COOPERATION AND COLLABORATION IN ECONOMIC DEVELOPMENT: A CASE STUDY OF MASSACHUSETTS MANUFACTURING CENTERS

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ABSTRACT

The economic rationale of cooperation and collaboration as strategic practices for companies to improve their competitiveness in today's competitive economy is examined. Based on that discussion, I conduct a case study of the Massachusetts Manufacturing Partnership (MMP) program, a center of the NIST Manufacturing Extension Program (MEP) in Massachusetts, as a public sector effort to promote cooperation and collaboration between small and medium-sized manufacturing firms and resources, i.e., universities, consultants, etc.

The case study illustrates that small and medium-sized manufacturing firms have difficulties to cooperate and collaborate with resources, because of the lack of internal resources, awareness to the changes in the market and/or technology, and the information about the resources. The MMP is supposed to provide incentives, such as financial subsidies to projects, broad services including the initial diagnosis and problem identification, and the information and networks with resources, so as to remove these barriers and facilitate the cooperation and collaboration.

Yet, the achievements of the MMP to date are limited and ambiguous. On the one hand, the MMP has difficulties in reaching companies in some of the industries and small companies. Moreover, the MMP may not be appropriate in such areas as product design and development, although these areas are critical in today's competition. On the other hand, the economic impacts on the company's profits to date are generally positive, although the data are limited. In addition, qualitative data indicate the MMP's role as infrastructure to remove the barriers for firms to cooperate and collaborate with resources.

Finally, I discuss the policy implications for the MMP.

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Finally, I would like to dedicate this thesis to my family: my wife, Kyoko, and our collaborative work, Hinako.

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LIST OF ABBREVIATIONS

BSMN: Bay State Manufacturing Networks
BSSC: Bay State Skills Corporation
CAD: Computer-Aided Design
CAE: Computer-Aided Engineering
CAM: Computer-Aided Manufacturing
CBWL: Corporation for Business, Work, and Learning
CMMP: Central Massachusetts Manufacturing Partnership
DED: Department of Economic Development
EDI: Electronic Data Interchange
EOEA: Massachusetts Executive Office of Economic Affairs
GBMP: Greater Boston Manufacturing Partnership
ISO: International Standard Organization
LAN: Local Area Network
LQ: Location Quotient
MEP: Manufacturing Extension Program
MMP: Massachusetts Manufacturing Partnership
MPWA: Manufacturing Partnership of Western Massachusetts
MVMP: Merrimack Valley Manufacturing Partnership
NESI: New England Suppliers Institute
NIST: National Institute of Standards and Technology
SIC: Standard Industrial Classification
SMMP: Southern Massachusetts Manufacturing Partnership

Chapter 1

INTRODUCTION

As economic activities become globalized, regions or urban areas become very important as an unit of economic activities. Some regions show much higher economic performance than that of the nation, while others do not. Such successful regions include the so-called "Third Italy," "Second Denmark," and Baden-Wurttemberg in Europe and Silicon Valley in the United States, for example (Sabel, 1989, pp. 22-23). Therefore, it is increasingly critical for regional policy makers, planners, and private business to learn how a successful regional socioeconomic system operates.

Although private firms are primarily responsible for the economic performance in the region, the public sector has to play an important role in the competitive regional socioeconomic system. However, there are a number of different theories and practices with respect to the role of the public sector. Public-sector policies include education and job training, infrastructure improvement and maintenance, development finance and intervention into the capital markets, tax policy, regulatory issues, industrial policies, and so on.

In addition to these roles, a number of researchers (Polenske, 1996; Kantor, 1995; Saxenian, 1994; Lorenz, 1992; Best, 1990) indicate that cooperation and collaboration are essential components of the new competitive environment. In

other words, cooperation and collaboration are necessary, more or less, for the improvement of competitiveness and business performance in today's economy. The public sector may play an important role as a catalyst and promoter of collective activities among firms and between firms and the public sector.

The Manufacturing Extension Program (MEP) is one such effort by the public sector to promote cooperation and collaboration in the United States. MEP is one of the four major programs of the National Institute of Standards and Technology (NIST), U.S. Department of Commerce. This program is a nationwide network of nonprofit organizations and related services to provide expertise, information, and other management and technical support to small and medium-size firms, which are defined as the firms with fewer than five hundred employees. According to the home page of NIST on the World Wide Web, more than one hundred offices have been established in all of the states in the United States and Puerto Rico, as of November 1996.

The purpose of this research is to examine and evaluate the role of the public sector in regional economic development as a catalyst or promoter of cooperation and collaboration among firms and between firms and the public sector.

I conduct case studies of the NIST Manufacturing Extension Partnership in Massachusetts, namely, Massachusetts Manufacturing Partnership (MMP). MMP was established in 1994

as an affiliate of NIST and funded by NIST and the Commonwealth of Massachusetts. At present, MMP has five offices in Massachusetts and has done more than six hundred company projects, according to their home page on the World Wide Web.

I answer the following questions by this research.

First, what is the economic rationale of cooperation and collaboration in today's economic environment and what is the justification of this particular intervention by the public sector?

Second, what kinds of cooperation and collaboration with what kinds of partners do Massachusetts firms need and why?

Third, what are the prerequisites in the region for the success of the program?

Fourth, what are the economic impacts and effectiveness of the programs from the viewpoint of firms and the local economy?

Fifth, what are the constraints of the program?

Finally, what lessons can we learn from the MMP experience in Massachusetts that is applicable to other activities in the state and in other states?

Based on these questions, the research outline is as follows. Chapter 2 examines the economic rationale of cooperation and collaboration and further discusses the history, rationale, and model of the NIST Manufacturing Extension Program.

Chapter 3 focuses on the recent trends of Massachusetts manufacturing and Massachusetts Manufacturing Partnership (MMP) and analyzes the organization, programs, and services of MMP.

Chapter 4 discusses the profile of client companies and projects, and economic impacts and performances of MMP, based on the actual performance data and survey results by MMP.

Finally, Chapter 5 concludes with an examination of the effectiveness and constraints of the program. Then, the general policy implications are discussed.

Chapter 2

COOPERATION AND COLLABORATION IN ECONOMIC DEVELOPMENT POLICY

2.1. Rationale of Cooperation and Collaboration as a Regional Economic Policy

In this section, I will discuss the background and theory of cooperation and collaboration from the viewpoint of industrial and regional restructuring. Then, I will examine the economic rationale of public intervention to these fundamentally competitive behaviors of private firms.

2.1.1. Background and Theory of Cooperation and Collaboration

There are a variety of thoughts and categories in the economic development policy at a regional level in the United States. Such categories include tax policy, business regulation policy, infrastructure maintenance and improvement, education/job training, capital market intervention. The policy goal tends to be attracting new businesses or retaining current businesses, which is, in essence, a zero-sum game among regions.

As Aoyama (1996, p. 5) points out, with respect to the small business policy of the federal level, there had been few active public-policy interventions in the market at the federal level until the 1980s. One exception is the antitrust regulations in the case of the market failure, because of the American tradition of the belief in free

competition. Thus, small business policies have been mainly conducted at a regional/local level.

Compared to these traditional economic development policies, promotion of cooperation and collaboration within a region or an area is a relatively new policy, which recently has gained broad acceptance from the national and regional level practitioners and academics (National Council for Urban Economic Development, 1995, p. 56). It is essentially because, as a number of researchers indicate, some regions, such as Silicon Valley in the United States, showed superb economic performances, while others do not, and networking of firms based on cooperation and collaboration[1] become essential in these successful regions and rational modes of firms' behavior, along with competitive behavior in the new competitive environment (e.g., Polenske, Forthcoming, p. 1). Thus, it is vital to review the new competitive environment based on the literature first, so as to understand these two modes of firms' networking behavior.

In the mid-1980s, researchers began to study industrial restructuring from the mass production system, which had been the principle of most industrial development up to that time.

Piore and Sabel (1984, pp. 165-193) focused on the issue of industrial restructuring, calling it "the second industrial divide." They argued that the mass production system, which emerged as a first industrial divide in the nineteenth century, is now facing its own "structural limits, in which one institutional block to expansion (the saturation

of mass markets) was reinforced by other blocks (changes in taste, raw materials shortages)." The alternative system is the "flexible specialization." They describe the flexible specialization as follows (Piore and Sabel, 1984, p. 17).

> Flexible specialization is a strategy of permanent innovation: accommodation to ceaseless change, rather than an effort to control it. This strategy is based on flexible--multi-use--equipment; skilled workers; and the creation, through politics, of an industrial community that restricts the forms of competition to those favoring innovation.

Likewise, Michael H. Best (1990, p. 2) argued that a "New Competition" is emerging, based upon "different production and organizational concepts." He agrees with Piore and Sabel on the limitation of the mass production system and the emergence of a more flexible manufacturing system, though he criticized them by saying that "flexible specialization is not the single alternative to mass production" and distinguishes the "Japanese Model" as the other alternative model.

Despite a number of differences, however, there seems to be an essential consensus among restructuring researchers regarding the distinct characteristics of the new competitive environment (see Polenske, pp. 3-6).

First, competition today focuses more on the innovation and continuous improvement and upgrade in the new competitive environment, whereas in the mass production system, competition focused more on the price differential, based on the economy of scale. In the new competitive environment,

the role of entrepreneurial firms is expected to increase significantly.

Second, the risk and uncertainty of the market and technology increases significantly in the new competitive environment. Therefore, flexibility in terms of organizational structure, business strategy, capital investment, etc. becomes essential in order to adjust to an unexpected change in the market and/or technology. In addition, firms have to be able to accommodate quickly to the changes in the market and/or technology.

In this new competitive environment, firms would use cooperation and collaboration as strategic practices for improving their competitiveness. Researchers explain this with the following economic reasons (see Polenske, 1996, p. 7).[2]

First, firms could keep/increase the capacity of continuous improvement of technology and/or product and innovativeness through the cooperative and/or collaborative arrangement (Saxenian, 1994). For instance, cooperation and collaboration with other businesses, universities/colleges, or research institutions could reduce the cost and time of getting new market and/or technology information, or even the cost of research and development activities. These practices could also help firms' employees keep learning the new skills and information critical for the competitiveness, through the cooperative provision of training services with other businesses and/or higher educational institutions.

