

# **Toward a Cross-Case Analysis of Outcomes of Exemplary Engagements By MEP Centers**

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## **Abstract**

Case studies are among the most common evaluation methods, often used for program promotional efforts rather than as a systematic method for evaluating program processes and outcomes. A pilot project to produce case studies which more systematically adhere to a defined methodology was directed by Robert Yin, President of COSMOS Corporation, and funded by the Manufacturing Extension Partnership at the National Institute of Standards and Technology of the U.S. Department of Commerce. This paper presents a cross-case examination of the 26 case studies produced in this pilot project. The examination focuses on three aspects of the cases: (1) the degree to which the case studies represent “exemplary” high impact engagements, (2) the qualitative impacts of the program on manufacturing customers’ capacity for change, and (3) the addressing of counterfactual, competing or rival explanations for why the high impacts occurred. The results of this cross-case analysis shows that exemplary engagements appear to have significant qualitative and quantitative benefits to the company, growth in business performance, and public benefits linked to MEP center technical assistance. Market conditions and existing business practices appeared to be important, possibly as preconditions to the manufacturers’ seeking out MEP assistance. These findings are limited by validity and reliability concerns.

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## **Introduction**

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

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rigor of quantitative evaluation practices. These “case studies” tend largely to be anecdotal success stories which emphasize the positive aspects of engagements for promotional purposes. (Shapira, et al, 1996).

At the federal level, the Manufacturing Extension Partnership (MEP) of the National Institute of Standards and Technology (NIST), U.S. Department of Commerce has incorporated this qualitative element into its reporting structure. The MEP reporting system requires that its center affiliates prepare and submit periodic qualitative success stories of the best engagements.

MEP sought to improve how these qualitative accounts of successful engagements were 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). In late 1995 and 1996, a systematic, program wide case study methodology developed and directed by Robert Yin, President of COSMOS Corporation, was sponsored by MEP. This more extensive case study effort was 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) The studies would provide descriptions of how specific services are delivered and received (the “wiring”), as well as showing quantitative analyses (of service “inputs” and “outcomes”).

Sixteen MEP centers throughout the country participated in the project. Center and MEP staff--representing such diverse backgrounds as marketing, evaluation research, technical service delivery, and program management--attended a day and a half long training program. Following this training, the attendees prepared 26 case studies which described a broad range of

types of engagements with small and medium-sized manufacturers.

The objective of this paper is to draw on these case studies to conduct a cross-case examination of the impacts of the assistance and services provided by MEP centers. The cross-case analysis is based on an early draft of the 26 case studies produced by COSMOS Corporation in June 1996.<sup>1</sup> It explores similarities and differences among the cases in their reporting of outcomes and impacts. In addition, the paper examines the implications of competing and alternative explanations for these impacts.

## **Overview of the NIST MEP Case Study Approach**

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The core element of the case study project was the implementation of a “logic model” developed by Robert Yin and Eric Oldsman to explain the impacts of manufacturing extension engagements on small and medium-sized manufacturers prior to conducting the cases. (See Figure 1.) The logic model expresses a hypothesized causal chain of events over time. Each step in the chain represents both an outcome of a previous step and a cause of a later step. For example, some condition leads a manufacturer to request and receive technical assistance which may be delivered directly by the center or brokered/referred to a third party private consultant or public organization. Together with initiatives of the manufacturing customer, the technical assistance may affect the capacity of a plant to change, which results in one or more changes in practice. These changes may yield intermediate outcomes related to

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<sup>1</sup>The author’s analysis and conclusions may, in some cases, reflect a subjective categorization of case study narratives. In addition, the conclusions may be limited or erroneous because of use of the draft document, rather than the original case write-ups, as source material.

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improved manufacturing performance which may in turn produce changes in the manufacturer's business performance, and may generate benefits which affect the broader local economy, such as creating new jobs and increasing the tax base (Yin and Oldsman, 1995). The logic model was designed to guide case study investigators in their data collection, enhancing the validity and reliability of their measurements.

Although the case studies profiled projects representing a broad range of service areas and were delivered to customers operating in a variety of industries, the common focus of the case studies was intended to be on "exemplary engagements." Exemplary engagements are ones for which there is a presumed strong link between the technical assistance and services provided by MEP centers and significant quantitative improvements in business performance among manufacturing customers (and possibly benefits to the broader economy). The focus on exemplary engagements not only fulfilled the need to provide further information for program justification, but was also likely to illustrate a clear link between the intervention and the outcome, facilitating case study investigation. On the other hand, the quantitative outcomes and impacts of these engagements had to be known prior to their nomination and selection as exemplary case studies. The need for *a priori* knowledge of high quantitative impacts meant that the bulk of the engagements were judged to be "successful" by the centers nominating them, although there was the possibility that some of the engagements might not have produced significant quantitative outcomes because of incomplete customer information.

