTC functions as an integrated knowledge network. Each can build local social capital and function as part of the regional technological infrastructure.
Part IV.

Comparative Standpoint
Introduction

In OECD countries, innovation policy is becoming increasingly concerned with promoting the development of technological capabilities required for innovation in small and medium-sized companies (SMEs). These companies play a large role in OECD economies, yet are generally regarded as underperforming. The technological capabilities they need are 'soft' as well as 'hard'. They relate to the creation and management of internal technological resources, external networking and the strategic management of technology and its relationship to business strategy.

This paper develops a taxonomy of these capabilities. It is based on a mixture of literature survey and our own evaluations and comparative studies of innovation policies. It offers an intellectual framework to decision makers wishing to review and improve policies for capability development.

Company capabilities are dynamic, growing as companies learn. They tend to increase with firm size and the possession of internal technological resources. Since firms themselves have differing levels of capability, public policy should differentiate between segments of the company population, offering an hierarchy of services to encourage and help companies learn new capabilities. Managing the coherence of the policy system and the transparency of the interface with SMEs are important policy functions.

The Place of SMEs in Industry Policy

Since the 1950s, there has been a movement away from separately-conceived science and industry policies and towards innovation policy.
Governments have become increasingly reluctant to provide large-scale industrial subsidies, and have signed trade and other treaties (e.g. GATT) which limit this type of activity. Instead, they turned to investing in technologies which could secure future industrial positions, notably in transport and electronics. Recently, these attempts to 'pick winners' have been complemented by more generic innovation policies, often aimed at smaller firms.

In science and technology policy, government intervention has historically focused on the innovation-creation process. This has been justified by arguments about market failure: the inability of market mechanisms to secure long-term, 'common good' improvements in science and technology. However, there are other types of failure in markets and in firms' capabilities which impede the technology diffusion process by preventing entrepreneurs from taking rational technology decisions. These failures tend to be most acute for SMEs. Tackling these problems extends the policy sphere to include not only technology generation but also diffusion and companies' 'absorptive capacity' for technology.

Over the last decade, policy makers have increasingly accepted that it is 'not the creation of technological leadership in itself that affords a nation its competitive advantage, but the rate and level of diffusion of the technology into economic use'.

- Technology development and diffusion are clearly of considerable potential economic importance, with diffusion offering particularly large benefits
- Technology diffusion involves far more than the simple introduction of new machinery into the firm. Additional measures, such as internal reorganisation of both production and management processes and upgrading of skills, may be essential to capturing economic value from investment in new technology
- Whereas it may not be necessary to produce technology to reap its benefits, diffusion is essential to maximise potential national economic returns. However, realising the benefits of diffusion may depend critically on broader social and institutional changes, which may, in fact, represent the most important obstacles of all.

Quite where adoption and adaptation of technology shade into incremental improvement and innovation is often hard to say, since "any act of adoption involves certain transformations and is an act of incremental innovation in itself." Similar technological capabilities are required for each, so policies which promote 'absorptive capacity' are part of a continuum with policies to foster invention.

Despite their limitations, SMEs collectively play a major role in OECD economies. They make up the majority of firms, but the SME population is unstable: there are high rates of entry and exit. They have a very wide range of capabilities and performance. Some stay small because they deserve to. Others are potential

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2 Rothwell, R. and Zegfeld, W., Reindustrialisation and Technology, Essex: Longman, 1985
motors of economic growth and move on
to seize the commanding heights in their
industries.

Collectively, SMEs - especially
those able to make technology central to
their strategies - have higher growth rates
than large firms. Their importance is
reinforced by the growing tendency of big
companies to fragmentation through
outsourcing, strategic partnerships and
other types of networking. This
fragmentation is increasingly enabled by
Information Technology, as is the growing
ability of SMEs and individuals to work in
networks and to form ‘virtual companies’.
We may, therefore, be seeing a
technologically-enabled shift in the
structure of industry in which smaller
economic units compete and cooperate
based on their combined ability to exploit
internal capabilities and to access external
ones. Networking becomes an
increasingly important capability in itself.

Innovation Characteristics of
SMEs

SMEs’ innovation characteristics
are increasingly been explored. Thus, the
Community Innovation Survey (CIS)
includes a question about the obstacles that
firms see to innovation. While the CIS
includes all sizes of firm, the larger
numbers of SMEs in the population means
that CIS responses primarily indicate the
views of these small companies.
Responses from Irish and Norwegian
companies are typical of the type of
response obtained by the CIS and, indeed,
other similar surveys.

The most important worry is
money. It is easy to jump to the policy
conclusion that, therefore, more finance
should be available. Yet there are few
symptoms of overall capital shortage in the
economy, especially at today’s low interest
rates. The problem seems to be that
lending SMEs money is objectively risky.
SMEs have a high death rate. Their small
scale and often underdeveloped business
capabilities make it hard for them to do the
kind of sophisticated research and business
case development necessary in order to
put a case to a financier. Technological
risks and uncertainties may be hard to
quantify and explain. SMEs also tend to
have insufficient assets to back major
loans or injections of equity

CIS respondents themselves regard
innovation as expensive and risky. Many
of the other obstacles identified relate to
technology capabilities - with the most
important being the company’s internal
capabilities (‘innovation potential’).
Several obstacles (such lack of information
on markets and technologies) may relate
more to inadequacies in companies’
interfaces with the outside world than to a
genuine deficiency in the environment.

The smallness of SMEs - their
defining characteristic - is an important
driver of capability. While there are many
actors in the environment emitting
‘signals’ about technology and market
opportunities, SMEs do not always have
good ‘receptors’ for this information.
SMEs tend to have relatively shaky
economics and therefore to focus on short-

5 US DoCdata, cited in the European Green Paper
on Innovation, Brussels: CEC, 1995; Arne Isaksen
and Keith Smith, Innovation Policies for SMEs in
Norway: Analysis and Policy Options, STEP
Rapport 2/97, Oslo: STEP Group, 1997
6 Anne Fitzgerald and Marcus Breathnach,
Technological Innovation in Irish Manufacturing
Industry, Dublin: Forfás, 1994

7 Svein Olav Nås, Tore Sandven og Keith Smith,
Innovasjon og Ny Teknologi i Norsk Industri: En
Oversikt, STEP Rapport 4/94: Oslo, STEP Group,
1994
term problems rather than long-term improvement opportunities. Managements tend to be small and multi-functional. Often, entrepreneurs run companies single-handed or take a disproportionate share of the key decisions, in addition to functioning as the general interface to the outside world. Creating a larger, ‘professional’ management is desirable, but until a certain size is reached it is difficult to create much division of labour or to develop specialised external interfaces.

SMEs tend to undervalue professional advice, to be shocked at its price or to be unable to ‘leverage’ strategic advice or cost-reductions across a sufficient volume of sales. Such advice may also be seen to undermine management’s authority. In many cases SMEs work within a small economic ‘space’. This generally means working within a small geography, but it can also mean a tight linkage to a particular industrial sector or to the supply-chain of one or a small number of large companies. SMEs tend in the first instance to work in interpersonal networks defined at these geographic and sectoral levels.

SME capabilities seem to vary with size. There are important exceptions - especially among New Technology-Based Firms - but in general, companies’ propensity to enter technology agreements, network with other companies and to exploit the state-run innovation support infrastructure with company size up to about 200 employees then tails off a little. This suggests that companies growing beyond 200 increasingly substitute internal capabilities for external relationships and support.

**Technological Capabilities**

Following Schumpeter, economists tend to describe innovation as “a new combination of the factors of production”. This can involve using results of scientific or technological research, but it can also involve much more mundane things such as laying out machines on the factory floor in a better order, changing product packaging or copying ideas from a producer in a distant market in order to create a local advantage. A key observation, however, is that innovation is fundamentally an economic process in which technology may play a greater or a lesser role: it involves a great deal more than creating and selling ‘black boxes’.

Perhaps surprisingly, in order to define ‘technology’ in a way which is relevant to industrial and economic development, the most useful place to go is probably the Oxford English Dictionary (OED), which defines technology as “the scientific study of the practical or industrial arts”. There is a great deal of content packed into this short definition.

- “Arts” here means the production of artifacts - not only ‘works of art’ but products more generally.

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11 In the UK, this old definition of “arts” is frozen in the name of the Royal Society of Arts - which is more concerned with defining and measuring the
Involves an holistic view, where design is part of production
- Technology involves knowledge about doing practical things, especially producing things
- The definition does not distinguish between engineering and managerial aspects. The modern discipline of management is, historically, an offshoot of engineering. Many would argue that this fragmentation was a mistake. The revolution in production engineering and management which has introduced ‘Japanese’ methods and ‘soft technologies’ such as continuous improvement and lean production can be interpreted as reintegrating the engineering and managerial aspects of technology.
- Technological knowledge is built up using scientific methods. It is described in books, tested by experiment and can make deliberate (sometimes rapid) progress by doing work in places which are located away from the production process. This distinguishes it from craft knowledge, which is defined and communicated through skills and which tends to evolve together with production
- Because it is a scientific study, technology involves codification: writing down knowledge in a systematic way. (In fact, the OED also lists an older definition of technology as “a discourse or treatise on an art or arts”.) Uncodified knowledge remains important in production. Technological progress involves a battle to try to codify knowledge which today is tacit, in order to study and improve it.
- Codification means that a crucial feature of technological production, compared with craft production, is that its principles can more easily be communicated or transferred. Craft skills move ‘vertically’ from master to apprentice. Technological knowledge spreads ‘horizontally’ between technologists.
- Codification also implies that people who work with technology must be educated. The idea of a skilled but illiterate craftsman is familiar from both history and anthropology. The idea of an illiterate technologist is self-contradictory.

This broad definition of ‘technology’ as something soft as well as hard, and as including important aspects of management and organisation, guides the scope of the company capabilities and the policies we have considered.

The innovation literature contains many observations about aspects of technological capability and a smaller number of discussions about how these develop but almost no attempts to provide an overall view. We need this overview both to ensure that our description of technological capability is reasonably comprehensive and in order to understand
companies' technological capabilities as **systems**, where individual components are related to each other.

Two exceptions are Howells and Dodgson and Bessant. **Exhibit 1** shows how they respectively characterise technological capability. Both recognise that the ability to use and develop technology is deeply embedded in the 'soft' factors which surround the hardware, consistent with the broad definition of 'technology' which we use in this paper. Howells' description is static. His concern is to show the interdependence of tangible and intangible assets in underpinning firms' competitiveness, making the distinction between these two kinds of assets central to his model and treating tacit knowledge as a particularly special category of intangible assets.

Bessant and Dodgson's approach is dynamic. They define their terms as

- **Resources** All the assets in the firm which enable firms to operate, including tangible and intangible assets, skills, knowledge, organisation, links with other firms

- **Innovative Capabilities** Features of firms and their management which enable them to **define** and **develop** competences to create competitive advantage

- **Competences** That focused combination of resources which enables firms to differentiate themselves from their competitors

These three elements interact through learning: namely, a purposive search for competitive advantage.

If our analysis of technological capability is to be consistent with the current neo-Schumpeterian or evolutionary view of the firm, it needs to involve this combination of resources and intelligence. Capability is much more than ... individual assets. If it were not, the firm would be no more than a bundle of bilateral contracts between owner and employee, and rent could not exceed the differences between current and next-best use value. One thing this tells us is that the organisation must possess a memory, or a tradition of practice, so that losses in personnel can be matched with new employees who can be trained in the firm's routines.

The need for a memory drives progressive companies to accumulate tacit knowledge, to identify its components and to try to codify it as intellectual capital. This happens in many companies through, for example, engineering and re-engineering, computer systems development and the articulation of processes and company standards. Creating intellectual capital - technology in the older sense of "a discourse or treatise on an art" - in this way is intended to improve the firm's effectiveness. But it also tends to lock the company into specific products, markets and technological trajectories, promoting 'path-dependency'. The problems can in principle be reduced if the corporate memory can forget as well as learn.

Modern, evolutionary economics

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17 J Stan Metcalfe and N de Liso, "Innovation, Capabilities and Knowledge: The Epistemic Connection," University of Manchester (mimeo) 1995

thus sees the firm as a searching, learning mechanism. It survives and improves by continually reinventing itself. It consists of a pool of assets, including both physical assets and intangible ones such as capabilities, and intelligence, which learns from the environment and modifies the resources (Exhibit 2). Each of these elements can be broken down much further. An important attribute of the firm’s ‘memory’ is that it comprises a mixture of knowledge (tacit as well as codified) and of the configuration of assets: namely, organisation, characteristics of the capital stock, relationships, and so on.

In Exhibit 3, we set out a simple way to think about technological capabilities which captures both this need for a corporate memory and the need to connect it with the market. It shows three kinds of capabilities: internal; external; and strategic. These are interlinked and interdependent.