Second, cooperation and collaboration (especially collaboration) with other businesses could decrease the uncertainty of the market for each firm. Although cooperation and collaboration are not fixed arrangements between firms or firms and other agencies, they also could provide a relatively stable business relationship for a while to each firm. Therefore, compared to the pure market arrangement, firms could avoid the short-term business risk as well as business transaction costs inherent in the market arrangement, by entering into a cooperative or collaborative relationship with other firms.

Third, the cooperative or collaborative operations by private businesses may have a considerable cost-savings effect to each participating firm through economies of scale (Sabel, 1992).

Finally, there may be an effect of improving the ability of differentiation, by being able to provide a wider variety of services by cooperative or collaborative arrangement (Porter, 1980).

From these aspects, consolidation/merger of companies for the purpose of internalizing all of the inter-firm transactions may be a strategic alternative to cooperation and collaboration. However, one problem with consolidation/merger is that firms are likely to lose their flexibility entirely by committing to the other firm(s). In contrast, cooperation and collaboration are very flexible relationships. For instance, changing partners in certain

areas of business is much easier in cooperative or even collaborative relationships than the case of consolidation. Firms can achieve the benefit without paying the cost of consolidation, to some extent. In that sense, cooperation and collaboration among firms may be established with a very subtle balance of strategic decisions of firms.

Thus far, I do not distinguish the usage of cooperation and collaboration. As I discussed in the previous section, the critical difference between these modes of collective activity is that collaboration means the direct participation/commitment in the major process of business activities, such as design, production, and/or marketing of a product (process), whereas cooperation does not mean it. However, in actuality, these differences may be ambiguous. In addition, each mode has a very broad variety in it. The major differences and generic characteristics of cooperation and collaboration can be summarized in Table 2.1.

Although the above discussion is focused on a company- or micro-level so far, this behavior may lead to a number of distinct regional industrial structures at the macro-level. In other words, those regions that build these types of regional industrial structure are likely to succeed in today's competition by being able continuously to improve and adjust to new technologies and market environments. In the new competitive environment that I briefly reviewed above, there are at least three successful types of industrial

Table 2.1: Differences between Cooperation and Collaboration

	Collaboration	Cooperation
Definition	Direct participation in design, production, and/or marketing of a product (process).	Sharing information, support training, and so on, but not working together.
Arrangement	Internal arrangement.	External arrangement, similar to public goods.
Participant	Closed.	Open/closed.
	Private firms and/or universities, research institutions, etc.	Private firms and/or public institutions, universities, research institutions, etc.
Economic rationale	Move to lower position on the average cost curve.	Change (lower) the average cost curve.
	Quicken the adjustment to new market/ technology.	Quicken the adjustment to new market/ technology.
	Reduce (spread) the risk to a greater extent than cooperation during periods of economic downturn among the participants.	Reduce (spread) the risk during periods of economic downturn among the participants.
	Increase product/service differentiation.	
Risk	Committing to relatively inflexible relationship.	
Examples	Joint ventures.	Sharing/exchanging information about R&D, engineering, and marketing problems, etc.
	Joint product development, research.	
	Long-term subcontract relationship.	Collectively support the training programs, research institutions, and other common resources.
	Joint marketing arrangement.	
	Setting up public/private corporation.	
	Joint problem solving by customers and suppliers.	

Source: Adapted by the author from Polenske (1997)

organization, according to Polenske (1997, pp. 16-29): (1) Italian model of small- and medium-sized firms networking and cooperating in particular regions, (2) Japanese model of collaboration among small firms and a large firm, (3) Global model of multinational corporation. Each type has its own combination of cooperation and collaboration relationship among firms.

Likewise, from the aspect of spatial agglomeration, Markusen (1996, pp. 293-313) identified four types of the industrial spatial types: "Marshallian NID (new industrial district) with its recent Italianate variety," "the hub-and-spoke district," "the satellite industrial platform district", and "the state-centered district." As she points out (1996, p. 308), many large industrial areas usually have, more or less, elements of all of these four (including Italian model) types.

A management strategist Michael E. Porter (1991, pp. 36-39) also argues that "what determines prosperity today is the potential of a region's industries and economy to upgrade constantly."[3] He argues, however, about competitive regions in a different manner. His theory is that four critical factors determine competitive advantage of regions, which are: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry. Although he put emphasis on the importance of competition and does not touch on the concepts of cooperation and collaboration explicitly, he also maintains the

importance of "fluid movement of information, skilled labor" and so on, all of which are chief reasons why firms seek cooperation or collaboration to enhance competitive behavior.

Among all of these models, the Italian model is one of the most important types from the perspective of cooperation and collaboration. It is called the "Italian Model," because the proto-type of this model has been researched extensively in Italy: however, there are also examples in the United States, such as Silicon Valley (Saxenian, 1994). As Sabel says (1989, p. 22), this model is "perhaps the most dramatic response to the continuing instability of international markets."

The Italian model is an industrial district comprised of small and innovative firms with flexible equipment, which enter into cooperative relationships to obtain access to credit, training, etc. Most of these industrial districts have a single dominant industry, in which firms compete and cooperate. As some analysts (Harrison, 1992; Markusen, 1996) point out, one of the key components of an Italian model industrial district is a "trade association" or "co-operative association." It usually provides firms with technical, training, marketing, and even financial assistance, and functions as the infrastructure for the cooperative activities.

Table 2.2: Major Characteristics of Italian Model Industrial District

General	Mostly dominated by a single industry. Small and medium-sized firms. Low level of scale economies. Strong regional identity.
Networks	Substantial trade within the district. High degree of cooperation and limited collaboration among firms. Availability of specialized business, financial, technical service firms. Strong "trade association" or "co-operative association" which provides firms with technical, marketing, management, and financial assistance.
Role of Government	Strong regulation and promotion of the dominate industry by local government.

Source: Adapted by author from Polenske (1997), Harrison (1992), and Markusen (1996)

2.1.2. Evolution of Cooperation and Collaboration and Role of Public Sector

Concerning the conditions for establishing these two modes of firms' relationship, a number of researchers indicate that "trust" is critical (e.g., Polenske, 1997; Harrison, 1992; Lorenz, 1992; Sabel, 1992; Saxenian, 1994). Some analysts argue that "spatial/cultural/organizational proximity" are critical (Gertler, 1995). Likewise, Porter (1980) argues that firms' sharing and understanding strategic

goals and perspectives are essential for the cooperative outcome among firms, from the perspective of a company's corporate strategy. He also argues that the continuing interactions would establish the "trust (the belief that competitors are not out to bankrupt each other)." Despite the differences among these arguments, all the analysts seem to propose an essentially similar idea: namely, the reciprocal understandability/predictability of strategic decisions based on sharing the same culture, goals, and perspective is the foundation of cooperative (or collaborative) arrangements among firms. They also contend that this relationship could be enhanced by continuing interaction, which is more likely to occur in geographical proximity (Harrison, 1992).

Although this argument seems fairly legitimate, in general, several important issues may be raised for the actual application toward the regional economic policy making process.

First, the actual modes of these relationships and the evolution process may differ, depending on a unique context of each region and/or industry, such as regional industrial structure, history, economic condition, organizational context, business culture, and so on. For instance, the single dominant industry-led regional economy structure of most of the Italian model industrial districts may make firms' interaction more often, more intense and easier than regions with a more diverse industrial base. As a result,

cooperation is more likely to take place in the regions with a single-dominant industry. Therefore, the modes of cooperation and collaboration in the diverse-industries regions, such as Massachusetts, may be different from those of the Italian model. Thus, it is desirable to understand how modes and the processes of cooperation and collaboration are formulated in a particular context.

Second, it is not clear if the public sector can facilitate these inter-firm relationships, which is essentially the collective result of strategic decisions of private companies. If it can, the next question is how the public sector or non-profit sector can actually facilitate these relationship. One of the strategies for public sectors is, as Best (1990, pp. 17-18) argues, "sector institutions" that facilitate various cooperative arrangements among firms.[4] One of the actual models of this idea may be the "trade association" or "co-operative association" of the Italian model I mentioned above, although they are not the public-sector entities.

As I discuss later, regional centers of MEP are expected to play a role for this type of organization. The effectiveness of this type of organization will be closely examined in the rest of this study, through the close examination of the case at Massachusetts.

2.2. History, Rationale, and Model of NIST Manufacturing Extension Program

In this section, I will examine the history, rationale, and model of the National Institute of Standards and Technology, Manufacturing Extension Program as a policy for promoting cooperation and collaboration.

2.2.1. History of the NIST Manufacturing Extension Program

The Manufacturing Extension Program (MEP) is one of four major programs of the National Institute of Standards and Technology (hereafter NIST), which is an agency of U.S. Department of Commerce, Technology Administration (NIST, 1996).[5] NIST has a long history of supporting industries, since it was established by Congress in 1901 as the National Bureau of Standards, whose primary mission is "to promote economic growth by working with industry to develop and apply technology, measurements and standards (NIST, 1996)."

In 1988, NIST was mandated by Congress to play a more active role in industrial modernization, especially helping smaller manufacturing companies in the intensifying global competition (Oldsman, forthcoming). The Omnibus Trade and Competitiveness Act designated NIST to establish regional Manufacturing Technology Centers (MTCs) that support the transfer of technologies to private firms. The other pilot project was the State Technology Extension Program (STEP), which helps states establish their own infrastructure of industrial services (NIST, 1996). The successes of these

pilot projects led the Clinton Administration to create the nationwide network of manufacturing extension centers.

To date, according to the NIST (1996), more than one hundred manufacturing centers throughout the United States and Puerto Rico have been established in this program, and more than 44,000 companies have been served nationally.