Given that this case study effort particularly focuses on engagements with successful outcomes, this cross-case analysis focuses on three elements of the outcomes described in the case studies: (1) whether or not these case studies do in fact report high quantitative outcomes and impacts, (2) the qualitative impacts of the program on the

manufacturing customer's capacity for change, and (3) the addressing of counterfactual, competing or rival explanations for why the potentially large impacts occurred.

## Summary of Quantitative Outcomes<sup>2</sup>

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The logic model developed by Robert Yin and Eric Oldsman defines four types of intermediate and later outcomes from the engagement:

- changed manufacturing performance (e.g., scrap rates, percent on-time delivery, productivity),
- changed benefits to the firm (e.g., cost savings, inventory turns, customer reject rates),
- changed business performance (e.g., increase in sales, profitability), and
- changed public benefits (e.g., jobs created or saved).

Table 1 summarizes the results of the cross-case analysis on the latter three types of outcomes. One striking finding is that there was a very high rate of reporting new jobs created, increases in annual sales, and cost savings. At least half of the cases reported impacts in these outcome categories. A few of the cases also suggested that there might be "spillover" benefits beyond those directly affecting the manufacturer being served. In two of the cases reporting job increases, the new jobs described were specifically for vendors or subcontractors rather than the company directly served, which shows that benefits can flow beyond the firm directly assisted to others in the region.

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<sup>2</sup>The numbers presented in this paper are intended to be for descriptive purposes only. Inferences about the general population of MEP manufacturing customers are not applicable.

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The actual quantitative gross benefits reported in the cases were quite high as well. For example, all but one of the cases reporting year one sales numbers referred to amounts over \$100,000. Moreover, these outcome data compare favorably to other outcome information reported in surveys conducted by NIST MEP. For example, MEP center surveys of 610 manufacturers conducted in 1994 yielded benefits per company that are less than half the size of those experienced by the case study subject companies.<sup>3</sup> These case studies overall do appear to be exemplary based on quantitative outcomes.

If one works backwards from these later outcomes, one can see the types of intermediate performance benefits which may have produced these large gross quantitative benefits. Because of the variability in the types of projects profiled, there was substantial variability among the cases in the types of manufacturing performance benefits mentioned. (See Table 3.) The most frequently mentioned manufacturing performance-related improvements were increased productivity and lead time/order time reductions. Scrap and rework rate reductions were also referred to in a notable number of cases.

### **Impact on Manufacturers' Capacity to Change**

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Prior to experiencing these quantitative benefits, it is possible that MEP assistance had a qualitative impact on the manufacturers' capacity to make changes in operational and business practices. This

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<sup>3</sup> See <http://www.mep.nist.gov/about/makediff.html>. Benefits per company anticipated by the 610 firms responding to MEP center surveys in 1994 included 5.5 jobs added or saved, \$43,000 savings in labor and material costs, and an increase of almost \$370,000 in sales.