The strategic level provides the intelligence or control mechanism which allows the firm to manage its capabilities and exploit them via the market. This meta-level involves the entrepreneur in deliberately stepping outside the accustomed circular flow of daily economic life, trying to understand what knowledge makes the business succeed and using this knowledge about knowledge to increase performance. In modern industrial practice, the strategic function does not have a monopoly of learning, but ensures that it takes place at all levels of the firm, for example through Continuous Improvement groups. Intelligence is thus distributed, rather than belonging solely to an ‘heroic’ Schumpeterian entrepreneur. The second category has to do with the internal capabilities of the firm: its management’s ability to

- Identify and invest in the right physical infrastructure to meet the competitive requirements of the firm
- Analyse its situation, identify and put in place the needed skills
- Organise appropriately, and have the vision to understand when organisation needs to change

The third group of capabilities is external - or, more precisely, concerned with managing the relationship between the firm and the outside resources which it needs. These are largely the issues addressed by the current discussions of ‘networking’ in the innovation literature. If contemporary writers are correct that networking is central to the innovation process, then the ability to network must itself be a crucial capability. This means: making use of external knowledge; using partners to access complementary assets; and managing the producer/user relations which have consistently been identified in the innovation literature as key to innovative success.

Different firms possess these capabilities in differing amounts. Exhibit 4 shows a simple hypothesis about a useful way to segment companies according to their level of research and engineering capability. It is far from perfect, and needs to be complemented with other hierarchies (for example, in formal business management) which may be even harder to measure but which nonetheless are likely to explain differing levels of overall technological capability.

Our segmentation suggests that there are four reasonably distinct levels in the development of firms’ engineering and research capabilities. At the bottom level, there is no meaningful capability and there will tend to be a presumption that none is needed. At the next level up, the ‘minimum capability’ level, the firm
acquires at least one person able to speak the language of technology, to monitor and understand the significance of technological changes happening outside the firm. These bottom two levels of firm rarely have much contact with universities. They do not share a common language or interest with them. The professors are likely to be interested in things which are longer-term than they can consider.

In OECD countries, many larger firms belong to the third level of 'technological competents', where there is enough capability to do fairly serious development work and where there tends to be a specialised innovation or development function. The highest level firms - 'research performers' - are of two types. Some correspond to the ideal of the very large company with capabilities in research as well as development and the strength and vision to work for the long term as well as the immediate future. Others are new, technology-based firms such as university or other research spinoffs, many of which exist primarily to do research and will be absorbed by larger companies if their work is successful. These highest-level firms' research departments communicate easily with universities. Third-level firms often have difficulties in doing so.

**Policy to Promote Learning**

Successive generations of 'innovation models' have characterised innovation as increasingly complex and bound up with socioeconomic factors such as market linkage and match with the available infrastructure.

Taking a fifty-year perspective, the government-funded Research and Development (RTD) systems in Europe are generally in a state of being refined, tuned and rationalised after the great post-war expansion. Changes in the RTD system have been accompanied by changes in innovation theory. Whether theory drives policy or the other way round is not always clear.

The startling achievements of physics during the Second World War had made clear the immense power of science, reinforcing belief in science as a force for social change. The 1950s and 1960s saw significant efforts in many countries to build up their university systems and, often, dedicated research institutions. There were many reasons for this, including an increasingly democratic view of education as well as a belief that this growth would hasten economic reconstruction and development. But in economic terms, underlying these efforts was the now-traditional 'linear' view of the innovation process as being essentially 'pushed' by science. The policy implication of the linear model is simple: if you want more innovation (and therefore economic development), you fund more science. During the 1950s, the technology-push model of innovation dominated. Then, thanks to the empirical work of those such as Carter and Williams, Schmookler and Myers and Marquis, more emphasis came to be placed on the role of the marketplace in innovation. This led to market-pull or need-pull models of the innovation process.

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22 Myers, S. and Marquis, D.G., *Successful Industrial Innovation,* National Science Foundation, 1969
In the late 1970s, Mowery and Rosenberg\textsuperscript{23} largely laid the intellectual argument to rest by stressing the importance of\textbf{coupling} between science, technology and the marketplace. Their coupling model constituted a more or less sequential process linking science with the marketplace (via engineering, technological development, manufacturing, marketing and sales), but with the addition of a number of feedback loops and variations over time in the primacy of 'push' and 'pull' mechanisms.

Rothwell\textsuperscript{24} has charted this succession of innovation models into the 1990s. His fourth and fifth generation models are essentially increasingly complex refinements of the third generation 'coupling' model. The upshot of these evolutions in innovation theory seems to be a need for greater humility: there is a great deal about the innovation process that we do not know, or know partially but cannot generalise. The policy implication and practice resulting is to retreat from simplistic solutions and to create a wide range of instruments to promote individual capabilities (\textbf{Exhibit 5}). There is not a single, simple lever that policymakers can pull in order to improve capabilities and performance at a stroke. The heterogeneity of firms, too, militates against such a simple policy approach. Policymakers must continue to struggle to\textbf{segment} firms into groups with generically similar needs. However, the design of policy delivery systems needs also to take account of the uniqueness of firms as individuals. Some state support infrastructures are (in our view, rightly) taking an approach of diagnosing needs at the level of individual companies as part of their approach to developing companies and capabilities.

The need for such a diagnostic approach is built into the 'learning paradox' associated with capabilities. Those with limited capabilities also have limited ability to identify their own problems and opportunities. If it is to help, the state needs to be\textbf{proactive} with those who cannot yet decide what to do for the best. Despite the attractions of 'hands-off' policies which do not involve the state in making firm-level decisions ('picking winners'), it is therefore difficult to imagine many effective 'hands-off' measures to improve capabilities (especially among weaker firms). This means that progress in policy depends not only on finding the right economic levers but on closer engagement with firms and technological practice.

Generally, quite a number of actors and programmes share the task of developing technology capabilities. However, the support system needs to operate as an effective whole. \textbf{Exhibit 6} illustrates how such programmes can relate together into a developmental staircase, even if the services need not map onto the staircase in a one-to-one manner.

It is important that individual programmes operate in conjunction with the other parts of the support system to
- Obtain cost synergies, especially in needs diagnosis
- Enable cross-referrals to and from other parts of the system
- Enable an holistic approach by the system to company development
- Avoid fragmentation and build the scale necessary to provide high-quality,


specialist capabilities.

A complete capability development system would tend to have services capable of moving firms some considerable distance up the capability staircase. At the top of the staircase, research-performing firms will be well integrated into global sources of science and technology. There is not a necessity for local or regional actors to meet their needs - though it may nonetheless be helpful, for example in influencing company decisions about where to locate R&D.

A good innovation support infrastructure would have the following services available:

- **Proactive mentoring** Someone in the infrastructure is needed who has a brief to guide firms - especially those with limited technological capabilities - in identifying their needs and finding ways to satisfy them.

- **Basic, general-purpose capability development services** To raise SMEs' competences, not only in technology but also in the basics of business, there need to be sources of practical help and training close at hand. Issues such as Quality, simple manufacturing strategy and use of IT are generic, yet these are areas where many SMEs need help. Some of these services are useful to firms at the 'Low-tech SME' stage in development; all have relevance to the 'Minimum Capability' stage, and provide an important basis for moving firms up the capabilities staircase.

- **Sector- or technology-specific capability development services** may not be more sophisticated than those considered under 2 above. However, for reasons of scale, they are certainly more difficult to deliver across the generality of the economy unless target firms are present in 'clusters' - especially where the sectors they address are relatively narrow.

- **Technological development services** such as contract R&D can be bought by almost any firm with money to spend. However, adequately specifying and making good use of them requires a fair degree of internal capability. By the time a firms climbs to this point on the staircase, the questions are no longer about creating a level of internal technological capability but about making best use of it.

- **R&D services** include collective R&D, research information and services to link companies with capabilities in universities and research institutes. These presuppose quite high levels of technological capability on the part of users. Most SMEs are not in a position even to have a conversation with university or research institute researchers, so users of this type of service are quite special.

Broadly, state financing will tend to be needed most in the services lower down this hierarchy. As companies' capabilities grow, and become increasingly 'rational' (in the economic sense), services should be provided on more of a market basis.

Both because there is a need for the support system to have this developmental structure and because of the complexity of current systems, it is important to have an 'intelligent interface' between the bulk of the system and its clients - especially those with weaker capabilities. The behavioural characteristics of SMEs have several implications for the type of support infrastructure needed, the way this should be delivered and how the interface to the system should work.
- SMEs have limited time and ability to absorb information coming from outside. Programmes' and actors' sales messages need to be short, to be right first time and to be convincing.
- SMEs learn only slowly about the support infrastructure. They tend to stick with known, well-established supports and mechanisms, moving beyond these only when under stress. Policy makers must therefore be cautious and gradualist in changing both the structure of the support system and the interfaces to it. Change requires learning, and SMEs have little time for this. In practice, it is possible to change the contents of support programmes over time while leaving the 'user interface' stable.
- The comparative importance of interpersonal networks and the small 'space' - geographic or sectoral - inhabited by SMEs makes local diagnosis and delivery of support services important and reinforces the need for interpersonal contact. An alternative mechanism is to use regionally-based advisors who visit firms in their area, identifying needs and and 'signposting' sources of help and advice. A key success factor for this type of interface is that it it is personal. Another requirement is that the advisor has some level of diagnostic capability.
- Because SMEs' horizons are short and their anxiety about risk is considerable, the promoters and deliverers of infrastructural support need to deliver demonstrable solutions and need continuously to be able to prove their competence and relevance.

Most support systems are trying to tackle this problem of transparency by creating dedicated interface functions which combine diagnosis or 'proactive mentoring' of firms with a role as 'signposts' to where individual SMEs should go in order to satisfy their needs.

Conclusions
Companies create and protect competitive positions using a wide range of technological capabilities: strategic; internal; and external. These capabilities are not just narrowly 'technical' but include important 'soft' and managerial aspects. Individual firms' capabilities change over time in response to competitive requirements, and tend to develop as companies grow. Technological capabilities seem partly to be driven by the possession of engineering and scientific personnel. SME capabilities are often limited, in part because of the limited opportunities for division of labour and specialisation in small economic units.

Since not only the creation of new technology but - especially - its diffusion and adoption is key to economic development, policy needs to consider the broad range of technological capabilities needed to handle the various parts of the innovation process. The complexity of the innovation system means actions are typically multi-point. The resulting support systems themselves tend to become complex. They need an overall design which helps users learn to climb a staircase of capabilities, reducing dependence on state finance as capabilities grow. They need a proactive interface linking the system with the needs of the less capable firms in the economy.
Exhibit 1 Approaches to Technology Capability

Technology Base
  - Tangible Assets
    - New products
    - Plant
    - Equipment
  - Intangible Assets
    - Formal
      - Patents
      - Licences
      - R&D
      - Other IPR
      - Training
    - Informal
      - Tacit

Resources
  - Innovative Capabilities
  - Competence

Howells, 1994
Dodgson and Bessant, 1996

Exhibit 2 Evolutionary Model of the Firm

Inputs
  - Information
  - Resources

Search Intelligence

Assets
  - Physical assets
  - Capabilities
  - Memory

Outputs
  - Products
  - Information
Exhibit 3 Key Elements of Technological Capability

Strategic Capabilities
- Search for market opportunities
- Understand and manage the fit between the firm’s capabilities and market needs

Internal Capabilities
- Manage tangible technology base
  - Products
  - R&D facilities
  - Appropriate plant and equipment
- Develop and manage appropriate intangible resources
  - Codified intellectual capital
  - Qualification and skills profile adapted to the needs of the firm
  - Tacit knowledge
- Create needed organisation
  - Technology management capabilities
  - Change-management capabilities
  - Coordination among internal ‘owners’ of capabilities

External Capabilities (Networking)
- Access external knowledge
  - Science
  - Technology, techniques
  - Artifacts, practices
  - Know-how, tacit knowledge
  - Information resources
- Manage producer/user relations
- Access partners with needed complementary assets
  - Complementary knowledge
  - Complementary production
  - Complementary supply-chain role
## Exhibit 4 Simple Hierarchy of Company Types

<table>
<thead>
<tr>
<th>Company Types</th>
<th>Notes</th>
</tr>
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</table>
| **Research Performers**        | • Research department or equivalent  
                               | • Able to take long run view of technological capabilities                                                                                       |
| **Technological Competents**   | • Multiple engineers  
                               | • Some budgetary discretion  
                               | • Able to participate in technology networks                                                                                                         |
| **Minimum-Capability Companies** | • One engineer  
                               | • Able to adopt/adapt packaged solutions  
                               | • May need implementation help                                                                                                                     |
| **Low-Technology SMEs**        | • No meaningful technological capability  
                               | • No perceived need for this  
                               | • May be no actual need                                                                                                                             |
Exhibit 5  A Policy Repertoire for Improving Technological Capabilities

Strategic Capabilities
- Business capability development, especially marketing
- Business and technology audits; mentoring
- Awareness programmes, including visits and comparisons
- Feasibility assessments

<table>
<thead>
<tr>
<th>Internal Capabilities</th>
<th>External Capabilities (Networking)</th>
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<tbody>
<tr>
<td>Manage tangible technology base</td>
<td></td>
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<tr>
<td>- Product development assistance</td>
<td></td>
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<tr>
<td>- R&amp;D tax breaks</td>
<td></td>
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<tr>
<td>- State-subsidised R&amp;D programmes</td>
<td></td>
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<tr>
<td>- Manufacturing consultancy</td>
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Develop and manage appropriate intangible resources
- Quality programmes
- Placements of qualified personnel, eg engineering graduates
- Loans of research personnel
- Training needs analysis and training programmes

Create needed organisation
- Technology management courses

Access external knowledge
- Innovation 'cheques' or credits
- Science parks
- Technology centres
- Research institutes and associations
- Technology development networks
- Technology transfer programmes and brokerage
  - Research-industry
  - Company-to-company
- University liaison officers
- Faculty industrial placements
- Subsidy to university/industry R&D collaborations
- Technology information services
- Metrology programmes and services

Manage producer/user relations
- Procurement programmes
  - State procurement
  - Company supplier development

Access partners with needed complementary assets
- Partner-search programmes
- Inter-company network programmes
Exhibit 6 A "Staircase" for Developing Company Capabilities

- Research Services
- Technological development
- Sector-specific capability development
- Basic capability development
- Proactive mentoring
Discussion

Russell. First, evaluation scientists often make things too complicated, but Erik Arnold really makes things understandable.