2.2.2. Rationale of Targeting the Small and Medium-sized Manufacturing Firms

Before turning to the model of MEP, the rationale of targeting of MEP must be briefly discussed.

As mentioned earlier, Manufacturing Extension Program targets the small and medium-sized manufacturing firms. Behind this targeting strategy, as some researchers argue (Cohen and Zysman, 1987, p. 3), there may have been a notion among policy makers that "manufacturing matters mightily to the wealth and power of the United States and to our ability to sustain the kind of open society we have come to take for granted" and "at the heart of our argument is a notion we call "direct linkage": a substantial core of service employment is tightly tied to manufacturing."

According to Jerry Rubin (1996, 1994), the executive director of the Greater Boston Manufacturing Partnership (GBMP), reasons for targeting manufacturing sectors over other industries are as follows.

First, the wage level of the manufacturing sector is significantly higher than other sectors, such as the service industry, which is desirable with no doubt.[6]

Second, manufacturing sector firms are likely to offer relatively low-skill jobs. In other words, even those who have less education or training could enter the job market in the manufacturing industry.

Third, generally speaking, there is a greater opportunity for the promotion in the job ladder for workers in the manufacturing sector. In contrast, the jobs in the service sectors are likely to have a limited chance of promotion, unless he/she has a sufficient level of education and skills.

Finally, the manufacturing sector could be an "export-industry" that sells products outside of regions and brings in the "outside dollars" to the region, unlike the many service industries.

Because of these reasons, Rubin (1994) points out that the manufacturing sector "has important implications for the economic viability of American cities" and "is the best hope for a high-skilled, high-wage career path", even though the total number of employment is decreasing nationally. Therefore, there is a rationale for the public sector intervention.

Although there is a consensus that "manufacturing matters" for the economic future of the United States, there is another concern with respect to the widening gaps between large manufacturers and small and medium-sized firms. These

gaps are: the productivity lag among small manufacturers, widening gap in wages by small and large firms, gap of the participation and conditions of health insurance and retirement plan for workers, and the gap of the likelihood of the job loss (Oldsman, forthcoming, pp. 1-4). Taking into account the importance of small and medium-sized manufacturers in terms of the number of jobs they support and roles they play in the manufacturing process, these gaps should not be overlooked. These gaps would explain to a great extent the targeting of MEP of small and medium-sized manufacturing firms.

2.2.3. Model of Manufacturing Extension Program

According to the NIST (1996), MEP is a "nationwide network of centers, co-founded by state and local governments that provide small, mid-sized manufacturers access to technical assistance as they upgrade their operations to boost performance and competitiveness." One of the important characteristics of this program is that it is not a system led by the federal government, but a nationwide system of "bottom-up" and community- and state-based non-profit organization by public/private partnership, although the federal government plays a significant role in terms of funding. In fact, at least 50% of the funding must come from local sponsors. Therefore, the scope of the program and size of each center differ significantly, depending on the focus and/or resources of each center.

Despite these differences, every center shares the fundamental concept, which is to "bridge a 'technology gap' between sources of improved manufacturing technology and the small and mid-sized companies that need it," which is described earlier as a fundamental background of this program.

The essence of MEP's role is to provide/support the linkage between the needed small and medium-sized companies and regional/local resources, such as universities, colleges, research institutions, private consultants, etc., such that small and medium-sized manufacturers improve their competitiveness in the broader market. The common programs that most of centers offer are: assessment of company's technology needs, competitive position; analysis and implementation of company's business practice change; support and implementation of technology projects.

Each center carries out company projects by utilizing local networks of universities, industries, research institution, and so on. In addition, the client companies have access to the federal government resources, such as the Small Business Administration (SBA) business development loan guarantee program and the Environmental Protection Agency (EPA) environment-related programs.

2.2.4. Manufacturing Extension Program and Cooperation and Collaboration

It seems clear that MEP is designed to facilitate the information flow as the "hub" or center of the network by the

manufacturers and the technology, management, and business related resources including local higher education institutions, research institutions, public organizations, and professional services. This concept is close to that of "sector institutions" or "extra-firm infrastructure" discussed in the previous section, which facilitate the cooperation and collaboration between firms and resources.

Thus, MEP may certainly play a critical role as a catalyst and provide infrastructure to support the networking of cooperation and collaboration activities between firms and resources in the regional economy, although the MEP's role in supporting the inter-firm cooperation and collaboration may be small.[7]

In the following chapters, I will analyze the actual modes and effectiveness of intervention by MEP by using the case of Massachusetts.

Notes.

1 I briefly clarify the definition of cooperation and collaboration. Following the definition of Polenske (Forthcoming, p. 10), "collaboration is direct participation by two or more actors in the design, production, and/or marketing of a product (process)," while "cooperation occurs when two or more of these actors agree formally or informally to share information, support managerial and technical training, supply capital, and/or provide market information, but do not work together on design, production, and/or marketing of the product (process)."

2 Michael E. Porter also discussed the benefits and costs of vertical integration in Competitive Strategy: Techniques for Analyzing Industries and Competitors (New York, NY: Free Press, 1980), pp. 300-323. However, Edward H. Lorenz argued in "Trust, Community, and Cooperation: Toward a Theory of Industrial District" in Pathways to

Industrialization and Regional Development (1992) that motivation by social norms can be the other explanation for cooperation, and it is not necessarily consistent with the economic rationality.

3 The idea is explained in more detail in Michael E. Porter, The Competitive Strategy of Nations (New York, NY: Free Press, 1990), pp. 69-129

4 As Best describes, Piore and Sabel call this organization as "extra-firm infrastructure."

5 Three other major programs of NIST are: Advanced Technology Program (ATP), Laboratory Research and Services, and Baldridge National Quality Programs.

6 Regarding this point, see the analysis of recent trends in manufacturing industry, in Chapter 3.

7 As I describe in the Chapter 3, Massachusetts Manufacturing Partnership (MMP) is supporting the inter-firm collaboration as well as firms-resources cooperation and collaboration, cooperating with other units in Corporation for Business, Work, and Learning (CBWL). Yet, the primary emphasis of the MMP activities appears to be put on the individual projects, which facilitate the firms-resources cooperation and collaboration.

Chapter 3

OVERVIEW OF MASSACHUSETTS MANUFACTURING INDUSTRY AND MASSACHUSETTS MANUFACTURING PARTNERSHIP

3.1. Overview of Massachusetts Manufacturing Industry

The purpose of this section is to delineate some of the major characteristics and recent trends of the manufacturing industry in Massachusetts from the perspective of standard industrial classification (SIC) two-digit employment and wage data.[1]

3.1.1. Manufacturing Industry in the State Economy

The number of employees in the manufacturing sector in Massachusetts in 1993 was 476 thousand out of 2,633 thousand total employment, or approximately 18%, which is slightly lower than the share nationwide (19%), shown in the Table 3.1. In 1980s, the number of manufacturing employees in Massachusetts declined by 23.1% (nearly one-fourth), while that of the United States declined by 9.4%. From 1990 to 1993, the number of employees continued to decline by nearly 61 thousand, or 11% of the 536 thousand employees in 1990. This was a much faster decline of manufacturing jobs than the nation (5% during 1990-1993). These data clearly show that Massachusetts lost many manufacturing jobs throughout the 1980s and early 1990s and lost them much faster than the nation.

Table 3.1: Number of Employees,
Massachusetts and United States (1980-1993)

				Annual Rate of Change	
	1980	1990	1993	90/80	93/90
Massachusetts					
Manufacturing	697,193	536,369	475,516	-2.6%	-3.9%
Share in Total Employment	30.4%	19.3%	18.1%	na	na
United States					
Manufacturing	21,151,842	19,173,382	18,183,381	-1.0%	-1.8%
Share in Total Employment	28.3%	20.5%	19.2%	na	na

Note: na = nonapplicable

Source: County Business Patterns (1980, 1990, 1993)

In terms of payroll, however, the manufacturing sector is still very important (Table 3.2). In 1980, the wage level per employee in Massachusetts was slightly lower, both in the manufacturing industries and all industries, than the average of the United States. Yet, in 1993, the wage level in Massachusetts is higher both in manufacturing industries and all industries than that of the United States. Manufacturing and average wages in Massachusetts are increasing at faster rates in 1980s and the beginning of 1990s (1990-1993) than the respective wages in the United States. Moreover, wages in the manufacturing sector remain significantly higher than the average in Massachusetts. It is still increasing along with the average wage increase.

These data tell us that manufacturing industries are very attractive in terms of their wage level, especially in Massachusetts, although the number of jobs in manufacturing is decreasing. As I discussed earlier, this is one of the reasons MEP has targeted the manufacturing industry.

Table 3.2: Average Wage Level of Employees, Massachusetts and United States (1980-1993)

	1980	1990	1993	Annual Rate of Change 90/80	93/90
Massachusetts					
Manufacturing	16,083	31,113	35,526	6.8%	4.5%
Average	13,299	24,065	28,312	6.1%	5.6%
Mfg/average	121%	129%	125%	na	na
United States					
Manufacturing	16,868	28,376	31,674	5.3%	3.7%
Average	13,886	22,510	24,934	4.9%	3.5%
Mfg/average	121%	126%	127%	na	na

Note: na = nonapplicable

Source: County Business Patterns (1980, 1990, 1993)

3.1.2. Sectoral Characteristics

Massachusetts has a distinct characteristic in the composition of the manufacturing sector, specializing in the so-called "high-tech" industries.

In terms of employment, electronics, and other electronic equipment (SIC 36) had the largest number of employees, 65 thousand, among all of the two-digit industries in manufacturing, followed by instruments and related products (SIC 38) with 61 thousand jobs, and industrial machinery and equipment (SIC 35) with 49 thousand jobs (Table 3.3).