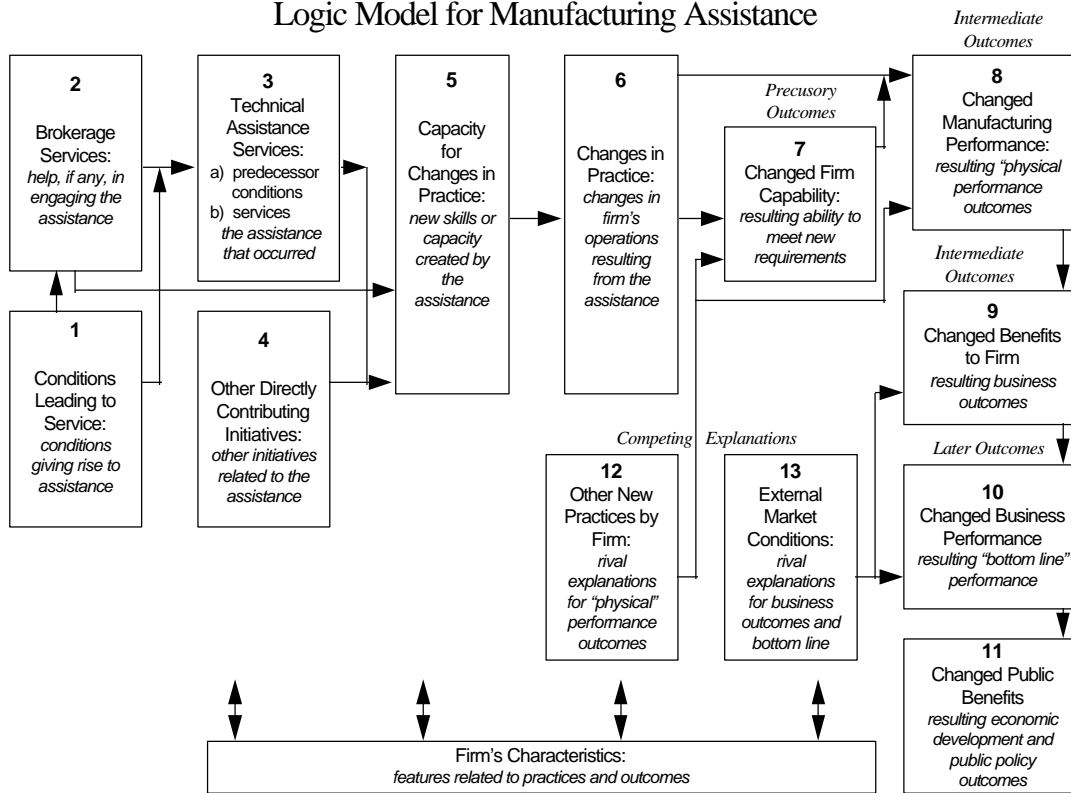
analysis examined references in the case studies to such qualitative impacts, including references to cost savings, time savings, and addressing of information deficits. (See Table 4.) In several cases, MEP center-delivered assistance led customers to take action by overcoming a price barrier, thereby bringing expensive solutions within small and medium-sized manufacturers' range of affordability. In several cases, manufacturing customers were already making changes in their practices, and MEP center assistance appeared to have accelerated changes that otherwise would have taken significantly longer to make. A few of the cases referred to critical information provided by the MEP center which the manufacturing customers themselves had not procured even after conducting extensive searches of their own. Significantly, three case studies mentioned that the manufacturing customers would probably have done nothing to change practices without assistance from the MEP.

### **Rival Hypotheses**

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Much evaluative information shows a link between the intervention and the outcome without considering factors besides the intervention that also could have produced or contributed to the outcome. One of the strengths of the Yin-Oldsman logic model is that it forces the case study investigator to explore possible alternative or competing explanations for the outcome, besides the engagement. The use of rival hypotheses is analogous to statistical models which control for industry and size of firm, or experiments which match firms based on these and other characteristics. (Campbell, 1989.)

Figure 1  
**Logic Model for Manufacturing Assistance**



Reproduced from: Robert K. Yin and Eric Oldsman, "Logic Model for Evaluating Changes in Manufacturing Firms," draft prepared for the National Institute of Standards and Technology, November 1995, p. 3.

**Table 1**  
**Outcome Measures Reported in Case Studies**

<b>Outcome Measure</b>	<b># of Cases Reporting Measure</b>
<b>Changed Benefits to Firm</b>	
Cost savings	15
Customer reject rate reductions	6
Reduced time to market	2
Increased inventory turnover	1
Increased market share	1
Reduced defense dependency	1
<b>Changed Business Performance</b>	
Annual sales	15
Profitability	3
Survival	3
<b>Public Benefits</b>	
Jobs created	13
Retained jobs	3
Increased wage rates	3
Subcontractor/vendor jobs increased or saved	2
Import reduction/substitution	2
Increased export sales	1

**Table 2**  
**Quantitative Benefits Reported in Cases for Year 1**

Case	Annual Year 1 Cost Savings	Cost Savings/ employee	Annual Year 1 Sales Increases	Sales Increase/ employee	New Jobs
1	800,000	16,000	8,000,000	160,000	16
2					23
3	9,000	643	34,000	2,429	
4			340,000	2,698	
5			1,500,000	30,000	
6	40,000	145			
7			500,000	250,000	13
8					
9					
10	40,000	667	200,000	3,333	6
11	500,000	2,500	625,000	3,125	21
12			500,000	23,810	
13	250,000	833			
14	18,000	327	250,000	4,545	5
15	150,000	1,000			60
16	30,000	357			7
17			100,000	2,500	5
18			600,000	4,444	10
19	700,000	2,333			
20	120,000	960			
21			1,000,000	31,250	10
22			770,000	2,169	90
23	116,750	1,358	1,250,000	14,535	20
24	448,000	14,000			
25	800,000	7,273			
26	2,270,000	7,567	400,000	1,333	
Total impact	6,291,750	55,963	16,069,000	536,172	286
Average impact	419,450	3,731	1,071,267	35,745	22
Average impact (over all cases)	241,990	2,152	618,038	20,622	11
Median impact	150,000	1,000	500,000	4,444	13
Number cases with impact	15	15	15	15	13