Second, it is a profound thought to link manufacturing extension and U.S. technology policy. The MEP is dealing with very large numbers of confused small companies, trying to be the change agent along with the noble enterprise of science. What would it mean if there were 30,000 SMEs touched in a significant way so that truly intelligent field engineers were able to apprehend some technology needs and a system to understand the unmet demand which could then be translated to the federal labs and the universities. What would it mean if we had a more coherent technology policy such as was discussed by Erik Arnold? We have a lot to learn from Europe in that respect.

Third, I’m interested in the variety of ways to describe the varying types of small and mid-sized manufacturing enterprises (SMEs). This community has paid little attention to performance differences within different sectors, which have been highlighted by the Performance Benchmarking Service (PBS). What are the implications for making choices about service allocation? I’m not persuaded that market penetration is a good metric. I think that dealing with the talented 5 percent that can really use the results is more important. How do we find the staff, marketing, and political skill to justify targeting? That’s how we’re going to make the strongest impact on the economy.

Finally, we have a memorandum of understanding with the United Kingdom’s Business Links program. It is the most natural correspondent to our MEP program. Erik Arnold’s description of Business Links raises the immense difficulty of understanding our work across different countries. We have a lot to learn from what other advanced capitalized countries are doing in this area. While the MEP is large, we’re very simple, we’re quite new, and we don’t yet do a very good job as a national system and we have a need of people who can stick it to us.

Redivo. It’s nice to come together and share results. I wish we could do this on a day-to-day basis.

Thompson. In order to follow up, we have to find ways to communicate more and do work. Are the NIST data sets going to be released to the wider community?

Haines. Maybe someday. But you have to have clean data, which we don’t quite have yet.

Thompson. Jack mentioned the targeting word. We have the technology to do that, but can we do that politically? How much analysis has been done in the area of targeting?

Russell. It is a lot to ask a center to understand its industrial base when the data we work with is sparse and dated. Eric Oldsman has worked with Florida and Cleveland about targeting. The only way to get there is to do that.

Martin. I have a strong opinion about that from a regional perspective. I don’t hear much about regional strategic impact. I hear about company impact. Regions are interested in getting beyond company impact. We’re ready for the next step. With the finite resources we have, how can we slice our customer base to have the most impact? I’m not calling it targeting, but it could be looked at that way. This can’t be done on the federal level because of Congress. It could be
done at the local and even at the regional level, not necessarily the state level. In New York, there could be at least four different levels. A number of us are ready for that. I hope NIST MEP will help us with that.

**Oldsman.** It's an issue of market segmentation. You know your market and that knowledge helps you make decisions about allocating resources. To think we're not making decisions now is ludicrous. Field agents are actually making decisions about which companies to work with, what services to offer, and how much time to give a company all the time.

**Martin.** The centers can figure this out on their own eventually. But you don't want 80 different organizations to discover this independently. That's the strength of the partnership. It would be helpful if you could help with a methodology or a couple of methodologies.

**Haines.** We have market research from 160 firms. Second, many people know Michael Porter's cluster analysis and are already doing that type of work in the various states.

**Martin.** It's not very useful for us.

**Shapira.** I'm reminded of Erik Arnold's diagram. We're being pulled into thinking about strategy. One thought is about the federal role. As the system is established and federal funding is one-third, what kind of money is that? Today, federal money seems the same as any other money in terms of how centers use it. Should some of that federal money be guided to more strategic, higher-level services? Some states may want the program to run almost like an entitlement program. But centers should use the federal money for more strategic impact.

**Haines.** As a federal investor, I note that all resources go together to have one output. It's not the state dollars buy this and federal dollars buy something else, but rather that all the resources go together. We recognize that some states have special needs.

**Korchak.** Regarding targeting, some centers are looking at targeting. But there is a large percentage of centers that aren't thinking about impacts. The smaller, newer centers getting money from the public sector and doing a public sector operation, they're not thinking about this. We need to not forget about those centers.

**Russell.** Talking about targeting to North Dakota, those people are concerned about defending industrial policy. I will report that I've never had a discussion with congressmen who a problem with targeting. Some congressmen focus on return on investment, but that's about it.

**Arnold.** I hear people say that maybe people want to be clearer about what they want the federal role to be. Regarding clusters, there's the approach of strategic districts, then there's networking. These pose an interesting challenge, because I like more organized systems. I'm currently working in a country that has four levels of planning, with none of the levels relating to each other. The temptation is irresistible to get small firms together, empower them, and enable them to do what they want. If there is power in the bottom-up clustering idea, then one reaction is to begin to regard clusters as legitimate clients, not just one-on-one companies. One may work on different levels.

**Martin.** I'm talking about more than segmenting by standard industrial classification (SIC). Targeting might not
focus so much on the industry group, rather it could focus the kinds of service you provide as an indicator of the way you have the biggest impact. People in this business for a while, we have some gut feelings, but I'd like data.
Part V.

Using Evaluative Information in Decision Making
How The Chicago Manufacturing Center Uses Evaluation in Decision-making

Natalie Davila

Introduction
The Chicago Manufacturing Center (CMC) works with manufacturers in the six-county metropolitan area to improve productivity, expand markets and create new jobs. CMC is a member of the NIST/Manufacturing Extension Partnership, a nationwide network of locally-managed centers that work with small and mid-sized to meet the competitive challenges of the global marketplace. Although CMC is an affiliate of the NIST/Manufacturing Extension Partnership the organization is required to raise at least 60 percent of its annual budget from local sources and client fees. Local funding sources include the City of Chicago, the Illinois Department of Commerce and Community Affairs, and major corporations and foundations. CMC has a staff of 40 senior manufacturing professionals backed up by an extensive network of affiliates and subcontractors.

CMC has used evaluation techniques as a source for continuous improvement ideas in three distinct ways. First, evaluation has been used as one component in evaluating partnerships and affiliates. Second, feedback from customer satisfaction surveys has indicated several areas where CMC needed to improve. Finally, CMC is using the NIST/Census project impact data for continuous improvement purposes.

The forum for discussion of evaluation data and analysis within CMC is the Quality Team. The Quality Team is comprised of six individuals who meet on a weekly basis to discuss continuous improvement issues, ideas, and propose solutions. This includes both internal and external activities. Areas that the Quality Team has addressed include: development, implementation and administration of CMC customer satisfaction surveys; developing procedures for populating CMC subcontractor database and evaluating performance; developing and implementing...
tools to visually display progress in project development, delivery and satisfaction; and instituting a regular CMC After Hours Social for staff.

Over the last 18 months the Quality Team has reviewed several statistical analyses evaluating certain aspects CMC performance, made subsequent recommendations to improve performance, and followed through with relevant actors within the organization to insure that new procedures and processes in fact get implemented. The team also monitors these changes to make sure they actually do improve performance.

Evaluation of CMC Partners/Affiliates
The first major evaluation-related project undertaken by members of the Quality Team was evaluating the performance of CMC partners from the local economic development community. CMC President at the time perceived the existing arrangement as less than satisfactory and requested a quantitative analysis to see whether or not his hunch was correct. He felt that CMC staff had a significantly higher success rate in turning company visits into either assessments and/or projects. Data collected on who made the initial visit and on assessment and/or project completion allowed for a fair comparison. The success rate was in fact significantly higher for CMC staff than for local economic development staff.

These findings make sense, since one of the main goals of CMC staff when they make a company visit is to determine whether or not the company needs help and, if so, provide technical assistance to address the problems. This is not the case for local economic development organizations. Their primary goal is to assist local firms in solving problems related to government services. These activities are significantly different from CMC services - for example they usually do not require the company to spend money. In addition, local economic development organizations provide companies with all kinds of information that may help their company, from loan packaging to informing them about relevant seminars. With such different missions and goals, it is easy in hindsight to see that a partnership with local economic development organizations based on CMC funding a person within each organization may not have been the most efficient use of CMC dollars. After some deliberation and negotiation, CMC decided to work with the local economic development agencies on a case by case basis. Activities that CMC agreed to sponsor included breakfast meetings, training, and/or special cluster activities. This cafeteria style partnership has led to closer working relationships between CMC and most of the local economic development groups.

Customer Satisfaction Surveys
CMC implemented a very basic customer satisfaction survey shortly after opening. However, initially, feedback from the surveys was not used for continuous improvement. This changed early in 1996. The customer satisfaction survey was redesigned. The outcome was one survey for assessments and a different one for projects. The initial survey had been administered by an outside telemarketing firm. With the redesign, the decision was made to bring the administration and analysis in-house.

Surveys are now sent out by the Evaluation Manager. When a response is received, the Evaluation Manager gives immediate feedback to the Vice President of Operations who shares the findings with the appropriate program managers. In the event that a company expresses negative comments, the Vice President of Operations
or the appropriate program manager immediately contacts the company (in person if possible) to try and clear up the problem.

Analysis of aggregate survey results has yielded some interesting findings, which in turn have been addressed by CMC Management Team. These findings are described below.

Assessment
A major concern expressed consistently in assessment survey responses was that clients really wanted CMC staff to provide more guidance in helping them set priorities. This concern has led to the addition of a section in the assessment report that prioritizes the recommended projects and includes a cost benefit analysis with each option (where possible).

Projects
Feedback from CMC project survey indicated client dissatisfaction with lack of clarity of project descriptions and goals. This issue has been addressed by requiring project managers to develop a benefits quantification to accompany project proposals (when possible). This tool prompts project managers to discuss project benefits in a way that should also make it easier for the company to quantify impact for the NIST/Census survey. At the same time, a decision was made to remove anticipated benefit questions from CMC customer satisfaction survey. The Quality Team felt that to ask the company to quantify anticipated benefits so soon after the benefit quantification exercise would be duplicative.

NIST/Census Survey: Economic Impact
The NIST/Census survey was first introduced in 1996. CMC first had to submit project information to the Census Bureau by the middle of February 1996 for survey over the following six months. This process has continued at six month intervals. Only recently has the NIST/Census survey yielded sufficient data points to allow analysis of results. As of October 31, 1997, the Census Bureau has attempted to survey 221 CMC clients.1 The type of activity clients received was split between assessments (109) and projects (112).

The first important fact to emerge is the high number of companies that the Census has been unable to contact for a variety of reasons (56 or 25 percent of total clients).

<table>
<thead>
<tr>
<th>Unable To Contact</th>
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</thead>
<tbody>
<tr>
<td>11 No Knowledgeable</td>
</tr>
<tr>
<td>Contact</td>
</tr>
<tr>
<td>3 Ring but no answer</td>
</tr>
<tr>
<td>10 Need to call back</td>
</tr>
<tr>
<td>7 Temporarily unavailable</td>
</tr>
<tr>
<td>8 Refused to answer</td>
</tr>
<tr>
<td>3 Closed</td>
</tr>
<tr>
<td>14 Other</td>
</tr>
</tbody>
</table>

The large number of companies for which there was no answer or no knowledgeable contact (14) has led to a review of CMC company database and development of procedures to make sure the database captures any changes in company information. Prior to adopting these new procedures, CMC program managers were not routinely providing company changes to the database administrator. The large number of contacts (17) where the contact was either temporarily unavailable or asked to be called back indicates that NIST should consider implementing a longer term survey follow up process.

1 See Appendix for summary statistics
Seventy five percent of the clients completed the survey protocol and answered the customer satisfaction question. For this population, the average satisfaction was 4.09, indicating an overall positive level of satisfaction. When asked questions about impact, less than 50 percent (104) of the total customer population claimed that they had made enough changes to comment on impact. CMC Quality Team is currently investigating why the remaining 25 percent (61 clients) were not able to comment.

The 104 clients indicating that they were able to comment on impact can be broken down as follows:

**In A Position To Comment On Impact**

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>16</td>
<td>No Impact</td>
</tr>
<tr>
<td>27</td>
<td>Qualitative Impact</td>
</tr>
<tr>
<td>45</td>
<td>Qualitative and Quantitative</td>
</tr>
<tr>
<td>16</td>
<td>Quantitative</td>
</tr>
</tbody>
</table>

The above table indicates that 16 companies claimed that the intervention resulted in no impact (quantitative or qualitative). Activities for the 27 clients indicating only a qualitative impact consist of 10 assessments and 17 projects. Seventy five percent of these projects are of a research, evaluation, or planning nature. Comments from clients claiming qualitative impacts fall into several main categories of improvement: morale, awareness, clarification, communication, and systems of production.

