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

Philip Shapira
and
Jan Youtie

Philip Shapira is Associate Professor in the School of Public Policy at Georgia Institute of Technology. Jan Youtie is a Senior Research Associate at Georgia Tech's Economic Development Institute.

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 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 under-estimate 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

[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 use 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 customers 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 realties 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.

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Table 1. GMEA Project Types by Relative Impact

Project Type	Sales Increase	Capital Spending Increased	Capital Spending Avoided	Inventory Savings	Cost Savings	New jobs Created	Jobs Saved	Mean Customer Time (days)
	Likelihood of an Impact, as Reported by Customers*							
Computers	0.90	1.41	1.12	2.55	1.21	1.02	1.22	1.21
Plant Layout	1.18	1.20	1.57	1.23	1.22	1.34	1.28	0.95
Environmental	0.35	0.86	1.96	0.30	0.78	0.38	0.78	0.57
Human resources	0.80	0.75	0.33	1.29	1.18	1.10	1.54	0.82
Marketing	1.66	0.65	0.43	0.21	0.07	2.20	0.80	0.64
Materials testing	0.65	0.81	0.80	0.26	0.73	0.81	0.50	0.57
Management	1.37	1.15	0.41	2.17	1.10	0.85	2.27	0.76
Process improvement	1.24	1.37	1.21	1.18	1.07	0.96	0.80	1.02
Energy	0.27	1.34	0.19	0.36	1.59	0.34	0.35	0.81
Product development	1.64	0.87	1.24	0.35	0.73	1.18	0.67	1.01
Quality	1.09	0.67	0.65	1.09	1.05	1.07	0.87	1.99

*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.

Source: Georgia Manufacturing Extension Alliance, Customer Evaluation of Service Surveys, February 1, 1994-December 31, 1996, based on 538 surveys.

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

Review	Panel composition	Recommendation
Review of TRP proposal 1994	External agency review	Two Year Funding of GMEA approved
First Year Review 1995	NIST internal staff review	Recommends TRP funding be continued
Second Year/Rollover Review 1996	NIST panel, with external reviewers	Recommends rollover into MEP status. Recommends strengthening of GMEA advisory board
Third Year Review 1997	NIST panel, with external reviewers	Recommends continuation of funding, three additional years. Recommends attention to strategic planning, financial planning