**Table 3**  
**Intermediate Manufacturing Performance Benefits Reported in Case Studies**

Manufacturing Performance Benefits	# of Cases Reporting Measure
Increased productivity	8
Lead time/order time reductions	8
Scrap/rework rate reductions	6
Inventory reductions	3
Capacity utilization	3
Increased on-time delivery/reduction in late shipping rates	3
Quality improvement/reduced customer complaints	2
Decreased work in progress	2
Set up time reduction	1
Reduced downtime	1
Decreased VOC emissions	1
Decreased material handling time	1
Improved housekeeping	1

**Table 4**  
**Qualitative Benefits from MEP Assistance Mentioned in Case Studies**

Benefits	# of Cases Referring to Benefit
MEP center solution was less expensive than addressing problems through other means	9
MEP center assistance saved the manufacturer time	8
MEP center provided information of which the manufacturer was unaware	3
Manufacturer would have done nothing without MEP	3
MEP center was an unbiased source	1
Number of cases reporting qualitative benefits	13

The logic model defined two types of rival or competing explanations. New firm practices unrelated to the technical assistance may have led to the reported positive outcomes. External market conditions, such as high industry growth rates, might also have produced the reported positive outcomes.

<sup>4</sup>Yin and Oldsman, 1995, 7-8.

Nearly all of the 26 case studies referred to external market conditions. (See Table 5.) The most frequently mentioned market condition was increased competition, reported in half of the cases. A substantial number of cases also mentioned that the manufacturing customer's industry was stable or declining. This high rate of references to external market conditions underscores their importance.

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The cross-case analysis further examined references to external market conditions to investigate the extent to which there was a link between, for example, rapid industry growth and reports of large sales increases. Rapid market growth was reported in only four of the 26 case studies. And only one of these cases also referenced a positive sales increase following an MEP engagement. In this case, the narrative noted that although the industry was rapidly growing, it was also becoming more competitive because of technological advances.<sup>5</sup> On the other hand, five of the eight manufacturing customers serving declining or stable markets reported sales increases following an MEP engagement. (See Table 6.) Thus, although external market conditions are important in an MEP engagement, it appears that their importance may not be to play a significant role in intermediating the sales increase outcomes of MEP engagements. Rather their role may be better thought of as that of an important precondition to a manufacturer's requesting MEP assistance in the first place.

Other firm practices can be thought of as changes causally related to beneficial outcomes which the manufacturer implemented prior, or at the same time but unrelated, to the MEP center-delivered technical assistance. (See Table 7.) These factors less frequently appeared in the case study reports than did external marketing conditions. Only 16 of the 26 cases referred to other firm practices. References to other firm practices did not coalesce around any particular type of practice across the cases. As such, it is difficult to link these practices to the reported outcomes.

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<sup>5</sup>See Tab Wilkins, Conservation Alliance, Inc., Southbury, Connecticut in COSMOS Corporation, "A Day in the Life of the Manufacturing Extension Partnership: Case Studies of Exemplary Engagements with Clients by MEP Centers (draft)," National Institute of Standards and Technology, Manufacturing Extension Partnership, June 6, 1996.

There was a notable segment of cases in which manufacturing customers had adopted practices which, along with MEP assistance, led to positive outcomes. Cross-case analysis indicated that in four of the five cases in which the manufacturing customers had existing quality commitments, and in three of the four cases in which customers had made capital investments or process improvements, cost savings were also reported.

This finding suggests that firms most successful in taking action following MEP assistance may have plan to take or are taking some modernization-related initiatives (e.g., quality commitments, capital investments, process improvements). Although these firms may not have been able to take action and achieve benefits without MEP assistance, there may be a degree of "self-selection" in terms of firms having instituted modernization-related initiatives. More systematic efforts at documenting other firm practices may help better measure and disentangle the effects of other firm practices on the link between MEP technical assistance and manufacturing customer outcomes.