Table 3.3: Composition of Employment of Manufacturing Sector in Massachusetts in 1993

SIC	Industry	Number of Employees	Percentage (%)
36	Electronic & Other Electrical Equipment	65040	13.7
38	Measuring & Analyzing Equipment	61393	12.9
35	Industrial & Commercial Machinery	48802	10.3
27	Printing Publishing & Allied Industries	46254	9.7
34	Fabricated Metal Products	33700	7.1
30	Rubber & Miscellaneous Products	26482	5.6
20	Food & Kindred Products	20447	4.3
26	Paper & Allied Products	19149	4.0
23	Apparel & Other Finished Products	18925	4.0
39	Miscellaneous Manufacturing Industries	17048	3.6
28	Chemicals & Allied Products	15775	3.3
22	Textile Mill Products	14921	3.1
37	Transportation Equipment	13135	2.8
33	Primary Metal Industries	12284	2.6
32	Stone Clay Glass & Concrete Products	7151	1.5
25	Furnitures & Fixtures	4759	1.0
24	Lumber & Wood Products	3929	0.8

Note: SIC = Standard Industrial Classification

Source: County Business Patterns (1993)

Using the location quotient (LQ) technique,[2] I identify the "economic base" industries. A LQ shows the relative share of an industry in the region, compared to the share of that industry nationwide. A LQ larger than 1 means that the region is expected to have net exports of the products of the industry. Likewise, a LQ smaller than 1 means that the region is expected to have net imports of the products of the industry. Table 3.4 shows the location quotients of the two-digit SIC industries in manufacturing. Instruments and related industry (SIC 38) has the largest LQ of 2.52, followed by a 1.64 for the electronics and other electronic equipment (SIC 36), and a 1.63 for miscellaneous manufacturing (SIC 39). Other sectors with a LQ of more than

1, which are also "economic base industries," are rubber and miscellaneous plastics products (SIC 30), printing and publishing (SIC 27), paper and allied products (SIC 26). All of the other industries have location quotients less than 1. These data clearly show that the economic base in Massachusetts is so-called "high-tech" industries, which are targeted in the Massachusetts Manufacturing Partnership programs I discuss later.

Table 3.4: Location Quotients by Employment in Two-Digit SIC Industries in Massachusetts for 1993

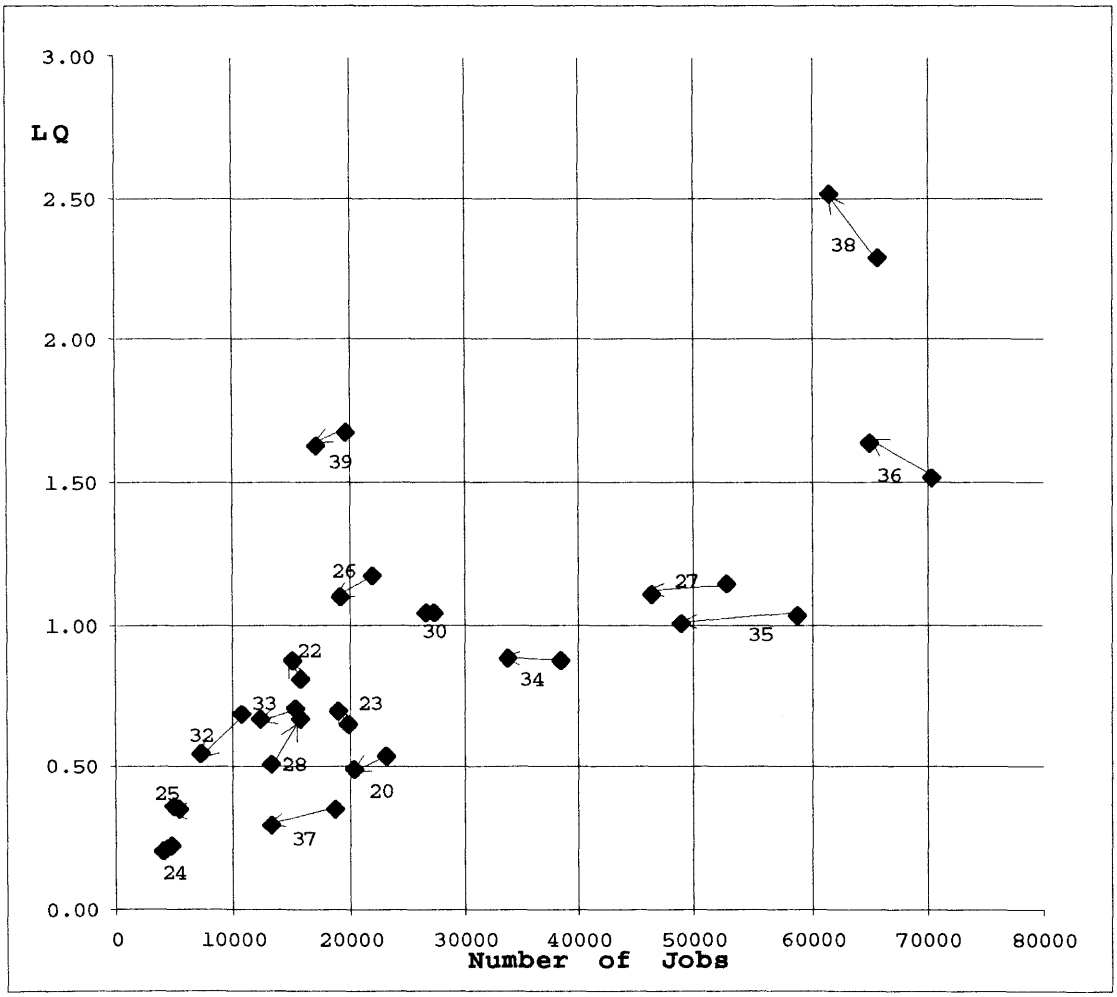
SIC	Industry	Location Quotient
38	Instruments & related products	2.52
36	Electronic & Other Electrical Equipment	1.64
39	Miscellaneous Manufacturing Industries	1.63
27	Printing Publishing & Allied Industries	1.11
26	Paper & Allied Products	1.10
30	Rubber & Miscelaneous Products	1.04
35	Industrial & Commercial Machinery	1.00
34	Fabricated Metal Products	0.88
22	Textile Mill Products	0.87
23	Apparel & Other Finished Products	0.70
33	Primary Metal Industries	0.67
28	Chemicals & Allied Products	0.67
32	Stone Clay Glass & Concrete Products	0.55
20	Food & Kindred Products	0.49
25	Furnitures & Fixtures	0.36
37	Transportation Equipment	0.30
24	Lumber & Wood Products	0.21

Note: SIC = Standard Industrial Classification
Source: County Business Patterns (1993)

Figure 3.1 shows the changes in the LQs and the number of jobs between 1990 to 1993. The Y axis and X axis represent the LQs and the number of jobs, respectively. Thus, the direction of an arrow indicates recent trends of an industry

in terms of employment and LQ. This graph shows that the two largest industries of Massachusetts in terms of employment, instruments and related products (SIC 38) and electronics and other electrical equipment (SIC 36) increased their LQs, although the number of jobs decreased during 1990 to 1993, whereas most of the small industries lost jobs as well as having lower LQs.

Figure 3.1: Location Quotients and Number of Employees by Industries in Massachusetts (1990, 1993)



Note: Numbers represent SIC codes.

Source: County Business Patterns (1990, 1993)

The recent trend in the industrial composition can also be quantitatively examined by the shift-share analysis technique.[3] In the shift-share analysis, the change of region's employment is decomposed into three factors: "national impact," "shift in sectoral mix," and "regional growth differential." The national-impact factor shows the impact on the region of the national employment growth. The shift-in-sectoral-mix factor shows the impact of changes in the region's particular industry mix. The regional-growth-differential factor shows the relative competitiveness of the region in each industry. The result of this analysis (Table 3.5) indicates that nearly 50% of the jobs lost from 1990 to 1993 are attributable to the national-impact factor; that is, the manufacturing jobs were declining during this period throughout the United States, not just in Massachusetts. Yet, the remaining half is largely due to the regional-growth-differential factor in Massachusetts, because the Massachusetts economy was not growing as fast as the rest of the United States; while the shift-in-sectoral-mix factor is also negative, because the major manufacturing industries in Massachusetts are losing jobs nationally. Overall, Massachusetts manufacturing lost competitiveness nationwide. However, certain sectors, such as instrument and related equipment (SIC 38), electronics and other electrical equipment (SIC 36), chemical and allied products (SIC 28), show a positive growth differential, which means a relative improvement in competitiveness.