**Clients Claiming Economic Impact**

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<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>39</td>
<td>21</td>
</tr>
</tbody>
</table>

Sixty one of the clients indicating that they had made enough changes as a result of assistance to comment on the impact claimed that the intervention had caused an economic (quantifiable) impact, while 43 claimed there was no economic impact. This figure is rather startling given that one of CMC goals is to act as a change agent for small and medium sized manufacturing companies. The Quality Team is currently investigating why so many companies are claiming no economic (quantifiable) impact. However, a cursory look at the statistics indicates that of the 43 clients claiming no quantitative impact, 22 received company assessments conducted by a CMC team. It is unlikely that an assessment, in and of itself, leads to an economic impact. The remaining 21 clients for which CMC did projects and who said there was no impact is rather disconcerting at first glance. However, this group had an average satisfaction rating of 4.14, indicating they were relatively happy with CMC services. These two facts can be reconciled if one looks at the type of project falling into this group. At least 14 out of 21 are either evaluation, research or planning projects of one type or another. These types of projects do not lend themselves to quantification. Clients did, however, provide qualitative impact information for 17 of these projects.

Twenty-two of the clients for whom assessments were conducted (50 percent) quantified impacts. The average satisfaction rating for this group was 4.50. The majority of these clients went on to do projects shortly afterward. We believe that they answered the impact questions based on the project rather than the assessment. Once this problem was identified, CMC introduced new procedures to minimize any future occurrence. A decision was made not to survey clients upon completion of an assessment if they go on to do a project.

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2 Economic Impact measured in terms of changes in jobs, sales, inventory, material cost, or labor costs.
3 This opinion is based on interviewing several clients and correlating clients that completed assessments with those that went on to complete projects.
The two activities are now bundled.

Thirty nine clients for whom projects were delivered were able to quantify the impact of the intervention. For this group, the average satisfaction rating was 4.59. Examining the types of projects falling into this category yields interesting, but not surprising, results. Most of the projects tend to involve implementation of one activity or another, including: management practices; process improvement; plant layout; market development; and quality. The most significant factor in determining whether or not the client believed the project had an impact appears to be project intensity (the number of hours spent on the project). For the entire population, the average number of hours per project is 62. This figure was 56 hours for those projects where the client said there was no impact. However, for those projects where the client said there was an impact, the average number of hours spent was 111 per project - the more intense the project, the greater the likelihood that the client will recognize the impact. In this instance, the number of hours acts as a proxy for cost, as CMC billed out at an hourly rate during the period of analysis.

<table>
<thead>
<tr>
<th>Companies Able To Quantify Impact</th>
<th>Impact</th>
<th>Quantify</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>17</td>
<td>14</td>
<td>$20,000 - $1,500,000</td>
</tr>
<tr>
<td>Labor Cost</td>
<td>17</td>
<td>8</td>
<td>$4,500 - $9000,000</td>
</tr>
<tr>
<td>Material Cost</td>
<td>8</td>
<td>4</td>
<td>$5,000 - $10,000</td>
</tr>
<tr>
<td>Inventory Cost</td>
<td>8</td>
<td>3</td>
<td>$50,000 - $500,000</td>
</tr>
<tr>
<td>Jobs Created</td>
<td>25</td>
<td>25</td>
<td>1 - 50</td>
</tr>
<tr>
<td>Jobs Retained</td>
<td>8</td>
<td>8</td>
<td>1 - 100</td>
</tr>
</tbody>
</table>

Few conclusions can be made using the data on which type of projects generate particular types of impact. Market development projects tend to lead to sales increases and job creation. Human resource projects tend to cause changes in labor costs. Process improvement projects tend to reduce labor and material costs and lead to changes in employment. Hopefully, over time, the addition of more data points will permit richer analysis in this area.

The NIST/Census survey results have caused several changes in how CMC decides when clients should be surveyed. Clients who have assessments are no longer surveyed if there is a reasonable possibility that the client will go on to do a project. Assessments are then bundled with projects. Second, research/evaluation type projects are no longer surveyed if additional implementation projects are pursued - in other words, evaluations are bundled with implementation. The major outstanding issue for CMC is to improve the number of clients claiming that CMC services generated an economic impact and the number who are able to quantify this impact. As mentioned above, one strategy already underway is to perform benefits quantification for every project, when possible. One idea currently being debated
within the Quality Team is the appropriateness of including measurables from the survey in staff performance measures.

However, the number of clients unable to quantify impact but able to offer qualitative statements should not be ignored or underestimated. MEP should examine the responses coming back system-wide in this category and determine if additional specific questions could be added to probe for quantitative results. In addition, if MEP staff intend to compare survey results across centers, guidelines on when to survey clients should be issued.

**Comparison of CMC and Census/NIST Survey**

CMC project survey is administered upon project completion. The NIST/Census survey is administered 9 months after a project is completed. Results obtained from these two surveys for the same companies are significantly different. For example, the CMC survey average satisfaction rating for the 16 companies that completed both surveys was 3.94, compared with an average of 4.46 from the NIST survey. In addition, CMC survey figures for anticipated benefits were much higher in all categories except jobs created. For example, the NIST survey figure for increased sales was only 43 percent of the figure obtained from the CMC survey data. Jobs retained figures in the NIST survey were 48 percent of the CMC total. The job creation figure in both surveys was similar.

These economic impact statistics indicate that information gathered upon project completion is very optimistic and not very reliable, with the exception of job creation which probably happens right away. This analysis will be used to demonstrate to CMC other funding agencies that they should not require reporting of impact at the time a project is completed as numbers are a highly inflated representation of what actually occurs in reality. These figures may also be an indication that clients have unrealistic expectations of the impact of the project. Again, hopefully the benefit quantification exercise conducted as part of the project proposal will make sure that clients have more realistic expectations.
Appendix

Summary Statistics - NIST Census Survey
Chicago Manufacturing Center

<table>
<thead>
<tr>
<th>Type of Contact</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eligible to be surveyed</td>
<td>221</td>
<td>100</td>
</tr>
<tr>
<td>• Could not be contacted</td>
<td>56</td>
<td>25</td>
</tr>
<tr>
<td>• Could not comment or impact</td>
<td>61</td>
<td>28</td>
</tr>
<tr>
<td>• Could comment on impact</td>
<td>104</td>
<td>47</td>
</tr>
</tbody>
</table>

Clients surveyed through to October 31, 1997.

Breakdown of Satisfaction Rating and Project Intensity

<table>
<thead>
<tr>
<th>Type of Contact</th>
<th>Number of clients</th>
<th>Satisfaction rating</th>
<th>Number of Average # hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>All contacted</td>
<td>165</td>
<td>4.09</td>
<td>61</td>
</tr>
<tr>
<td>Could not comment on impact</td>
<td>61</td>
<td>3.67</td>
<td>53</td>
</tr>
<tr>
<td>Could comment on impact</td>
<td>104</td>
<td>4.34</td>
<td>66</td>
</tr>
<tr>
<td>No impact</td>
<td>16</td>
<td>3.81</td>
<td>30</td>
</tr>
<tr>
<td>Qualitative impact only</td>
<td>27</td>
<td>4.15</td>
<td>51</td>
</tr>
<tr>
<td>Quantifiable impact</td>
<td>61</td>
<td>4.56</td>
<td>82</td>
</tr>
<tr>
<td>Quantifiable project</td>
<td>39</td>
<td>4.59</td>
<td>111</td>
</tr>
<tr>
<td>Quantifiable assessment</td>
<td>22</td>
<td>4.50</td>
<td>31</td>
</tr>
</tbody>
</table>
Western New York MTC Uses Evaluative Information for Continuous Improvement

Overview
The Western New York Technology Development Center, Inc. (TDC) views evaluation and continuous improvement from two conceptually different but strongly linked perspectives. The external perspective measures the impact on customers; the internal perspective measures operational performance compared to planned goals. This paper focuses on the TDC’s view from an internal perspective.

The TDC uses the same planning and evaluative tools as many organizations. It serves as a model for linking these tools, dedication to the use of processes, and management’s commitment to improvement. The key tool in the linkage is the Strategic and Operating Plan. This paper describes the relationship between plan and other planning and evaluative tools. It also describes the related processes used to build, report, modify, and evaluate the plan and evaluate performance measured against the plan.

Introduction
The Western New York Technology Development Center (TDC) views evaluation and continuous improvement from two conceptually different but strongly linked perspectives. Our external perspective measures the impact of our operations on our customers. The internal perspective measures our operational performance measured against our planned goals. This presentation focuses on the TDC’s view from an internal perspective. The TDC uses the same planning and evaluative tools as many organizations.

- vision and mission statements
- strategic plan
- operating plan

Robert J. Martin is with the Western New York Technology Development Center, Inc., Buffalo, New York.
- budget
- marketing plan
- training plan
- job descriptions
- personal plan
- performance review
- compensation plan

The TDC serves as a model for linking these tools, dedication to the use of processes, and management’s commitment to improvement.

Our use of evaluation and continuous improvement must be viewed in the context of our organization. The TDC is an independent, non-profit corporation operated under a business model. Our directors actively participate, reflect our market, and strongly support our mission to strengthen, expand and diversify the technology and manufacturing base in Western New York. We functionally structure our operating staff into four teams: manufacturing, technology transfer, business incubation, and administrative (diagram 1). The organization is very flat and managers at all levels must deliver products and services to customers. Everyone makes coffee!

**Evaluative Tools**

The TDC links its evaluation and continuous improvement tools (diagram 2). The key tool in the linkage is the Strategic and Operating Plan. This one document contains our vision, mission, strategic plan, operating plan and budget. Following a defined planning process, the TDC annually updates the plan from the bottom-up; planning starts at the team level. We then integrate the individual team contributions to the plan to coordinate and leverage the work of the teams. After acceptance by the staff, we present the plan to the board of directors for their review, modification and approval. From this point, both the staff and the board own the plan; the board must approve changes to the plan. Team Leaders quarterly report our performance against the plan to the board using an efficient format that lists major accomplishments, missed objectives, and areas for concern.

The Strategic and Operating Plan is actionable in the sense that action plans link to objectives and provide responsibility and time-line assignments. The action plans are quantitative whenever possible. Measures include the number of activities, customer satisfaction, the impact on customers and financial goals. Responsibilities assigned in the plan link to specific employees through their personal plans.

The Marketing and Training Plans are separate documents developed and owned by the staff. They support the objectives and action plans contained in the Strategic and Operating Plan. During the planning process, the staff presents the Marketing Plan to the board for their input. The staff also reports their performance against the plan to the board with the quarterly Strategic and Operating Plan report.

The TDC believes that we must clearly articulate goals and reinforce them through processes that encourage employees rather than threaten them. The goals contained in the strategic, operating, marketing and training plans are assigned to employees through our personal planning process; a personal plan links each employee with these assignments. We use job descriptions only to describe the general authority and responsibilities of employees. Personal plans are developed and owned.
by the team leader and employee. A personal plan contains both normal and stretch goals; stretch goals link to team and individual variable compensation. In the personal planning process the team leader identifies training required in the training plan; the process also allows the employee to request additional training. We encourage employees to use their personal plans to define training and other goals that are important for them but not required by the TDC.

Since the TDC's success depends on our employees' competence and motivation, we hope that our compensation plan:
- attracts and retains superior employees,
- encourages employees to focus on well-defined corporate, team and individual goals, and
- encourages employees to contribute to the financial success of our business by sharing in that success.

There are two components to the TDC's compensation plan, market value and variable (diagram 3). The market value of an employee's services depends on job category, education and experience. The second component, variable compensation depends on:
- corporate performance compared to the strategic, operating and market plans,
- each team’s performance compared to the strategic, operating and marketing plans,
- each employee’s performance compared to his/her personal plan, and
- corporate financial performance.

The maximum possible variable compensation is the same for all employees. In concept, the staff shares corporate excess revenue adjusted for factors outside the control of the staff. Variable compensation emphasizes corporate success but provides additional variable compensation for teams (an additional 20 percent) and individuals (an additional ten percent) that meet their stretch goals.

The TDC also has a traditional performance review process that complements the personal planning process. We use it to evaluate employees' performance against qualitative corporate expectations.

**Process Performance Measurement**

It is equally critical to make certain that, day to day, the internal processes that drive our organization are monitored and tracked. Internal efficiency, quality and performance measures are used to manage the organization. For example, we monitor cash flow to ensure that our strategic goal of financial stability is attained. To that end, we regularly track bookings, billings, backlog, estimated costs vs. actual costs, etc. Other measures used to monitor processes include capacity utilization, activity measures such as the number of projects, on-time delivery, as well as others.