One issue lies in the extent to which the investigator can objectively and rigorously search for rival explanations for manufacturing customer outcomes. There may have been more emphasis on finding positive impacts than on substantiating the logic model and exploring competing explanations. Many of the case study investigators were representatives of the centers from which the technical assistance was provided, or from the national MEP program. It is possible that case study investigators had more of an interest in documenting positive impacts than in ruling out rival hypotheses (Cummings, 1996).

## **Discussion**

The MEP case study program sought to focus on evaluation issues which cannot be easily measured through quantitative methods as well as to highlight, both to other programs and to sponsors, the steps through which good results are achieved. The results of this cross-case analysis shows that exemplary engagements have significant qualitative and quantitative benefits to the company, growth in business performance, and public benefits linked to MEP centers technical assistance. Market conditions and existing business practices were important, possibly as preconditions to the

manufacturers' seeking out MEP assistance. The rival hypothesis analysis suggested that there were few cases in which there was a link between, for example, rapid industry growth and reports of large sales increases.

Generalizations based on these case studies are tenuous because the cases vary widely in their adherence to the logic model and approach presented in the training program. The logic model implies a degree of rigor similar to quantitative analyses with comparison groups or statistical controls, but applying a different technique. The ability to conduct a case study in such a rigorous manner depends on the skills of the investigator. It is not clear that the cases were conducted by investigators of equal skill levels.

**Table 5**  
**External Market Conditions Reported in Case Studies**

External Market Conditions	# of Cases Reporting
Increased/fierce/global competition	13
Slow growth/static/declining market	8
Rapid market/industry growth	4
Increase cost pressures/price a competitive factor	3
Quality a competitive factor	2
Suppliers (went out of business, limited production)	2
Off-shore manufacturing encouraged	2
Number of cases reporting	22

**Table 6**  
**External Market Conditions Reported in Case Studies**  
**Which Also Reported Sales Increases**

External Market Conditions	# of Cases
Increased/fierce/global competition	5
Slow growth/static/declining market	4
Rapid market/industry growth and increased/fierce/global competition	1
Slow growth/static/declining market and increased/fierce/global competition	1
No market condition reported	2

**Table 7**  
**Other Firm Practices Reported in Case Studies**

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Other Firm Practices	# of Cases Reporting
Existing quality commitment	5
Existing marketing/defense conversion efforts	4
Company capital investment/ automation/process improvement (e.g., new plant layout) efforts	4
Management changes	3
Product development initiatives	2
Low employee turnover	2
Outside private sector assistance	2
Increased skill training	1
<b>Number of cases reporting other firm practices</b>	<b>16</b>

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In addition, validity and reliability issues which plague most case studies appeared here. For example, “increased competition” and “quality organization” were phrases mentioned in several of the cases and could be perceived as rival explanations for the reported outcomes. Yet it is difficult to know whether these phrases were included as “writing artifacts” or whether they reflected real, valid attributes. Perhaps the inclusion of other types of information (e.g., market statistics) would have helped to strengthen the validity of these phrases. Furthermore, the lack of correspondence among these cases suggests that cross-case conclusions may be unreliable. These concerns should be addressed before the methodology is applied to other aspects of MEP assistance to promote understanding about outcomes resulting from MEP center services, to learn about best practices in service delivery, and to redress failures.

## References

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## Rival Hypotheses: Discussion

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**Oldsman.** Although we can pick this stuff apart, let's remember that we're trying to present econometric results where data is not very good. I want to re-emphasize that we should look at evidence from a variety of sources to support a position. Given the data and as rigorous approach as possible, that's the best we can do.

**Shapira.** In the Census study, could you take a subset of firms and see where in the distribution MEP-served establishments were before receiving service and where they were afterwards?

**Jarmin.** I'm controlling for the selection of the good guys. It would be interesting to go within the clients' distribution and see if we are moving people within the distribution.

**Swamidass.** When do MEP interactions start?

**Jarmin.** I can't say whether these clients had an engagement in 1992.

**Swamidass.** How long does the MEP have an effect on the firm?

**Oldsman.** That gets to the issue of persistence. It's possible that some of the impacts from 1992-1994 persist into 1995.

**Jarmin.** I'd like to look at that, but I don't have the data yet. Payroll data is not useful for looking at productivity issues. A lot of these companies were successful downsizers.

**Luria.** How hard would be to re-run regressions for those instances in which service had to be completed by 1991?

**Bury.** I worry about the lack of random nature of the sample, and the use of the Performance Benchmarking Service database which is also nonrandom.