Table 3.5: Shift-Share Analysis of Massachusetts Manufacturing Industry

SIC Industry	Employment 1990	Employment 1993	Changes Percent (%)	Changes Number	National Impact	Shift in Sectoral Mix	Regional Growth Differential
United States							
Total	19,173,382	18,183,381	-5.2	-990,001	-990,001	0	na
20 Food & Kindred Products	1,452,803	1,498,078	3.1	45,275	-75,014	120,289	na
22 Textile Mill Products	655,010	615,683	-6.0	-39,327	-33,821	-5,506	na
23 Apparel & Other Finished Products	1,027,456	972,060	-5.4	-55,396	-53,052	-2,344	na
24 Lumber & Wood Products	706,949	675,081	-4.5	-31,868	-36,503	4,635	na
25 Furnitures & Fixtures	510,423	476,488	-6.6	-33,935	-26,355	-7,580	na
26 Paper & Allied Products	631,448	627,746	-0.6	-3,702	-32,604	28,902	na
27 Printing Publishing & Allied Industries	1,551,685	1,500,580	-3.3	-51,105	-80,120	29,015	na
28 Chemicals & Allied Products	864,307	851,720	-1.5	-12,587	-44,628	32,041	na
30 Rubber & Miscellaneous Products	882,821	915,166	3.7	32,345	-45,584	77,929	na
32 Stone Clay Glass & Concrete Products	522,856	471,639	-9.8	-51,217	-26,997	-24,220	na
33 Primary Metal Industries	722,603	655,556	-9.3	-67,047	-37,311	-29,736	na
34 Fabricated Metal Products	1,483,334	1,371,072	-7.6	-112,262	-76,591	-35,671	na
35 Industrial & Commercial Machinery	1,922,159	1,749,735	-9.0	-172,424	-99,249	-73,175	na
36 Electronic & Other Electrical Equipment	1,556,961	1,424,351	-8.5	-132,610	-80,392	-52,218	na
37 Transportation Equipment	1,797,524	1,601,554	-10.9	-195,970	-92,814	-103,156	na
38 Measuring & Analyzing Equipment	965,916	878,379	-9.1	-87,537	-49,874	-37,663	na
39 Miscellaneous Manufacturing Industries	394,154	375,501	-4.7	-18,653	-20,352	1,699	na
Massachusetts							
Total	536,369	475,516	-11.3	-60,853	-27,695	-3,599	-29,559
20 Food & Kindred Products	23,144	20,447	-11.7	-2,697	-1,195	1,916	-3,418
22 Textile Mill Products	15,814	14,921	-5.6	-893	-817	-133	56
23 Apparel & Other Finished Products	19,900	18,925	-4.9	-975	-1,028	-45	98
24 Lumber & Wood Products	4,690	3,929	-16.2	-761	-242	31	-550
25 Furnitures & Fixtures	5,328	4,759	-10.7	-569	-275	-79	-215
26 Paper & Allied Products	22,025	19,149	-13.1	-2,876	-1,137	1,008	-2,747
27 Printing Publishing & Allied Industries	52,682	46,254	-12.2	-6,428	-2,720	985	-4,693
28 Chemicals & Allied Products	13,194	15,775	19.6	2,581	-681	489	2,773
30 Rubber & Miscellaneous Products	27,376	26,482	-3.3	-894	-1,414	2,417	-1,897
32 Stone Clay Glass & Concrete Products	10,689	7,151	-33.1	-3,538	-552	-495	-2,491
33 Primary Metal Industries	15,267	12,284	-19.5	-2,983	-788	-628	-1,566
34 Fabricated Metal Products	38,449	33,700	-12.4	-4,749	-1,985	-925	-1,839
35 Industrial & Commercial Machinery	58,735	48,802	-16.9	-9,933	-3,033	-2,236	-4,664
36 Electronic & Other Electrical Equipment	70,289	65,040	-7.5	-5,249	-3,629	-2,357	738
37 Transportation Equipment	18,642	13,135	-29.5	-5,507	-963	-1,070	-3,475
38 Measuring & Analyzing Equipment	65,676	61,393	-6.5	-4,283	-3,391	-2,561	1,669
39 Miscellaneous Manufacturing Industries	19,629	17,048	-13.1	-2,581	-1,014	85	-1,652

Note: na = nonapplicable; SIC = Standard Industrial Classification

Source: County Business Patterns (1990, 1993)

Through these trends, it is clear that Massachusetts manufacturing industry is increasingly specializing in some "high-tech" sectors, which are instruments and related products and electronic and other electrical equipment sectors, in terms of competitiveness and number of jobs.

From the perspective of the wage level, this trend of specialization of Massachusetts manufacturing looks favorable, because the high-tech industries in which Massachusetts specializes have relatively higher wages than others (Table 3.6). The chemical and allied products industry (SIC 28) has the highest average payroll per employee both in the United States and Massachusetts, followed by instruments and related products (SIC 38), transportation equipment (SIC 37), industrial and commercial machinery (SIC 35), and electronics, and other electrical machinery (SIC 36).

Table 3.6: Average 1993 Payroll Per Employee
United States and Massachusetts

SIC	Industry	US	MA	MA/US
28	Chemicals & Allied Products	$39,844	$40,743	102.3%
38	Measuring & Analyzing Equipment	$37,301	$40,559	108.7%
37	Transportation Equipment	$38,998	$39,761	102.0%
35	Industrial & Commercial Machinery	$33,716	$37,764	112.0%
36	Electronic & Other Electrical Equipment	$32,071	$37,098	115.7%
32	Stone Clay Glass & Concrete Products	$28,984	$33,453	115.4%
33	Primary Metal Industries	$34,735	$32,806	94.4%
27	Printing Publishing & Allied Industries	$28,317	$31,754	112.1%
34	Fabricated Metal Products	$29,551	$31,398	106.3%
26	Paper & Allied Products	$33,413	$30,932	92.6%
30	Rubber & Miscelaneous Products	$26,661	$30,009	112.6%
20	Food & Kindred Products	$25,292	$29,249	115.6%
22	Textile Mill Products	$21,417	$28,357	132.4%
39	Miscellaneous Manufacturing Industries	$23,554	$27,648	117.4%
25	Furnitures & Fixtures	$22,265	$25,287	113.6%
24	Lumber & Wood Products	$22,182	$24,426	110.1%
23	Apparel & Other Finished Products	$15,996	$18,954	118.5%

Note: MA = Massachusetts; SIC = Standard Industrial Classification; US = the United States.

Source: County Business Patterns (1993)

This analysis suggests that only those industries that have a strong competitive edge in technology, innovation, etc. can compete in today's marketplace despite the high wage level of Massachusetts.

To summarize, Massachusetts manufacturing is shifting from a relatively diverse industrial composition to a concentration in a few "high-tech" industries that are nationally competitive. These industries have higher wage levels than the average. In other words, it is desirable for these industries in Massachusetts to keep and/or improve their competitive edge in such areas as the product/process innovation, quality, and productivity, etc., so as to remain competitive nationwide in the future.

3.2. Overview of Massachusetts Manufacturing Partnership

In this section, I will examine the history, goals, strategies, and programs of the Massachusetts Manufacturing Partnership (MMP) based on the information the MMP provided, and discuss a couple of characteristics that are important to analyze the actual performances of the MMP in the following chapters.[4]

3.2.1. History and Background of MMP

In 1992, the Bay State Skills Corporation (BSSC), Tufts University, manufacturing companies, University of Massachusetts, policy makers, public officials, and others met to discuss the "state of manufacturing in the

Massachusetts economy," supported by the National Institute of Standards and Technology (NIST). As a background to this discussion, there was a serious downturn of the Massachusetts manufacturing through the late 1980s to the early 1990s. Massachusetts had lost a significant number of manufacturing jobs during these years. Based on the discussion held at this meeting, the plan for the Massachusetts Manufacturing Partnership (MMP) was formulated by the BSSC, together with the Massachusetts Executive Office of Economic Affairs (EOEA) and the University of Massachusetts.

As a result of these studies and efforts, the MMP was established in February 1994 as a NIST Manufacturing Extension Program center. The five MMP regional offices were established and started to provide services in September 1994. In that sense, the MMP said that the "start-up process" was completed by the end of year 1996.

3.2.2. Mission and Strategies of MMP

The mission of the MMP is described as follows (MMP, 1996):

> The mission of the Massachusetts Manufacturing Partnership (MMP) is to improve the competitiveness of small and medium-sized manufacturers in Massachusetts. Consequently, MMP is a unique "mission-driven" organization rather than a single product or service corporation. The mission was developed to address the need and desire to maintain a strong economic base of manufacturing companies in Massachusetts. This mission ultimately addresses the needs of individual manufacturers, manufacturing supply chains, local communities, and the Commonwealth.

Toward this mission, the MMP provides "cost-effective and practical solutions", for manufacturing companies with less than five hundred employees in Massachusetts.

The principle strategy of the MMP is based on the notion that "competitiveness ultimately relies on a high level of flexibility of manufacturing processes, products, and employees (MMP, 1996)." This perception of today's competition seems to be very close to the recognition of "the new competitive environment" I discussed in the previous chapter. Especially, as Jerry Rubin of the GBMP pointed out (1996), manufacturing firms in Massachusetts have to be competitive in such areas as product quality, productivity, and product/process innovation, because firms cannot compete by the cost leadership strategy with the high wage level of Massachusetts, as analyzed in the previous section, although cost decreases should be pursued at the same time. Among these strategic options, the MMP determined its strategy to put an emphasis on quality, productivity, and costs, rather than innovation. The MMP called these focus as: "better, faster, cheaper, and cleaner" (MMP, 1996).

The MMP is not a non-profit consulting firm, nor a governmental organization. According to the "Principles" of the MMP (1996), "the underlining philosophy behind the Partnership is that it be seen as a catalyst for change." In essence, the MMP is supposed to become a "hub" of the networking among manufacturing companies, supporting professional services, research institutions and

universities, and governmental organizations. The MMP is not competing with private consulting firms. Rather, the MMP is supposed to facilitate the access to these professional services and public resources for manufacturers. Therefore, it is essential for the MMP to have a public/private and non-profit partnership organizational structure.

3.2.3. Organization of MMP

The MMP was initially established as a partnership entity by the Bay State Skills Corporation (BSSC), the state of Massachusetts (Massachusetts Executive Office of Economic Affairs), the National Institute of Standards and Technology (NIST) of the U.S. Department of Commerce, and manufacturing businesses in Massachusetts. Although the BSSC and the EOEA were both reorganized to the Corporation for Business, Work, and Learning (CBWL) and the Department of Economic Development (DED), respectively, in 1996, the MMP maintains its character as a public/private and non-profit partnership. In terms of organizational structure, the MMP is now an unit of the CBWL, along with other related units I discuss later.

The MMP contracts with the following five regional offices in the state, each of which is a "separate, non-profit corporation and addresses the needs of the industries and companies specific to its region" (MMP, 1996):

- Manufacturing Partnership of Western Massachusetts (MPWA) in West Springfield
- Central Massachusetts Manufacturing Partnership

(CMMP) in Worceter

- Merrimack Valley Manufacturing Partnership (MVMP) in Lowell
- Greater Boston Manufacturing Partnership (GBMP) in Boston
- Southern Massachusetts Manufacturing Partnership (SMMP) in Taunton

Concerning the staff deployment, the MMP currently hires nearly 30 Project Managers, who have substantial professional knowledge and expertise in some technology areas or business management/administration areas. According to Jan Pressler (1997), director of the MMP, most of them have substantial experience in manufacturing, so that they should be responsive to the needs of manufacturers. Especially, the majority of the staff have either primary or secondary expertise in the target industries, which I will discuss later. In terms of expertise, the number of staff with expertise in process improvements is the largest (Table 3.7). These areas of staff expertise reflect the strategic focus of the MMP at that time. However, the variety and quality of services are not necessarily restricted by staff expertise, because the MMP often introduces outside experts/professional resources to undertake the actual projects.