**Evaluation**

The TDC believes that the key to evaluation is to develop objectives in specific and quantitative terms. This reduces ambiguity and provides clear targets to guide employee performance. Except for the job description, each of our tools is evaluative. Additionally, each tool has an owner. This is the person or group responsible for developing, completing and tracking the objectives specified in each tool.
We find that problems arise in our evaluation and continuous improvement processes when the processes are unfocussed. Trying to measure too many objectives is a common cause of unfocussed processes. Meaningful feedback also helps us to maintain our focus. Each of our tools provides direct feedback to employees or links to another tool that does. Feedback must be frequent enough that we do not lose sight of our planned goals. The TDC uses many feedback mechanisms including one-on-one employee meetings with team leaders, team meetings, corporate (all hands) staff meetings, performance reviews and quarterly board reports to provide feedback. An e-mail congratulating an employee for a good job easily provides immediate feedback.

There must be implications for missed objectives. In theory, these implications need to encourage performance and avoid threats that make employees afraid to stretch beyond easy objectives. Since the real world is dynamic, we sometimes need to modify our plans for changing business conditions. Of course exceeding objectives is never a problem! We are reluctant, however, to reduce or eliminate objectives. The fact that the board owns the Strategic and Operating Plan helps, because we need board approval to modify the plan. Team leaders usually develop a strong rationale before they recommend a plan modification at their quarterly performance report to the board.

Continuous Improvement

The TDC tries to use two key elements for continuous improvement, quantitative measures and processes that are in control. The TDC is a process driven organization and our evaluative tools provide measures that we feel are appropriate. As we streamline our processes and improve our competencies, we are able to increase our goals in our corporate and personal plans. All employees are involved in continuous improvement through the TDC’s corrective action process. We encourage employees that own processes to continuously improve them.

The TDC struggles with the same issues as our peer organizations. Are our strategies and tactics appropriate? Are our measures meaningful? Our answers to these questions are never totally satisfying and usually lead to other questions. We do believe, however, that we are on the right track on a journey that we know is never ending.
Discussion

Korchak. In Illinois, does the state require additional data to what NIST MEP requires?

Davila. They just started requiring it. We’re trying to work something out to minimize the number of times that the customer is contacted. We already survey them twice and they get surveyed from researchers around the country. So we’re trying to look at how we can combine survey questions.

Oldsman. In Western New York, do you practice open book so that the financials are there for all center employees to see?

Martin. Except the individual performance reviews and compensation, everything else is open. We couldn’t be more open. Two issues here were key issues for us. One was revenue from projects and the other was technical assistance over eight hours, so we tried to emphasize those two things in our operations. We increased objectives in those two years in our center operating plan and in center staff personal plans. We track initial visits, on-site visits, backlog, etc. It moves into evaluation, personal compensation, etc. That’s how it flows through the organization. How have we done over last three years? The number of technical assistance projects has grown every year, from less than 20 in 1994 to about 100 in 1995 to about 150 in 1996. Project fees have risen from less than $50,000 in 1994 to more than $50,000 in 1995 to $250,000 in 1996.

Scriven. Let me react to the papers in general. These are reactions from an outside evaluator, so you may expect some significant missed hits due to lack of familiarity with the area.

The main problem with much of the work done is that it’s much too cozy, for example Georgia Tech evaluating a Georgia Tech-run program weakens credibility and validity. Be self-conscious about the long relationships that evaluating teams have, so that with every passing year you’re becoming more coopted.

There’s nothing in the studies presented at this workshop about customers of customers. It would be better to get downstream benefits from customers of customers. You are not doing qualitative case studies. It would be appropriate for an exploratory move.

In Western New York, you’re tied to the idea that evaluation drives program objectives, but what you are focusing on is monitoring rather than evaluation. That’s a weakness of Western New York. You are much too goal based. Side effects are either bad, and must be noticed, or are good and become key to understanding the program.

The thing that’s missing is triangulation of the advice and the needs assessments delivered to manufacturers. I don’t see you doing assessments with multiple field agents. The biases that come to mind as a result are serious. For example, field agents become too familiar with assessment tools so everything is “a hammer looking for a nail.” The enormous predominance of tools makes one worry about that.

It’s not appropriate to call estimated dollar benefits, dollar benefits. That’s cause for nervousness.

You are too worried about the NIST Census showing that you have low impacts. It may be the reverse. The psychological mechanisms in the course of the field agent distributing advice involve the desire that no one else helped
the company make decisions. But the role that other influences play is greater as time goes on. If you survey customers one year later, it's not at all clear that you get more accurate impact estimates. One problem is the design of the questionnaires used by the Census. Except for the controlled study, you are really relying on that survey. Because of this reliance, you have to assume that that is the best questionnaire ever written. That's probably not true. The survey is probably masking effects. You need to get people solely concerned with questionnaire design to look at it. It might make a difference of several million dollars in impact.

Clients reported in the Chicago study, which was concise and honest, that they wanted a prioritization of recommendations. It seems like a sensible idea. So why would you go to cost benefit analysis and not cost effectiveness analysis. Loss and gain of jobs should be treated independently of productivity gains, which means you are recognizing a value other than jobs. That moves you into cost effectiveness analysis. It recognizes timeliness among other things.

Given the extent to which the center's recommendations are focused on the business side, there is a question about whether or not you are recruiting for those skills. It may be that field agents were recruited for their engineering skills but are being asked to perform management skill-based tasks. That would be an interesting evaluation question and an essential part of any serious evaluation.

The whole approach to causal attribution is central. The Georgia study tries to get at that. The quote that controlled studies are not an option is false. It is so important that you seriously consider the possibility that a controlled survey could be done. The use of panel data to estimate fixed effects is not the best approach. You could look at the options the CEO has for getting advice. You could ask the CEO about who would be used in the absence of Georgia Tech. You then could get a likelihood, which may weaken your estimate of the impact.

Case studies do sometimes identify causal connections, but it is a poor approach to just go to the good studies with good effects. You also need to study the failures. Case studies are a mine admirable to get into but which you are not getting all the diamonds out of.

Loss of jobs traded against economic gains needs a more explicit discussion than it is getting. There are various models of trade off that can be used. You can gain from increasing jobs and you can gain from productivity so you can compare that, or you can put them on an absolute scale to look at various weighting models.

Then, there is the total impact problem: you are hitting 5% of the target population but it is non-cumulative, so your total impact is 3-4%. You'll never finish the job. It would be helpful to look at radical alternatives. Massive targeting of opinion leaders and flock leaders is one example. Find the people that others follow. Another is a massive move to interactive training at various levels by getting stuff up on web. Use expert techniques to breakdown the skills of the best engineers to be able to clone them.

There's a frequent reference to costs of $300-$400 an hour. That will not look sensational to politicians. Is that necessary to report to sponsors? That wouldn't be well looked on by Congress. You could consider using university interns to reduce center costs.
Standardize tools, improving assistance with much greater speed. There is the problem with data integrity. Who's checking the data? I don't think any one is.

ISO 9000 has troubles to it. You should be more specific about the problems with ISO service. You should have a policy on it regarding the centers.

Regarding, the dropout problem in the one-year follow-up of the Census, we have to get a grip on who can't be reached. We aren't looking at the possibility that those guys are saying, "you cost us a lot of money." You seem like you don't want to hear about that.

I don't like the Georgia Tech paper calling their study a controlled study, it really is a comparative study.

To improve dollar impacts, you could do more advance planning regarding the impacts. Pre planning of the measurement procedure in the course of delivering services to manufacturers would be a good idea.

Finally, estimating that projects should be surveyed at 8 hours is arbitrary. It could be that the impacts occur at the second hour. You should ask field agents when a project should be considered significant.

Korchak. Its important to make sure the research side is in touch with the practitioner side. I'm going to try to anchor us in reality and talk about the issues involved in evaluation. Here is a word of caution. Make sure that the research is in fact usable. Some of the research presented yesterday is not useful to me. If the research isn't useful, why should we do it? Regarding state needs, we really don't have anyone representing the states. There are people in our state agency that evaluate us as well. We had two or three centers talk about their evaluation process. There does not seem to be a lot of standardization. There are different practices going on. All those best practice papers maybe are not quite getting out there to the people that need to get them. Maybe we've created a reporting system rather than an evaluation system. I'm frustrated that I haven't been able to conquer this evaluation issue. When we talk about evaluation, we want to know where we're getting the most impacts. That will help us generate revenue and meet the objectives of the state. For example, everyone assumes that as more revenue generation occurs, centers will work with larger firms. I don't believe that. That would be an important evaluation question.

One issue is that we need an anticipated impact survey. We need that for the state and our field agents. Florida has adopted a "pay-for-performance" system. I've got to tell them what we do every quarter. They go back and pay us for performance. It's a good idea, but it shows the importance of a shorter-term survey and evaluation process. I also need to give my board of directors information about impacts, what types of projects get the best impacts, and whether we should focus on those. That's an important feedback loop. Many centers don't have this feedback loop.

We talk about the dangers of standardization, but its worse to have no standardization. Regarding the census data, other MEP centers have tried to standardize anticipated impact questions against the census questions to be able to compare the two. I haven't been able to do that yet.

Then there's the issue of the marketing report--taking evaluative data to sell not just to the state but also to other parties like customers.
This is the process I'd like to implement but I haven't been able to get there. If I can't get it going, what kinds of problems are smaller centers having? That's what I'd like to see from evaluation.

**Blackerby.** This thing about tracking what client's anticipate impacts to be at 30 days. We've looked at this in forms from various centers. Philip Shapira's work clearly shows that anticipated impacts tend to overestimate benefits and underestimate costs. Usually we see that anticipated impacts are higher than actual benefits by roughly a decimal place. I wonder whether given that systematic bias in the numbers if they have any evaluative value.

**Estes.** The study that Philip Shapira did showed that the difference between actual and anticipated impacts was not that great—not different by a decimal place, more like anticipated results were about one and a half to two times higher than actual results given one year later.

**Arnold.** The discussion is mixing up running a program with evaluative impact data. Some Norwegian programs focus on money as a way to get people involved in the program and teaching people how to manage and run a program. The goal of the program is to increase the business by 5 percent. Does this have a relationship with the benefit in a benefit cost analysis? No it doesn't. If we start mixing up these things, then we're going to get confused. The other issue is the ability of firms to provide monetary impacts over time. I'm not optimistic about that. We see that the impacts keep going down in European studies over time. We need to keep these things separate--money to motivate the staff and impacts.

**Oldsman.** When we ask people about quantitative impacts, there are two issues. One is the ability of our clients to estimate quantitative impacts. The problem is that what we ask about—sales impacts or cost savings—may be very far removed from the actual engagement. We're asking clients who received assistance to implement a local area network (LAN) to report on material savings—clients see no relationship between the assistance and the quantitative impact questionnaire item. Or even if the relationship between the quantitative impact and the assistance project seems close—e.g., scrap and material savings—the clients focus on the material cost reductions only. They don't take into account the labor cost savings associated with the scrap reduction and freed up production capacity. The second issue is the issue of attribution in the context of no baseline data. We're asking people to come up with a change and then attribute it to something. That's fraught with problems. For example, if costs go down over time, did the company change its attribution or did new information come in over time? In Florida there's work being done on contingent payment/gain-sharing. Because outcomes are linked to payment, you can be sure that field agents put together very good measurement schemes to assess outcomes. This means when you are doing projects, you build the measurement scheme into the up-front definition of the project. Then questions about outcomes make sense. It is necessary to understand the relationship between the project's goal and whether these goals were achieved. In a lot of centers we're missing that. We're going from loosely defined projects (in terms of impacts) to loosely defined impacts.
**Wilkins.** We have three pronged goals: revenues, outreach (a public policy criteria), and impact. Impact is the biggest issue. You get these surveys back that ask questions not able to capture the appropriate impact from the project. For example, an ISO 9000-assisted company will not say they received sales impacts. From the company's perspective, the company has to become ISO 9000 certified. Another example is a project to implement a LAN system. Our customers don't necessarily invest in LANs because they hope to see cost savings, they invest in LANs as an investment in their future. I'm sure our LAN customers will not say that the project had a monetary impact. A third example relates to NIST MEP's emphasis on product development projects. We interacted a company on product development issue in 1995, and the first sales will occur in 1998. We get no credit from this from the Census Survey because the company is only surveyed eight to 10 months after the close of a project. I've got to sort through all the noise in the Census Survey process. I've got to filter through that and say that these are important programs to continue with companies but I'm not able to capture that in the process we use. My suggestion is to have different ways to survey different types of projects.

**Estes.** Our debate has for too long been on anticipated vs. actual impacts. At both points the results are flawed. I don't put much validity on these data points. But we can't spend more money on the evaluation than on delivering services. It has to be merged with the other elements, and with gut instinct. It is the long-term relationship with companies that's important.

**Wilkins.** The point about focusing on companies rather than projects is good.

**Martin.** I don't think there is any question about the need for data that can stand the scrutiny of analysis or spending money on that. That's interesting from an academic perspective. There's another side of the issue that's very critical. Getting the data back to the people in the field. One point I didn't make is that compensation is procedure to do that. Most of us are not in the program for the money. We're trying to make the world a better place. If we don't provide data that flows down to the staff, we're missing an important issue. If we don't do this, we're not enforcing good practice. Right now, the centers and the national system are not doing well. We need to spend more time on how to get the data into the hands of field agents.