**Oldsman.** You don't want a random sample. You want to find somebody who is exactly like the client except not served.

**Haines.** How well was this analysis of the New York MEP received?

**Oldsman.** Initially, the key administrator in New York state government was not a believer. But at the end of the day he said, "You took your best shot, the weight of the evidence says that this program is having an impact. I'm not sure about the number, but I believe that it is having an impact on the economy of New York and the standard of living." But the report was not what it's about. At the end of the day it was about sitting down over a period of time and working through discussions with people. The numbers became a prop to talk about what people really want to talk about.

**Bury.** I want to commend Eric Oldsman on the evaluation of the New York MEP. This evaluation was kind of shoved down the throats of the New York MEP staff, and now they've gotten used to evaluation as a normal part of their operation. At first, they felt threatened and vulnerable, and evaluation wasn't built into their daily lives. Now it is.

**Oldsman.** This is a state in which people didn't think much of their program, but they have spent more on evaluation than any other state. Management says evaluation is important, and it's written into the legislation. Management, for all its issues, is actually committed to this stuff. There was our cost, but also the cost of the field staff. They made that commitment.

**Feller.** New York has been distinctive in funding evaluation. New York and Kansas are the only states that have committed themselves to this. What is the politics of the state science and technology community which makes it willing to support this kind of evaluation? Why has it hit these few states and not the others?

**Carlisle.** I'm impressed by the study and New York's commitment to do this. In North Carolina, there has not been a consistent commitment to evaluation. If some agencies had done this kind of evaluation, it would have given the legislation more information and maybe they might not have lost funding. Another thing that helps

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encourage this type of evaluation is an external shock, a change in administration.

**Rhoades.** It is evolutionary too. We haven't had a long history with the MEP program. We have brought experts in to look at our programs in other areas. We've relied on university sources. Some people find outsiders more credible and some find them less because they don't understand the state. But evaluation is becoming more and more a part of the discussion.

**Luria.** I want to get Rick Carlisle to react to that. If you were told that the control group was at a minimum four years out of date, which is the case with the Census data, how would you react to that?

**Oldsman.** We were also able to compare intermediate outcomes with Performance Benchmarking that you couldn't do with Census, and Census has data that the Performance Benchmarking data base doesn't have.

**Carlisle.** I think the questions that New York asked were probably pretty similar to what we would have asked. I don't care just about the customers I also want to know how this effects citizens.

**Oldsman.** This gets to the issue of how to frame the evaluation. Here, there was a clear client. We had to satisfy one guy. We had a lot of meetings along the way with center managers, NIST, economic developers, etc. By the time we presented the results, people were happy. People were brought on board. I'm a little unhappy with not having the legislative branch on board. Maybe that's the state administrative agency's job to do that. But my guess is that there is a disconnect.

**Swamidass.** If you make generalizable hypotheses out of case studies, it is an advantage. I'd like to see the case studies and quantitative comparison group models combined. The latter model has value to the client, but I believe that no model is perfect. I also wonder that in taking the top 10 percent of customers (the high

performers), if you are defining an a priori variable.

**Jarmin.** Is there a relationship between predicted high impact cases and actual impacts.

**Oldsman.** We ran correlations and found that the two were reasonably well correlated.

**Ellington.** I'm more interested in the cases.

**Jarmin.** You should look at the unsuccessful cases too.

**Feller.** There is great value in using case studies. But it is hard to discriminate between rival hypotheses. Competitive market conditions are considered important, but all are not well specified. Is it rising markets or falling markets? Both are mentioned. The rival hypotheses still have to be theoretically grounded. And you don't have power to statistically differentiate between competing hypotheses.

**Jarmin.** Cases should be used when you don't know the variables to specify a quantitative model.

**Oldsman.** In a case study, you want to use rigor. It's the same logic using different techniques. But what about generalizability? What do we learn? The case study relies on the skills of the investigator. Can we trust them?

**Gray.** I agree. But the case study has helped me understand the program. That gets past the black box.

**Youtie.** Dr. Yin likes to focus on exemplary cases where things are easier to understand.

**Feller.** But there are also exemplary failures and many ways to reach success. Was the failure because of the program or problems in the market?

**Buress.** We are using unemployment insurance data for our control group. The advantage is that it is available more quickly. The disadvantage is that it has limited data: employment, payroll, SIC. But we find similar results to what has been presented in these studies.