Table 3.7: MMP Staff Expertise (1996)

Target Industries	Primary Expertise Number of Staff	Secondary Expertise Number of Staff
SIC 20	0	0
SIC 23	0	1
SIC 26	1	1
SIC 27	1	0
SIC 30	2	1
SIC 34	10	11
SIC 35	2	1
SIC 36	7	10
SIC 38	2	0
Other	2	2
Substance Categories		
CAD/CAM	2	1
EDI/MIS	2	4
Business Systems	4	2
Environmental	2	1
Quality	1	1
Plant Layout	2	3
Automation	1	1
Control Systems	3	3
Marketing	1	4
Material Engineering	0	1
Process Improvements	6	5
Product Development	2	0
Human Resources	1	1
Others	0	0
Total	27	27

Note: CAD/CAM = Computer-Aided Design/Manufacturing; EDI = Electronic Data Interchange; MIS = Management Information System; SIC = Standard Industrial Classification.

Source: MMP, Center Progress Report, 1996.

3.2.4. Activities and Services of MMP

As a "mission-driven" organization, the MMP offers a very wide variety of activities and services to small and medium-sized manufacturing companies with fewer than five hundred employees: technical assistance projects on an individual company basis, company assessments/benchmarking, training/educational events, industry networking initiatives.

Each regional affiliate office is supposed to set quantitative goals with respect to these activities, based on the negotiation with the state-wide MMP.

There is a broad spectrum of company projects, reflecting the complicated and multi-faceted nature of today's competitive environment for small and medium-sized manufacturing companies. These projects are categorized in Table 3.8, based on the objective of projects.

Table 3.8: Company Projects Types and Objectives

Objective	Project Type
Increase of Productivity/Efficiency in Operations	CAD/CAM/CAE.
	EDI/Communications/LAN.
	Plant Layout/Manufacturing Cells.
	Automation/Robotics.
	Control Systems/Integration.
	Process Improvement.
	Business Systems/Management.
Improvement of Quality	Quality/Inspection/ISO.
	Material Engineering.
Design/Development	Product or Design Improvement.
Improvement of Marketing	Market Development.
Improvement of Organization/Management/ Human Resource	Human Resources.
Other	Environmental.

Note: CAD = Computer-Aided Design; CAE = Computer-Aided Engineering; CAM = Computer-Aided Manufacturing; EDI = Electronic Data Interchange; ISO = International Standard Organization; LAN = Local Area Network.

Source: Author and MMP, Massachusetts Manufacturing Partnership Strategic Operating Principles and Year 3 Policies and Strategies, 1996.

As I mentioned earlier, the MMP employs outside resources, such as university/colleges, private consulting firms, depending on the project substance. The MMP also subsidizes the project fee up to 50% in the first year of the project. Although the rate of subsidy diminishes as the project years pass by, this subsidy is certainly one of the incentives for manufacturers to use the MMP's services.

Although the MMP accepts any manufacturing companies on a request basis, the MMP strategically sets certain types of target companies and specific industries, besides size of firms.

The following four industries were determined to be targets during the year 1 (1994) to year 3 (1996): Fabricated Metal Products (SIC 34), Industrial Machinery (SIC 35), Electronics (SIC 36), and Instruments (SIC 38). As discussed in the previous section, electronics (SIC 36) and instruments (SIC 38) industries are the largest and the second largest industry in Massachusetts, respectively, in terms of employment as of 1993, and both are those in which Massachusetts is specialized and is gaining its competitiveness through 1990 to 1993 in terms of employment. Furthermore, their average wage levels are high among the manufacturing industries. In contrast, fabricated metal products (SIC 34) and industrial machinery (SIC 35) also have a large employment, while Massachusetts is not especially competitive in them and not necessarily gaining the

competitiveness, though not losing it. Yet, their average wage levels are also relatively high.

In short, the MMP picked the "winners" in Massachusetts, rather than troubled industries. This strategy makes sense, in terms of their number of employees and their wage levels. Yet, in practice, as Jan Pressler pointed out, the MMP employed a "shot-gun" strategy, which does not necessarily concentrate their marketing effort on the targeted industries, because the MMP needs to establish broad recognition and reputation through the projects, according to her.

From year 4, some other industries are going to be added as the target industries, based on the record of the first two years. In addition to them, each regional office is supposed to have additional regional-specific target industries.

The other targeting strategy of the MMP during the last two years was to get involved in "unionized, defense, and woman- and minority-owned companies."

An industry networking initiative is another focus of the MMP activities. However, the MMP does not help firms forming the networks. As a division of the Corporation For Business, Work, and Learning (CBWL), the MMP is supposed to focus its market and to cooperate with the other two units of the CBWL, both of which are also supporting the interfirm collaboration: the Bay State Manufacturing Networks (BSMN) and the New England Suppliers Institute (NESI). Division of

responsibilities among these three units is as follows. The NESI supports supplier-customer networks with a large firm and smaller supplier firms. The BSMN helps firms establish collaboration groups. The role of the MMP, in contrast, is to organize and participate in collaborations (group projects) in these networks the BSMN establish (Table 3.9).

Table 3.9: Division of Focus Among Three Units of Corporation for Business, Work, and Learning (CBWL)

Units	Market Focus/Niche
MMP	Improvement of competitiveness: Individual and group projects.
BSMN	Forming networks/groups of companies to do business together.
NESI	Customer(large company) and supplier relationship.

Note: BSMN = Bay State Manufacturing Networks; NESI = New England Suppliers Institute.

Source: MMP, Center Progress Report, 1996.

It should be noted, however, that the chief role of the MMP seems to be to facilitate the cooperation and collaboration between the companies and the resources, i.e., universities, consultants, etc. by the individual company projects, at least to date, although the industry networking initiative focuses on the interfirm relationship.

Finally, one of the characteristics of the MMP is the usage of a systematic project performance/achievement

evaluation method. The project economic impacts on client companies' bottom-line are to be anticipated/measured in before, just after, six months later, and twelve months later of the project. In addition to these quantitative data, a customer satisfaction survey is also carried out in the end of every company project by a third party, the Donahue Institute of University of Massachusetts. These data are analyzed in the following chapter, so as to evaluate the effectiveness of the program.

Notes.

1 All of the data in this section are from County Business Patterns Massachusetts, and United States. 1982, 1992, 1995. Washington, D.C.: Bureau of the Census, U.S. Department of Commerce.

2 The Location Quotient (LQ) technique is a method to identify the "economic base" industries in a region, which are exported from the region. Although this method relies on a number of very simplistic assumptions, such as the homogeneous demand across regions and so on, it is commonly used to sketch the characteristics of a regional economy. The actual calculation of location quotients is as follows. Employment data are usually used for calculation, although other data could be used as well. For a more detailed discussion, see Avrom Bendavid-Val, Regional and Local Economic Analysis for Practitioners (West Port, CT: Praeger Publishers, 1991), pp. 73-76.

LQ of industry i = $(e_i/e_r)/(E_i/E_n)$

where, e_i: number of employees of industry 1 in the region
e_r: number of total employees in the region
E_i: number of employees of industry 1 nationwide
E_n: number of total employees nationwide

The results of LQs could be interpreted in the following manner.

LQ >1, region exports industry i

LQ =1, region neither exports nor imports

LQ <1, region imports industry i

3 Shift-share analysis is a simple and commonly used technique by regional analysts to decompose the regional economy's growth into three factors: national impact, shift in industrial mix, and regional growth differential. Usually, employment is used as the data. The actual calculation procedures are as follows, using the notation by DiPasquale and Wheaton (1996). For a more detailed discussion, see Denise

DiPasquale and William C. Wheaton, Urban Economics and Real Estate Markets (Englewood Cliffs, NJ: Prentice Hall, 1996) pp. 166-169.

$$\Sigma (e_i * n_i) = \underset{\text{Share}}{\Sigma (e_i * N)} + \underset{\text{Mix (Shift)}}{\Sigma (e_i * (N_i - N))} + \underset{\text{Competitive (Shift)}}{\Sigma (e_i * (n_i - N_i))}$$

where, N, n : total employment growth rate nationally, and in a particular region

N_i, n_i: employment growth rate in industry (i) nationally, and in a particular region

E_i, e_i: industry (i)'s level of employment, nationally and regionally.

4 Most of the information in this section is based on the following sources.

1. The report of the MMP submitted to NIST: Massachusetts Manufacturing Partnership, Center Progress Report, February 1994 - August 1996: Three Years of Service to Massachusetts Manufacturers. (Boston: Corporation For Business, Work, and Learning, 1996)

2. Discussion with Robert W. Biela, Louis J. DeFrancis-Block, and Russ Green of MMP; and other materials of MMP provided by Rob Biela.

3. Interview with Jan Pressler, director, MMP (March 24, 1997).

Chapter 4

ECONOMIC IMPACTS AND PERFORMANCES OF MMP

4.1. Profiles of Client Companies and Projects[1]

In this section, I will examine the actual profiles of client companies and company projects of the MMP from the perspectives of the focus and strategy of the MMP discussed in the previous chapter.

4.1.1. Profiles of Client Companies

From February 1994 until August 1996, the MMP staff have made initial visits to nearly 2,500 companies, completed more than 900 company projects in nearly 600 companies, and held approximately 140 events.

Given the total number of approximately 13,400 small manufacturers statewide, these results during less than three years seem promising: approximately 18% of the smaller manufacturers in Massachusetts were visited, while 4% of them actually conducted the technical assistance services (Table 4.1).

Table 4.1: MMP activities (February 1994-August 1996)

	Number of MA firms	Percentage (%)
Initial Company Visits	2,470	18
Informal Engagements	1,593	12
Company with Projects	593	4
Events	138	na
Company Attending	1,880	14
Massachusetts	13,400	100

Note: MA = Massachusetts; na = nonapplicable.