**Arnold.** What seems to be going on is that the system is trying to get over a big political block. I would think the question to ask is if you have x centers doing the same thing, do you evaluate all of them or just a sample of them? Then you can do addition research to answer other questions. Maybe we're trying to do too much with evaluation.

**Wilkins.** Or worse yet, evaluating every project.
Part VI.

Feedback of Evaluation Results into Program Design and Policy
The MEP Evaluation Approach: Past, Present and Future

Overview
In 1995, the Manufacturing Extension Partnership (MEP) put in place a multi-pronged evaluation strategy that emphasizes examining impacts at both the client firm level and the MEP Center level. Accomplishments to date include setting up MEP-wide information collection systems, beginning work to compare clients with non-clients and to examine economic impacts beyond client firms, setting up systems for Center benchmarking, and developing a strong infrastructure to support the evaluation work. Over the next three years, MEP’s evaluation work will emphasize producing information that is useful for Center management and NIST MEP management. This emphasis will be supported by a greater focus on data quality, analysis, and preparation of products intended to present “actionable insights” for decision makers.

Introduction
Most analysts would agree that the heart of evaluation involves: The collection and analysis of data to gain a greater understanding of how well a specific institution is operating, and how it might operate better. This basic concept of evaluation underlies the evaluation work that NIST MEP has undertaken.

The MEP evaluation effort approaches evaluation with two key purposes in mind:
- Continuous improvement, and
- Program accountability.

In short, a key question is: “how to use the greater understanding of the MEP system that evaluation work can provide?”; this question has two possible answers. If one focuses on continuous improvement, then the greater understanding can help determine what types and levels of changes, directed at what points in the system, are likely to produce the most positive effects. On the other hand, if
one focuses on program accountability, then the greater understanding can help determine whether—or to what extent—the investment in the program is worthwhile.

These two purposes are mutually supportive. And, MEP has designed its evaluation effort to pursue both continuous improvement and program accountability.

**MEP’s Basic Approach to Evaluation**

During the 1994-95 period, MEP constructed an evaluation strategy. This strategy was built on the foundation experience of the small network of the seven Centers that were funded by NIST during the early days (1989-94) of the MEP program. MEP developed the strategy over most of 1994, and incorporated the insights of a wide range of key experts. Much of the guidance came through the Evaluation Working Group, which in 1994 contained almost all of the key policy and evaluation experts from throughout the MEP system.

In all, input came through several sources:

**First**, the Evaluation Working Group hosted discussions of practical evaluation issues; for example: “What are the critical performance metrics for Centers? What project data can reasonably be collected? Where should we draw the line between larger projects—ones where we would generally expect some measurable impacts—and smaller projects—where we would be less likely to see impacts? Should that line be drawn at five hours of assistance, or eight hours, or 24 hours, or somewhere else? Of what significance are intermediate impacts? When during or following the assistance implementation cycle should data be collected?”

**Second**, individual experts prepared “white papers” on key evaluation issues; for example: how to use case studies as part of MEP’s evaluation approach; the advantages and disadvantages of various approaches to measuring return on investment.

**Third**, MEP used an informal group of advisors—a so-called “kitchen cabinet”—including Center Directors, evaluation experts and others, to provide ongoing guidance on policy and evaluation issues.

**Fourth**, a major national conference—held in September 1995—brought together academics, independent investigators, interested evaluators from across the MEP system and from other public programs, and others. This diverse group came together to review the draft evaluation strategy and to suggest revisions.

This open planning process led to an evaluation strategy that is a good example of an innovative approach to assessing the value of a public sector program. This strategy looks beyond outcome measurement by utilizing econometric analysis, balancing quantitative survey methodology with qualitative in-depth case studies, assessing Center performance both comprehensively and comparatively, and seeking to spread high quality management and service delivery practices systematically throughout the MEP network.

The MEP approach divides evaluation work into six categories, or strategies. The six strategies are:

**Strategy I. Conduc project-level evaluation.**

Measuring short-term impacts of specific engagements—e.g., technical assistance provided to small manufacturing firms by MEP Centers—can produce early information about emerging trends, potential problems, and opportunities for improvements. It can also satisfy stakeholders’ needs for outcome measures, such as in annual budget reviews.
Strategy II. Conduct firm-level long-term evaluation.

Many believe that the impact of manufacturing extension is most fully measured only over the long term. For example: product development assistance typically requires a minimum of two years to achieve results in the marketplace; years after creating manufacturing cells, the effects of associated team-based organization, reduced inventory, and increased throughput on the firm’s bottom line may continue to grow; the effects of integrating information systems across manufacturing and business management functions may become apparent only in terms of the firm’s long-term survival, and may never show up in its financial statements.

Consequently, MEP is developing methodologies to trace the long-term effects of assistance on client firms in comparison to non-client firms, in terms of productivity, employment growth and survival rates.

Strategy III. Regularly assess individual Center performance.

MEP’s statute requires a third-year review by an outside panel—chaired by a NIST official—before awarding federal funds for later years (15 U.S.C. 278k (c)(5)). In most cases, Center performance justifies continued funding; therefore, the focus of the Center review is usually on opportunities for continuous improvement. Each panel—made up of managers from other Centers, manufacturers, economic development specialists, and a NIST chair—reviews a progress report written by the Center, reviews other information collected by the MEP staff, listens to a presentation by Center personnel, and engages in a thorough discussion of issues with the Center. After its review, the panel issues a report assessing the Center’s work and making recommendations that would improve performance.

New legislation also requires a six-year Center review as one condition for further funding. MEP is developing new procedures for this review that will provide Centers an opportunity to demonstrate that they are high performance organizations.

In addition, MEP Regional Managers annually review each Center in terms of: performance relative to its plans; leadership position in the local economic development community and among industrial service providers; strategic plan and strategy development processes; customer relationship management and market focus; information systems and use of data; human resource development and management processes; and integration of marketing, sales, service delivery, and evaluation processes.

Strategy IV. Regularly assess NIST MEP performance.

Ideally, the MEP program should be more than the sum of its Centers. To achieve this, NIST MEP must provide value to Centers beyond federal funding. This value would be produced if MEP can accelerate Centers’ productivity with a variety of services, including additional tools, specialty expertise, national marketing support, inter-Center networking, and efficient evaluation services. MEP’s performance as a catalyst, research and development center, support organization, and evaluator is therefore also subject to evaluation.

Strategy V. Assess program on the creation of an integrated, continuously improving national service delivery system.

Over its first few years of operation, MEP has focused on covering the nation with manufacturing extension services. Having achieved that goal, recently MEP has changed its emphasis, focusing now on upgrading the delivery of effective services to small manufacturers by all Centers, in order to achieve a high-performing national system.
Strategy VI. Interpret, verify and report on national program mission and results.

As the largest single source of manufacturing extension support in the nation, MEP has a responsibility to key stakeholders—Congress, taxpayers, manufacturers' groups, labor unions, and others—to compile accurate national program outcomes and to report regularly on progress against the national program mission.

The intent of the MEP evaluation strategy document was to lay out work over a five-year planning horizon. Thus, implementing the strategy has required choices in terms of sequencing activities and setting priorities.

Some specific evaluation activities logically had to precede others. For example, data reporting and management systems development logically had to precede data analysis. Also, long-term assessment of client impacts could not occur until a sufficiently large population of served clients had "aged" long enough so that they could be identified across a multi-year study period covered by the semi-decennial Census of Manufacturers and the annual Survey of Manufacturers.

Other choices reflect MEP's evaluation priorities, based either on the importance of the project, or on MEP's ability to deliver the most bang for the buck. This priority-setting process has meant deferral of some important work, particularly under Strategies IV and V.

Some customers have misunderstood the relative emphasis placed on various components of the MEP evaluation work. Perhaps because of its visibility, and because early implementation of reporting procedures proved unexpectedly difficult, the client valuation survey, administered by the U.S. Census Bureau, has mistakenly appeared to some as the primary—if not sole—evaluation activity in the system.

For example, a Center director recently lamented that a valuable recent project, using the World Wide Web to match manufacturers with users of their waste resources, will have great impacts on clients, but the work is not easily measurable with the client valuation survey. The director's perception was that the only way for a Center to report beneficial impacts of its work with manufacturers was through the survey. This director was surprised, but pleased, to learn that this project would be an excellent candidate for an in-depth case study.

The above is a thumbnail sketch of the MEP evaluation approach. We next turn to a description of our implementation efforts. First, we describe our accomplishments to date, and then, our work focus for the next three years.

Accomplishments Over the Past Two-to-three Years

In a systematic approach to evaluating a start-up government program, at least two—fairly different—phases are needed. For MEP, the first phase involved developing the evaluation strategy, creating reporting mechanisms, collecting information, and piloting methodologies. As many of these processes have become routinized, a second phase is emerging. The second phase will involve analyzing data, converting it to information, working with customers to apply information toward solving problems, developing "actionable insights," and producing evaluation products.

Major progress has been made on several fronts over the past 2-3 years or so, during the first phase of MEP's evaluation work. Five key areas of accomplishment stand out:

- First—major data collection systems, focusing on Center activities, are in place. One system collects financial and activity
information from each MEP Center on a monthly and a semi-annual basis. This system permits the production of regular reports describing various measures of Center finances, workloads, productivity, and efficiency.

A second system collects impact information from firms served; this information is collected on a rolling basis 8-10 months after project close, to learn how the clients value the impacts of the assistance they have received. Response rates have been outstanding: overall, 77 percent of clients contacted have responded; and, of clients identifying specific business, job and/or capital investment impacts, 85 percent have been able to quantify at least one of these impacts.

A third data collection system emphasizes qualitative, rather than quantitative, data about Center assistance to firms. MEP has established a large group of trained Center evaluators, academic researchers, and system consultants to document client impacts through in-depth case studies that follow a rigorous analytical logic model. The logic model has been tested, and MEP published the first compendium of 24 case studies in May 1997. An additional 18 case studies are currently in progress.

Together, these data sources can provide a good picture of (1) what the MEP system is doing (thus permitting the use of efficiency measures) and (2) how well it is improving the competitiveness of small manufacturers (permitting the use of effectiveness measures). Implementing these systems has not been painless, but Center participation is now approaching 100% and data quality continues to improve. In short, the information collection systems are in place and are functioning reasonably well.

- **Second**—a system for comparing clients with comparable non-clients has been developed and is being tested. While preserving confidentiality, the U.S. Census Bureau has been able—for a small group of selected Centers—to identify a significant proportion of clients in the semi-decennial Census of Manufacturers and the annual Survey of Manufacturers, and to compare the performance of clients to that of non-clients over a period of several years.

  Preliminary results from using this approach show an encouraging productivity effect. By feeding this effect into a regional economic model (REMI), analysts have estimated that the fiscal effects of the NIST MEP effort exceed its cost, and that the economic benefits of the program are significant.

  This method is also being applied to employment-based data sources to compare clients and non-clients in terms of employment growth rates and survival rates. In sum, MEP has developed a unique approach to measuring long-term program impacts, and this approach appears very promising.

- **Third**—MEP has developed—and is currently testing—a system for examining impacts beyond client firms. Under this system, client outcomes are taken from the short-term impacts survey, and then run through a highly-respected regional economic model (REMI). This model quantifies secondary and tertiary multiplier effects, while discounting that portion of the effects that come out of neighboring competitors’ contribution to the economy (the “transfer” effect). With the benefits measured in this way, matched with system and client cost information from other data sources, a benefit/cost ratio for the program can be estimated. In short, use of REMI enables a look beyond client firms to the broader downstream economic impacts and the fiscal benefits and costs of the MEP program.
Fourth—systems intended to enable Centers to benchmark their operations and performance against other individual Centers or groups of Centers are under development. One effort, funded by MEP, involves 14 Centers which have agreed to share information among themselves on a rigorously-defined set of common management metrics. This process produces high-quality benchmarks to support continuous management improvement for the participating Centers.

Another effort along the same lines has sprung up from a Center initiative, involving five Centers. This group uses a different set of metrics, emphasizing aspects of Center business performance.

A third effort, also MEP-funded, uses a linear programming technique called data envelopment analysis to identify the highest-performing Centers in terms of a mix of productivity and cost-effectiveness measures. This project is intended to produce a method that will permit a Center to benchmark its performance against the highest-performing Centers that are most like it in terms of objectives. Centers will often find it useful to compare themselves with others; these developing benchmarking systems will enable them to do so.

Fifth—MEP has developed a strong and useful infrastructure to support its program evaluation work. One key element of this infrastructure is a series of agreements with a variety of consultants and academic researchers—with expertise in specific evaluation and analysis methodologies, manufacturing extension, economic development, and other relevant subject matter areas. With these agreements in place, MEP can—and does—call on these resources as needed to help collect and analyze data, review draft plans and products, and provide technical insights on work in progress. Having such resources available has been so useful that MEP is working to expand the number of these agreements it maintains.

Another key element of this infrastructure is the Evaluation Working Group, made up of evaluation contacts at each Center, interested Center Directors, and consultants involved in various aspects of manufacturing extension work. The most recent meeting of the Evaluation Working Group—held in September 1997—had 118 people in attendance. Topics addressed every level of the MEP program; for example: the role of continuous improvement in the lifecycle of MEP; continuous improvement systems currently in place at MEP Centers; continuous improvement of the NIST client valuation survey; and dissemination of distinctive management practices throughout the national MEP system. MEP intends to continue using the Evaluation Working Group in evaluation design and implementation.