Source: MMP, Center Progress Report, 1996.

Concerning the industry sectoral distribution of the company projects, the MMP has conducted projects in a very wide variety of sectors.

In terms of the number of projects by industry among the 544 projects during February 1994 to August 1996, the number of industrial and commercial machinery (SIC 35) projects is the largest with 87 projects. or 16% of the total projects, followed by fabricated metal products (SIC 34), electronics and other electrical equipment (SIC 37), measuring and analyzing equipment (SIC 38) (Table 4.2). All of these four largest industries are the targeted industries of the MMP. These four targeted industries accounted for approximately 55% of total projects.

Table 4.2: Distribution of Industries in Company Projects (February 1994-August 1996)

SIC	Industry	Number of Companies Served	Percentage (%)	Number of MA Companies	Percentage of Served Companies (%)
20	Food & Kindred Products	11	2.0	571	1.9
22	Textile Mill Products	13	2.4	299	4.3
23	Apparel & Other Finished Products	35	6.4	621	5.6
24	Lumber & Wood Products	5	0.9	581	0.9
25	Furnitures & Fixtures	3	0.6	342	0.9
26	Paper & Allied Products	27	5.0	306	8.8
27	Printing Publishing & Allied Industries	23	4.2	2,480	0.9
28	Chemicals & Allied Products	21	3.9	447	4.7
29	Petroleum Refining & Related Industries	0	0.0	48	0.0
30	Rubber & Miscelaneous Products	51	9.4	541	9.4
31	Leather & Leather Products	5	0.9	186	2.7
32	Stone Clay Glass & Concrete Products	5	0.9	365	1.4
33	Primary Metal Industries	18	3.3	268	6.7
*34	Fabricated Metal Products	83	15.3	1,231	6.7
*35	Industrial & Commercial Machinery	87	16.0	2,086	4.2
*36	Electronic & Other Electrical Equipment	76	14.0	978	7.8
37	Transportation Equipment	7	1.3	221	3.2
*38	Measuring & Analyzing Equipment	56	10.3	926	6.0
39	Miscellaneous Manufacturing Industries	18	3.3	897	2.0
	Total	544	100.0	13,394	4.1

Note: MA = Massachusetts; SIC = Standard Industrial Classification; * = Targeted Industries.

Source: MMP, Center Progress Report, 1996.

In order to see the degree of penetration of the MMP's service in each industry, I calculate the percentage of client companies in all companies of each industry. In terms of the penetration ratio, there is a wide variation from zero percent in petroleum refining and related industries (SIC 29) to 9.4% in rubber and miscellaneous products (SIC 30). Among the five most penetrated industries, rubber and miscellaneous products (SIC 30), paper and allied products (SIC 26), and primary metal industries (SIC 33) are not the targeted industries. Despite the targeting strategy of the MMP, the penetration ratios of the targeted industries are not necessarily higher than those for other industries. Moreover, the penetration ratio seems to have no clear relationship with such factors as the competitiveness (location quotients) and the industry size (number of employees).

However, there are a couple of possible factors that may have caused the variation in the penetration ratio, according to the interviews with Jan Pressler, director of the MMP, and Jerry Rubin, executive director of the Greater Boston Manufacturing Partnership (GBMP).

First, there may be a supply-side factor: the marketing strategies of the MMP and regional offices. According to Pressler and Rubin, on the one hand, the MMP does not necessarily concentrate the marketing efforts on the targeted industries in practice. They say it is the reason why the targeted industries do not have the highest penetration

ratios. On the other hand, the regional offices may have had marketing strategies of their own. For example, according to Rubin, GBMP has focused their marketing efforts on some high-tech industries based on their growth potential, competitiveness in Greater Boston area, and the degree of industrial linkage in the regional economy. Thus, although the MMP as a whole does not have a clear marketing focus, these individual strategies at the regional office level may have resulted in the variation in the penetration ratios.

Second, there may be some demand-side factors: the industry-level factors, and the individual-level factors. As an industry-level factor, Pressler (1997) points out that the industrial infrastructure, such as an active trade association and inter-firm relationships, may be an important factor. In other words, she argues that in the industries that have a relatively active trade association and/or active interfirm relationship, there may be less demand by companies for the MMP services, which means a lower penetration ratio, and vice versa. Nonetheless, this explanation is not satisfactory for some industries, such as the fabricated metal products (SIC 34), as Rubin points out, because they have relatively high penetration ratios despite their relatively active trade associations.

As the other possible industry-level factor, there may be industry unique circumstances. For example, a mature industry with relatively mature technology may be less likely to use the MMP's services, than an industry with changing

technologies. Although this hypothesis may hold in some industries, such as lumber and wood products (SIC 24) or furniture and fixtures (SIC 25), there is no conclusive evidence to support it.

As an individual-company factor, Rubin (1997) points out that the company's culture may be more important, regardless of industry. In his view, "joiner" type companies that are willing to join the trade associations are more likely to use the MMP's services than "non-joiner" type companies. Even though his view seems legitimate, it does not explain why there is such a wide variation in penetration ratios among industries.

Thus, although each theory could explain the causes of the variation in the penetration ratios to some extent, there is no clear-cut interpretation.

As for the distribution of the company size, there is an obvious deviation in the medium-sized companies. The companies with 26-100 employees account for approximately 50% of the total companies served by the MMP. However, in terms of the percentage of companies served, the MMP has been especially penetrating medium-sized companies with more than one hundred employees, rather than small companies, although there are many more small companies than medium-sized companies. As a matter of fact, nearly 20% of the companies with 101-500 employees have been served by the MMP projects during 1994 to 1996, whereas less than 1% of the companies with fewer than 10 employees have been served (Table 4.3).

Table 4.3: Distribution of the Company Served by Size (February 1994-August 1996)

Company Size by Number of Employees (1)	Number of Massachusetts Companies Served (2)	Number of Massachusetts Companies (3)	Percentage (%) Col.(2)/Col.(3)*100 (4)
1-10	51	8193	0.6
11-25	78	2264	3.4
26-50	151	1219	12.4
51-100	133	815	16.3
101-250	111	595	18.7
251-500	37	197	18.8
500 +	5	113	4.4

Source: MMP, Center Progress Report, 1996.

There are no data to explain this deviation. The MMP Center Progress Report (1996, p. 8) has hinted that the budget constraints concerning cost subsidies, which the MMP provide to these small companies' projects as a limited percentage of total costs, may be the fundamental problem of underrepresentation of the small companies with fewer than ten employees.

In addition, Jan Pressler says (1997) that small companies include a large number of "family-business type" companies that may have no/little interest in the company growth. She also mentions the time and resource constraints of the small companies.

Moreover, it is also possible that the MMP's service focus may mismatch the needs/demand of small companies, because small companies may have different service demands from medium-size companies. This point will be discussed in the later section.

Yet, taking into account the potential importance of the small companies, some of which will be the growing entrepreneurial firms, this bias of the MMP's service delivery toward medium-sized companies is problematic.

4.1.2. Profiles of Projects

As I mentioned earlier, the MMP is conducting several different types of activities. Among them, the technical assistance projects and the industry networking projects are the main activities. Thus, I will analyze the profiles of projects in these two areas.

(a) Technical Assistance Projects

In terms of technical assistance projects, there is a clear focus on the production-related areas (82%), rather than non-production areas (17%), which are market development (8%), business systems/management (5%), and EDI/ Communication/LAN (4%) (Table 4.4).[2]

In the production-related areas, the areas of quality and productivity improvement are especially focused. Among the projects from February 1994 to August 1996, quality/ inspection/ISO area projects account for 34% of the total number of projects, followed by human-resource area projects (mainly workforce training) for 20%, process-improvement area projects for 12%, and so on. Thus, quality- and process-improvement projects account for more than half of the projects, including plant layout, automation/robotics,

control systems/integration projects. Research and product development (R&D) related projects, which include CAD/CAM/CAE, material engineering, and product or design improvement, account for only 7%.

Table 4.4: Number of Projects by Area of Projects (February 1994-August 1996)

Area	Area of Project	Percentage of Projects
P	Quality/Inspection/ISO	34
P	Human Resources	20
P	Process Improvement	12
NP	Market Development	8
NP	Business Systems/Management	5
NP	EDI/Communication/LAN	4
P	Product or Design Development	4
P	Environmental	3
P	Plant Layout/Manufacturing Cells	3
P	CAD/CAM	2
P	Control Systems/Integration	2
P	Automation Robotics	1
P	Material Engineering	1
na	Others	1
na	Total	100
na	Production-related areas	82
na	Non-production-related areas	17
na	Total*	99

Notes: 1. CAD = Computer-Aided Design; CAM = Computer-Aided Manufacturing; EDI = Electronic Data Interchange; ISO = International Standard Organization; LAN = Local Area Network; na = nonapplicable; NP = Non-production-related projects; P = Production-related projects.

2. *: Total is excluding "others (1%)."

Source: MMP, Center Progress Report, 1996.

Thus, the major project areas correspond with the MMP's strategy with an emphasis on the productivity and quality improvement. Although product development and innovation area are also critical components in today's competitive

economy along with productivity and quality, as discussed in the Chapter 2, these types of projects have relatively small shares in the total projects.

According to Pressler and Rubin, there are four possible reasons for it. First, the MMP's marketing is based on its own strategy.

Second, the product design projects are limited for the consumer products, according to Pressler. For other types of products, the product design may be less important.

Third, many small and medium-sized companies, especially in the high-tech industries, have sufficient capacity in research and product development activities, while they tend to lack the production-related technology projects in which the MMP can help them (Rubin, 1997).

Fourth, many companies do not want their technologies to be exposed to such outsiders as the MMP, because their technologies are the chief source of their competitiveness (Rubin, 1997).