To guide program development directly (and program evaluation indirectly), MEP’s senior management team is in the midst of a strategic planning effort to direct the MEP system through the next several years. When completed, this effort will provide strong overall guidance to the MEP evaluation work. Completion is expected during the first half of 1998.

MEP semi-annually compiles and distributes a National Data Highlights publication, which provides national totals of key outputs and outcomes generated by the MEP system. As the MEP strategic plan gains widespread acceptance and approval, this document will likely be modified; it should become an opportunity to report on progress against the MEP system’s strategic goals and objectives.

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gains widespread acceptance and approval, this document will likely be modified; it should become an opportunity to report on progress against the MEP system's strategic goals and objectives.

In addition, in September 1997, the officially-chartered MEP National Advisory Board convened for the first time. Board members represent the views and needs of customers, providers, and others interested in manufacturing extension throughout the U.S. The Board will provide guidance to MEP on key management and policy issues, including evaluation.

**What Needs to be Done Over the Next Three Years**

In mid-1997, the MEP Evaluation Team engaged in an interim planning exercise that involved assessing accomplishments to date, and assessing the current state of the MEP evaluation effort, prior to looking ahead to the work to be carried out over the next few years. The Team's basic conclusion was that the work of the past 2-3 years has set a solid foundation for future analytical efforts, and that the evaluation effort now has an opportunity to focus on some different tasks.

Looking ahead, MEP's evaluation work should line up with three key goals:

- Evaluation should contribute to high performance Centers by providing actionable insights to Centers and Regional Managers;
- Evaluation should contribute to a high performance MEP system by providing actionable insights to senior MEP management; and
- Evaluation should contribute to a well-understood MEP system by assessing program results and providing them to senior MEP management and Centers.

In working to achieve these goals over the next three years, MEP's evaluation work will focus on four key dimensions:

**Greater focus on information for use by Customers**

The key direct customers for MEP's evaluation work are the Centers and MEP's stakeholders. Both of these customer groups are interested in both the continuous improvement and the program accountability aspects of evaluation. Much of the evaluation information useful to Centers will be provided through the MEP Regional Managers who work directly with individual Centers on a daily basis. Senior MEP managers will often want to provide key evaluation information to interested parties in the Administration and in Congress. Centers will want to provide state-level evaluation information to interested state stakeholders as well.

Over the past two years, as data collection systems were being established, only limited information has been available from the evaluation work to share with key customers. With greater data availability, providing that information to customers will now become a major focus.

**Greater focus on data quality**

The basic law of computer science--garbage in, garbage out--also applies to the evaluation process. Thus, only with high quality data are high quality analyses possible. Data collection procedures result in high quality data consistently only if they are clear and easily applied to all cases. In the MEP system, these procedures are not mandatory; in addition, Centers vary widely across several critical program dimensions. Consequently, the quality of data across the system is somewhat variable.

As a primary approach for addressing these data quality issues, MEP has developed the concept of "quadrangulation" to improve data comparability. The concept is simply
stated: if a Center is to report a particular assistance activity and the client outcomes it produces, it must also report the associated staff, expenses, and fees associated with that activity. Applying this concept successfully across all Centers will improve the system’s data quality dramatically. Working through the Regional Managers, MEP Evaluation Team members will be striving to ensure that all Center reporting systems are fully quadrangle by the end of 1998.

MEP is also undertaking a comprehensive—top to bottom—continuous improvement review of the client valuation survey. This review will examine the survey instrument itself, as well as the entire survey process. This review has a target completion date that will permit implementing any resulting recommendations by August 1998.

At the same time, MEP is committed to an even wider review of all Center performance measurements, and the associated data reporting and collection mechanisms they require. As MEP solidifies its strategic plan, understands the benchmarking needs of Centers more precisely, and reorganizes its Center review process to focus more strongly on creating high performance Centers, better alignment of data collection and data quality efforts with the evolving needs of the MEP system will be possible. After this improved alignment, it is reasonable to expect that all collected data will support management information needs and will be of high quality.

**Greater focus on analysis**

The major data systems mentioned above—the reporting system, client valuation survey system, and the case study system—were established to help answer important questions about the operation of the overall MEP system and individual Centers. To date, little analysis has been carried out using the data. Now that these data sets are becoming more densely populated, the MEP evaluation effort will move forward by focusing a large part of its resources on data analysis.

The analytical focus is closely related to the customer focus (described above); data that has been analyzed will be much more useful to customers than raw data. Thus, a primary purpose of data analysis is to provide customers with “actionable insights,” suggesting specific actions they can take that will drive improvements in a Center or across the system as a whole.

**Greater focus on products**

As MEP turns its attention from process development to analysis, new and useful products will emerge. Already new reports have been produced that highlight key indicators of Center progress—showing, for example, system-wide benchmarks at the 90th percentile, and intra-Center month-to-month trends. This focus on products is also closely related to the customer focus; for example, these new highlights reports were suggested by—and developed in conjunction with—the MEP Regional Managers, a key customer group.

Future products will include:

- Improved tools to measure client satisfaction;
- New tools to measure employee perceptions and attitudes;
- Analyses of the factors that produce strong client impacts under different conditions—with a special focus on identification of high performance services;
- Analyses of the willingness of different-sized client firms to pay fees for extension services;
- Analyses of benchmarking data using a variety of comparison group analysis techniques;
- Additional benchmarking measures;
Future Directions

Evaluation is always a challenging enterprise. It involves trying to determine the answers to important questions within often severe time and other resource constraints. In addition to the usual challenges, evaluation at MEP has faced a somewhat unusual challenge: MEP is a brand new program. Thus, a new evaluation system has been designed and implemented while, simultaneously, the program itself has been designed and implemented.

The MEP system as a whole is currently involved in thoughtful self-examination: the MEP strategic planning process. The MEP strategic plan that emerges from that process will set the framework for future MEP evaluation work.

Once the basic structure of the MEP strategic plan becomes clear, then the MEP evaluation effort will be thoroughly reexamined. All aspects of the evaluation effort will be on the table for review; no components will be out-of-bounds. A wide-ranging process will be established for assuring the design of the MEP evaluation system so that it is fully supportive of the MEP strategic plan. Key participants in the reexamination process will include evaluation experts from inside and outside the MEP system, and key players (e.g., Center directors, MEP senior management) from within the MEP system.

It is quite plausible that the four key focus areas spelled out above—customer focus, data quality focus, data analysis focus, and products focus—will continue as focus areas after the reexamination process. It is also plausible, however, that additional focus areas may force a reprioritization of work—this is because the MEP evaluation work must concentrate on measuring progress in terms of the strategic priorities and questions identified in the MEP strategic plan.

Thus, MEP evaluation is now at an important crossroads, where it can build upon

- Program accountability measures that can be used for communicating with state legislatures;
- Regional economic impact analyses;
- Improved access to data through the World Wide Web; and
- New reports summarizing national system performance.

In addition to these four focus areas, the MEP evaluation work over the next three years or so will address a number of other areas. Among these are:

- Beyond upgrading data collection and analysis systems, MEP will carry out some one-shot studies of special issues (e.g., does the pressure to produce more fee revenues push Centers to serve larger firms);
- MEP will undertake a thorough reexamination of the major Center review process, including a rethinking of the best way to effectively deal with poor Center performance;
- MEP will expand its reach into the evaluation community—bringing in a handful of evaluation experts not currently inside the MEP evaluation community;
- The MEP evaluation work will be expanded—especially in terms of case studies—to look at instances of failure as well as success; and
- Working through the Evaluation Working Group, the MEP evaluation system will put greater emphasis on improving the ability of individual Centers to effectively design and use evaluation to upgrade management capability.
the data systems put in place over the past couple of years, and can now begin to provide a significant level of useful information about the MEP system to key decision-makers within the system. In addition, a major reexamination of the MEP evaluation strategy will be undertaken within the next few months, and it will be firmly based upon the foundation of the MEP strategic plan. The evaluation effort can--and must--be central to the task of determining the MEP system's success in achieving its strategic goals and objectives.

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Overview
There are several overriding themes that have recurred throughout our two days of discussion. This paper summarizes these themes.

Conflicting Goals
The first is the problem of conflicting goals for Manufacturing Technology Centers. The centers are asked to increase revenues, outreach, and impact. Outreach, or maximizing the number of firms assisted, is a very different goal from a focus on the impacts achieved, and both of these are distinct from a goal of fee revenue. Our discussions have highlighted the fact that a focus on outreach, which might well involve only initial contacts with a large number of firms (including very small firms) is likely to reduce fee revenue, which comes from a smaller number of clients chosen (targeted) as able and willing to pay for MTC services. The big impacts are probably more likely to come from a select few clients with whom multiple projects are undertaken.

At the Center level, conflicts also arise, mainly between a standardized national best practice of service delivery and the particular needs and options appropriate for each state. The choice this poses for Centers involves whether to target all firms, the average firm (for outreach), the top 5% of firms most likely to have the impact needed to secure political support, or to simply avoid the lowest tier of firms, from which both impacts and revenues are least likely. This conflict revolves around the perceived public purpose of the MTCs, and that purpose varies among states, and depends in part on whether or not they predated NIST/MEP.

Data Base Issues and the Census Survey
It is clear from our discussions and from experience with manufacturing extension
that there are serious issues surrounding what is and what should be measured. Should it be projects, as is currently the case with the Census survey? Should it be firms, many of which have had multiple projects, and for which we would like to measure the combined or cumulative impact of these projects? Or should it be the long-term relationship that some firms have developed with their field agents or Centers? This is related to the issue of bundling projects before the data are submitted for Census follow-up. Are they being bundled too soon for later projects to be added in? Is there a Center policy of no bundling of projects? There is no standardization across the country, and perhaps there should not be. The issue is not so much of bundling as it is one of timing. Are firms being surveyed too soon? Too late? We don’t know yet.

Other data issues have been discussed as well. Disaggregation is necessary for meaningful analyses, such as the quasi-experimental design studies advocated by Eric Oldsman and the analyses of panel data by Ron Jarmin. Yet, it is clear from the reports of several people here that the problems of (1) non-response or inability to find the firms nine months after the completion of a project, and (2) the inability of respondents to identify an impact jeopardize the number of respondents needed to identify and estimate impacts.

In large part, this seems to vary among types of projects, some being easier to see and to estimate impacts. It also seems to be a people issue, one that focuses on a firm owner’s or manager’s personal relationship with a particular field agent. Because of turnover, this relationship can break down or break off completely and result in missing data. The project may have been completed from the Center’s point of view, but it may never have been completed satisfactorily from the firm’s perspective.

The definition of what is long-term also has relevance. Although the 9-month delay before the Census survey-takers phone may seem long-term, it may in fact take considerably longer maybe 18 months or even longer for product development or other projects for impacts to be measurable.

**Qualitative Analysis**

The analysis of the final, open-ended question in the Census follow-up survey seems to have been ignored. NIST staff acknowledges that firms do respond to this question, despite the fact that two-thirds of respondent firms are unable or unwilling to estimate numbers related to the impact of their MTC projects. This drop-out problem suggests that there should be surveys, at least by the states, of the drop-outs in order to understand impacts more completely.

The only qualitative analyses with the NIST evaluation effort are the case studies undertaken by the Centers and by the COSMOS Corporation. Other qualitative analyses are not only possible but recommended by the consensus of this group. As Erik Arnold recommends from European experience, this would include in-depth analysis or evaluation of a few firms, from which we obtain good and complete data. Follow-up interviews of old clients should be a routine part of the work of each Center, but especially of firms that have been repeat clients on multiple projects.

**Center Performance**

The activities and skills of field agents are an aspect of NIST/MEP that is avoided because it involves personnel evaluation. However, the benefit of any Center depends in large part, Erik Arnold reminded us last evening, on whether the transfer is of technology only or addresses business capabilities as well. The need of many firms for broader sorts of knowledge is well known but has been outside the bounds of
the traditional concerns of NIST. If firms need assistance outside or beyond the technological, which links or outside resources are used? Which are used most often? Are these tracked? Are there other firms that can provide a demonstration effect of Center benefits to other firms?

**Competing Causes, or Who Takes the Credit?**
The issue of whether firm changes and effects would not have taken place otherwise is a significant issue. MTCs are not the only sources of assistance to small firms. To determine attribution requires qualitative research, and is in the case study protocols and logic model, but only there. A complicating factor is the fact that high-performing firms also have a greater number of competing causes, because they are more open to outside knowledge and assistance.

**Studies of Failure and Job Loss**
These are sensitive issues, and should not be buried in an effort to highlight only successes. We have discussed the fact that, in some firms, productivity efficiency gains are related to lower levels of employment or job loss. Maybe NIST has been very honest thus far on the MEP, but it may not be honest enough to study these two issues.

**Project Effects over Time**
Except in the COSMOS case studies, we do not really know if firm practice really changed as a result of a Center project. If it did, to what degree? If not, why didn’t it? What if other causes or changes in practice also intervened? We cannot expect MEP to be the only force for positive change among small manufacturers, and it is important to learn the process of change. It is clear that changes in practice can often take more than nine months (as well as less than that in some cases). Eighteen months has been suggested as a better time for follow-up.

**Brand Recognition**
Finally, it is necessary to put a consumer slant on NIST/MEP. Although older Centers are recognized within their territory, or have brand recognition, this is rarely the case for newer Centers. NIST/MEP does not have brand recognition or name identity. Even an opportunity such as the recently published volume, *MEP Successes: A Case Study Approach* does not have a prominent logo. Does this matter? We are back to the problem of conflicting and multiple goals. Customer loyalty turns into long-term relationships. This is the opposite of quick encounters with a large number of client firms. Does this difference matter to NIST? To state stakeholders? I believe it should matter.
Discussion

Sears. The MEP evaluation system is much larger than just the few NIST evaluation team members located in Gaithersburg. We do have the NIST MEP evaluation staff, but we also have dozens of additional people scattered across the country in Centers, universities, and elsewhere doing evaluation activities. One of the interesting – and heartening – things I’ve learned at this meeting is that there’s a lot more alignment within this entire evaluation community today than there was in the past. I think that’s good. I was also glad that we had Michael Scriven come in here and shake us up a bit by taking an outsider’s look at the whole MEP evaluation system.

Estes. From a center director’s perspective, specifically our center, I’m concerned about our position with our state stakeholders, and figuring out how to make the state a more active participant in the planning and execution phase. Once we transition into the sixth year, the state may be the largest stakeholder from a funding standpoint. MEP may be the third largest stakeholder, if you consider the manufacturing customer in combination as the second stakeholder. From my center’s standpoint, we view ourselves as a state economic development agency, not a consulting firm. What we do as a center must fit into what the state is doing. This has to be a component of the state’s economic development plan. Here is an example. We were on a visit with the General Accounting Office (GAO) when they did their study of the impact of industrial extension. We went to a South Georgia firm near Plains, Georgia--Jimmy Carter territory. This firm was involved in agricultural processing of peanuts. We worked with company to help design a crop dryer because the company’s current dryer was too noisy. Our engineer worked a couple of days on the design. The company seemed to like it. The GAO visitor asked the company, “What would have happened if the folks from the MEP center had not been here to help you?” The client said, “I guess our people would be waiting for the check to come in from the government.” Our center is about economic development. Our first priority is from the state perspective.

From the overall system perspective, keep the evaluation system simple. We have a tendency to get too complex, to do too many things. You’ve mentioned problems of centers having trouble collecting data, and we’re one of those centers. One problem is resources--we can either put money into reporting infrastructure or into delivering services. We have a certain amount of resources for R&D, a certain for marketing, etc. Some of the things coming from NIST MEP require too many resources. We’re at the point of declining government revenue. We have the challenge to retain capacity. We’re making some progress in getting other sources of revenue. But to maintain capacity, we’re having to chop things out of our center that add value because we don’t have the money to support them. NIST/MEP needs to be careful about what information we ask for from the centers.

The concept of intermediate outcomes is important. We have to take some firms through building blocks to produce change. I encourage participation of center directors in designing metrics. There are many stakeholders. Let’s see what we need from each stakeholder and look for the overlap.

The validity of the data points is another issue. We depend on external
specialists and NIST to provide expertise to analyze the data because we don’t have that infrastructure in-house.

Thompson. I have three broad comments. I’d like to come out of this meeting with more positive feelings. We’re beating ourselves up over low numbers. A lot of programs play games with numbers that we’re too honest to play. Maybe we dwell too much on the fact that our numbers aren’t what we want them to be but at least we have honest numbers. Thirty-two percent of clients check boxes indicating that we’re having an impact; 68 percent do not indicate an impact. I think one problem is that the questions are not capturing the impact.

When I was a center director, I reviewed our Census survey results and I found that in many cases when the company indicated no impacts, the company would turn around and describe impacts from our services in open-ended questions. We need to come up with a way to measure the value of ISO 9000 implementation., the value of meeting environmental regulation, the value of agreement with disaffected workforce, and the ability to value new product development services. We have a table that shows that new product development has the greatest anticipated impact but it takes a long time to see these impacts. We need to do a better job capturing this. If our idea that here’s one survey and here’s one job total that describes the outcomes from our program, we’re shooting ourselves in the foot.

I love the phase actionable insights. I’m skeptical that most of these insights we need will come from the evaluation system. There’s stuff we need to know—special issues such as the impact of environmental non-attainment. What’s the impact of that going to be? It is likely to be more regulations imposed on manufacturers. But this evaluation mostly comes up with things innate such as more capital investment. Everything is a cost in an environmental project. Another topic is the interaction of our projects with labor issues against the current resurgence of unions.

A further issue is how do you deal with pressures for job growth and productivity improvement simultaneously? There’s no industry that’s achieved above average in value-added and in job growth. Watch out because you aren’t going to get both. We may be in for a collision with the interest in labor, prompted by the supply chain optimization development initiative. We need to head that off with some research. But our evaluation system doesn’t collect wage data.

Third, social service agencies have had a paradigm shift. It is used to be that people had problems and they’d come to you for solutions to the pathology. Now they are saying that maybe the approach is wrong and they are changing from focus on pathology to focus on strengths. They are moving from a needs-based paradigm to an assets-based paradigm. Now they are trying to capture people’s resources, not just their problems. Social services agencies have in place indicators of what it takes to have a healthy lifestyle (e.g., a child should have a quiet place to do homework, an adult to call outside the home). If you have more of these indicators, then you are doing better. That brings the issue of the MEP. Do we know what the elements of a high performance manufacturer are? The evaluation system could be a system to measure how centers help manufacturers to have the good manufacturing life.
Arnold. This resource-based approach has been used in the national innovation system. They are beginning to predict what resources are necessary to have such a system. One irritated sense I have is that the Monroe Doctrine rules here, as if there weren’t others trying to do the same thing as the MEP is. Go steal ideas from these other programs. One idea has to do with leverage, because one-on-one assistance has a little impact on the largest economy. For example, this program could go and look at what large companies are doing, and steal those ideas for SMEs. Another old idea is that a piece of equipment used by large manufacturers could be brought to small manufacturers. The federal state may want to invest in these things. Some European programs, such as in Norway, have best practices networks. The notion is that there are ideas and practices and tools that can be stolen.

Wilkins. The issue of regional impact will become more important for us as we go forward. This involves the REMI model. I’d like to achieve at the public level some measure of the magnitude of impact we’re having on the manufacturing economy. The issue of fast track firms is a second concern. Are we here just to serve the fast track companies or all companies? That’s goes to the fundamental purpose of the program. We need to address this question before we talk about targeting high performance firms. Third, the state partner may in fact become a more important partner given the funding situation. But NIST through its evaluation strength has the opportunity to get together with the states. In larger states it may not be important, but in small states where we have to fight for every dollar, a visit from NIST will have a big impact.

Blackerby. I hear people talking about the characteristics of effective manufacturers. These should be identified and then services could be geared more precisely toward advancing those firms. I think that’s a good idea, but I’m wondering if that’s an appropriate role of the evaluator. Maybe that’s more of a role of program design before the fact, because evaluation examines results rather after the fact.

Thompson. I agree.

Martin. From a center perspective, you don’t just look at what types of firms to serve to get the most impact, rather you look at what types of services to provide to get the greatest impact. It implies a conceptual matrix consisting of the customer base and the service provision base. That’s not to say that any analysis of the customer base is worthless, it is very worthwhile.

Haines. I’m talking about the 160 case studies of firms. We have data in the system where we can do reality checks.

Shapira. Looking back at what we’ve accomplished and where we’re going, I get worried when there’s too much agreement so I appreciate what Michael Scriven has said. Evaluation should not just serve strategy but it should challenge strategy. In some ways it will suggest incremental improvements and in some ways dramatic changes. I would ask, how effectively is the evaluation community doing that? The size of the evaluation community has not grown commensurate with the growth of the program. How can we bring more people and perspectives in?

Russell. I haven’t encountered any objection to the idea that MEP should kick in and grow. But a few years ago there was pressure to grow. Now the expectation is that we need to maintain
what we have. Now competitor programs are emerging, so the quality of the evaluation is an issue. I’m eager to arm us with this type of information.

Second, our discussions haven’t sustained self-criticism. I think the purpose of the program is clear—to build commonwealth on a regional basis, and particularly to improve productivity. Our national survey doesn’t focus on productivity yet. I eagerly await the details behind the NIST MEP plans about high performance centers and high performance firms.

Oldsman. A lot of ideas have been thrown out about what we need to do and what we don’t need to do. I find it useful to frame a set of questions we’d like to answer. We only have a certain set of resources to answer, so I’d like to be really hard-headed about framing questions that are researchable, then think about the sources of information we can use to address these questions. Next year we can come back and say, “here are my answers to these questions.” Right now we are data mining. That’s ok sometimes. But I also think we need to focus on a few questions based on our judgements about where we think we need to make improvements to the program, and use not just surveys, not just case studies, etc. to answer these questions.

Haines. I see issues coming out of this meeting that fall into three areas: policy, center performance, and strategic planning. I believe what we’ll see at the policy level is a call to lay out the questions we want to answer. To revise our evaluation strategy—we’ll be moving more toward the mixed methods approach and hopefully we’ll be able to generalize to avoid asking the same questions of every project to continuously get answers. At the local level, we will try to make it simple. We’ll try to answer questions with a specific study to simplify what local centers have to provide. I do hear what you are saying about the state stakeholder. As it impacts the strategic plan, all stakeholders will be called on to give insights. We all have to design studies that will collect information to better inform the plan. For example, regarding Jack Russell’s assertion that productivity is the aim of the program, we need to have better ways to inform that opinion. I appreciate everybody being here. I appreciate Philip Shapira’s call for new faces at the table. We haven’t expanded the community in the way that we have expanded the infrastructure. I make a commitment that in March I’ll report out on the things that will change.
Appendix
This appendix provides an index to papers presented at the four workshops on the manufacturing modernization held in Atlanta between 1993 and 1997. These papers are collected in the following volumes:


- *Evaluating Industrial Modernization: Methods and Results in the Evaluation of Industrial Modernization Programs*. Philip Shapira and Jan Youtie, editors. School of Public Policy and Economic Development Institute, Georgia Institute of Technology, Atlanta, 1995. [Edited collection of papers from the 1994 workshop.]


- *Manufacturing Modernization: Implications of Evaluation Results for Program Improvement and Policy Development*. Philip Shapira and Jan Youtie, editors. School of Public Policy and Economic Development Institute, Georgia Institute of Technology, Atlanta, 1998. [Edited collection of papers from the 1997 workshop.]

References to the papers in these volumes have been organized by title and author. After each entry, there is a reference which indicates the volume publication year (94, 95, 97 or 98) and the page numbers for the paper.

Electronic copies of all papers can be downloaded via the worldwide web at http://www.cherry.gatech.edu/workshop.
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Customer-Based Extension Center Metrics. David H. Taylor - 94:37-41


Do Manufacturing Extension Programs Matter? Eric Oldsman - 95:18-48


Evaluating Industrial Modernization: Methods, Results, and Insights from the Georgia Manufacturing Extension Alliance. Phillip Shapira and Jan Youtie - 98: 29-46

Evaluating MEC's: Benchmarking With Ourselves. Tab Wilkins - 98: 83-90

Evaluating the Impact of Manufacturing Extension Programs on their Customers:

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Evaluation Approach for the Arkansas Pilot Rural Enterprise Center. David A. Swanson, John Opitz, Clayton Franklin, Sandra Miller, and Floyd Fenix - 95:114-119.


Evaluation of the Iowa Heartland Technology Network. John C. Dugger, Janet D. Sweeney, Christine Sorensen, 95:64-72


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The Importance of Manufacturing Extension - A State Perspective. Susan Rhoades - 97:29-34.


Using Customer-Based Assessment to Evaluate Industrial Extension Programs. Gene R. Simons - 94:49-54
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Gatewood, Elizabeth J. Lessons from the Evaluation of the Small Business Development Center Program - 94:73-78


Mark, Melvin A., Irwin Feller, and Amy Glasmeier. Evaluation of the Appalachian Regional Commission Industrial
Competitiveness Demonstration Projects - 95:144-150.


Martin, Robert J. Western New York MTC uses Evaluative Information for Continuous Improvement – 98: 149-152.


Mendelowitz, Allan. Overview of GAO’s Study of Companies Perspective on Manufacturing Extension Program Services - 95:156-158.


Oldsman, Eric. Assessing the Quality of Services in Industrial Modernization Programs - 94:29-36


Reamer, Andrew D. Institutional Assessment of Technology Programs - 95:122-127.


Rhoades, Susan. The Importance of Manufacturing Extension - A State Perspective - 97:29-34.


Rosenfeld, Stuart A. Evaluating the Impact of Networking and Group Services - 94:68-72


Sabel, Charles F. Discussing Evaluation in a World of Discursive Standards: Assessing the NIST Centers - 95:6-15


Simons, Gene R. Using Customer-Based Assessment to Evaluate Industrial Extension Programs - 94:49-54


Taylor, David H. Customer-Based Extension Center Metrics - 94:37-41