These latter two possible reasons indicate the limitations of the MMP, if they are true. These two reasons seems to be related with each other. One limitation may be that the MMP's service may not be effective to help firms to become innovative, although innovativeness is one of the key components in today's competition (see the Chapter 2). The other limitation may be that the MMP's service may not be appropriate to nurture the collaborative relationship,

because companies do not have the same kind of "trust" in the MMP as the collaborative companies have.

There is not a distinct difference in the projects portfolios among industrial sectors (Table 4.5). In all of the four targeted industries, the share of quality/ inspection/ISO related projects is the largest, followed by human resources (training) projects. Process-improvement projects have either the third or fourth largest share.

Table 4.5: Top Five Areas of Projects in the Target Industries (February 1994-August 1996)

	SIC 34 Fabricated Metal Products	SIC 35 Industrial and Commercial Machinery	SIC 36 Electronics and Other Electronic Equipment	SIC 38 Measuring and Analyzing Instrument
1	Quality/ISO (39)	Quality/ISO (52)	Quality/ISO (53)	Quality/ISO (50)
2	Human Resources (24)	Human Resources (21)	Human Resources (14)	Human Resources (28)
3	Process Improvements (13)	Process Improvements (10)	Market Development (11)	Product/Design Development (18)
4	Market Development (9)	Market Development (10)	Process Improvements (8)	Process Improvements (12)
5	CAD/CAM (6)	Plant Layout (9)	EDI/ Communication/ LAN (5)	Market Development (4)

Notes: 1. The numbers in parenthesis are the number of projects.

2. CAD = Computer-Aided Design; CAM = Computer-Aided Manufacturing; EDI = Electric Data Interface; ISO = International Standard Organization; LAN = Local Area Network.

Source: MMP, Center Progress Report, 1996.

Yet, there are differences in the distribution of company size by the type of project (Table 4.6). Small size

companies are more likely to engage in the market-development projects, whereas medium-size companies are more likely to undertake the human-resource projects. Thus, as discussed before, these differences of demand by company size may be one of the reasons why there are differences in the penetration ratios among the company size.

Table 4.6: Company Size Distribution by Selected Project Type (Percent)

Company size	Business systems/ management	Quality/ inspection/ ISO	Market Development	Process Improvement	Human Resource	Total Projects
less than 10	10	6	24	7	2	9
11-25	20	23	27	18	14	14
26-50	21	23	21	22	13	27
51-100	22	26	18	21	22	23
101-250	15	15	10	24	41	20
251-500	12	7	0	8	8	7
Total	100	100	100	100	100	100

Note: ISO = International Standard Organization

Source: MMP, Center Progress Report, 1996, and Donahue Institute, Year Three Evaluation of the Massachusetts Manufacturing Partnership, 1997

As I discussed in Chapter 2, these productivity and quality improvements are thought to be of critical importance in today's competition. The customer satisfaction survey data by the Donahue Institute at the University of Massachusetts indicate that two-thirds of these client companies (66%) would have undertaken these projects sooner or later, even if the MMP had not supported them by the technical assistance projects. These results are generally consistent with the hypothesis that these types of projects are thought to be critical for companies in today's competition.

However, the MMP projects may supposedly have positively influenced the substance and quality of the projects that would have been undertaken without the assistance of the MMP, although there are no data collected to prove it.

Moreover, the survey results also indicate that more than half of the projects would have been made significantly later than the actual timing of projects, as shown in the Table 4.7. Because the timing of the project is critical in today's competition, as discussed in the Chapter 2, it seems reasonable to suppose that the client companies have benefited by the assistance of the MMP that made the projects happen earlier than otherwise.

In addition, taking the fact that one-third of companies would not have undertaken these projects into account, it is fair to say that there may be some barriers for small and medium-sized manufacturing companies to undertake these projects timely without the assistance of the MMP.

Table 4.7: Question: "When would change have been made?"

	Percent of Responses (%)
Project already started	4
Same time frame	38
Delayed 6 months or more	17
Uncertain	40
Total	100

Note: This question was asked to those who answered that "they would have undertaken projects without MMP."

Source: Donahue Institute (1997)

The MMP asked in the survey about the reasons why they would not have undertaken these projects without the support by the MMP, if they answered "they would not have undertaken these projects" in the previous section. Because the number of answers to this additional question was limited, and the answers are descriptive, it is impossible to reach a definite conclusion. Yet, they provide us with a sense of reasons why they would not have done them (Table 4.8).

First, a number of answers mention the lack of financial, technical resources to undertake these types of projects. For small and medium-sized companies, the lack of resources may be one of the fundamental difficulties to solve these problems or improve the competitiveness in terms of productivity and quality improvement. In other words, the subsidy system and outside resources of the MMP program might possibly have made some of these projects possible and attractive to client companies.

Second, the lack of awareness about the problems or misunderstanding of the problems they are facing may be another barrier for them. In the individual descriptions, some companies did not even notice the importance of the process improvement. According to the interview with Jerry Rubin (1997), he also argues that client companies often misunderstand their problems and fail to define it clearly. Thus, there is a potential conflict of interest with the professional consultants in the narrow area of expertise and the client companies, so that the probability of failure is

relatively high, even if a company undertakes a project with a professional consultant without the MMP.

Table 4.8: Reasons Companies Would Not Have Undertaken the Project Without MMP

Activity Substance	Description
Business Systems/ Management	Started to work on project, foresaw immense work load, needed assistance.
CAD/CAM	Not aware of availability.
CAD/CAM	Company does not have the financial resources to provide training in another form.
EDI/ Communications/ LAN	Not confident in return on investment.
Environmental	Expense; expertise of Toni Guerrero introduced opportunities
Human Resources	Most employees speak spanish. MVMP taught english in the workplace with interpreter.
Human Resources	Needed your guidance
Human Resources	Did not know actions that could be undertaken.
Market Development	However would have failed without assistance
Market Development	Outsourcing makes this possible.
Market Development	Need the creativity.
Process Improvements	Would not have known or thought about topics.
Process Improvements	It never reached high enough priority - displaced by "firefighting" projects.
Process Improvements	Do not have time and resources.
Process Improvements	May have not attended/been made aware.
Process Improvements	Do not have the organizational structure and discipline to undertake this type of project.
Quality/ Inspection/ISO	No resources

Note: CAD/CAM = Computer-Aided Design/Manufacturing; EDI = Electronic Data Interchange; ISO = International Standard Organization; LAN = Local Area Networks.

Source: MMP customer survey results as of February, 1997

Finally, the lack of information and guidance about the services available for small and medium-sized companies are pointed out. According to the individual descriptions, some companies were not aware of the availability of services. It is consistent with the account of Jan Pressler of the MMP (1997) that the biggest barrier for the small and medium-sized companies to undertake these projects is the searching process for resources, because they have little information about the availability of resources.

The MMP staff have tried to provide some incentives for companies corresponding to these barriers. According to Rubin, the major incentives in the GBMP are the financial subsidies to projects, broad area of services including the initial diagnosis, and the networks with universities (University of Massachusetts, MIT, etc.). All of these incentives may probably be very important for client companies.

(b) Industry Networking Projects

In terms of industry networking projects, as mentioned earlier, the role of the MMP in industrial networking calls for close cooperation with the other two units of the CBWL, namely the Bay State Manufacturing Networks (BSMN) and the New England Suppliers Institute (NESI).

The overlapping of activities has occurred especially with the BSMN in the MMP networks (Table 4.9). In every case, the MMP has organized and led a group project, such as

a joint training and actual business marketing project, through which the participating companies will build up "a beginning level of collaboration and trust." Moreover, 45 MMP client companies join at least one of the networks, and 65 companies are members in 16 ISO collaboratives sponsored by the MMP. In that sense, the MMP's role is a catalyst of the collaboration among private companies.

However, because the industry networking may take longer time, in general, to achieve the results than the company projects, and the history of MMP is only three years to date, the performance data of these activities are not available. Because of this data constraint, the performances of industry networking projects are not analyzed in the following section.

Table 4.9: MMP Networks (as of November 1996)

Name	Activity
Merrimack Valley Plastics Network	With 22 members, MVMP sponsors forum and training specific to the plastics industry.
Printed Circuit Board (PCB) Joint Production Alliances	A group of 6 vertically integrated PCB companies joined to provide completed sub-assemblies to customers.
Attelboro Jewelry Network	13 companies have begun to offer joint training programs for the jewelry industry.

Note: MVMP = Merrimack Valley Manufacturing Partnership

Source: MMP, Center Progress Report, 1996.

4.1.3. Conclusion

Throughout this section, the following characteristics of the MMP activities in terms of client companies and project profiles are found.

First, in terms of industry distribution among client companies, the targeted high-tech industries account for more than 50% of the total client companies. However, in terms of the penetration ratio, there is a wide variation among industries. Interestingly, the penetration ratios of the targeted industries are not necessarily higher than the other industries. According to Pressler and Rubin, the marketing effort of the MMP, as a whole, did not concentrate on these four targeted industries. With respect to the wide variation in the penetration ratio, there may be a couple of possible explanations. For example, according to Pressler, the penetration ratios largely depend on the industry infrastructure, such as the trade association, and the interfirm relationship. In contrast, Rubin argues that the individual company's culture is critical.

Second, in terms of the client company size, the penetration ratio of small companies is much lower than that of medium-size companies, despite the importance of them in the economy. It may be attributable to the existence of "family-business type" companies in the small companies, the resource constraints, and/or the difference of demand by company size.

Third, the major areas of the technical assistance projects are quality improvement, human resources (training), and process improvement. This focus corresponds with the strategy of the MMP, and is thought of as critical components in today's competition. Yet, although the product development area is also essential in today's competition, companies are less likely to use the MMP in this area, due to a couple of reasons. This may be a constraint of the MMP.

Lastly, according to the satisfaction survey of Donahue Institute, two-third of the client companies would not have undertaken these projects, if the MMP had not supported them. In addition, more than half of the remaining two-thirds companies would have undertaken the projects, but later than the actual timing. Thus, there may be some barriers for small and medium-sized companies. According to the descriptive data, such barriers are the lack of financial and/or technical resource, the lack of awareness of the problems, the lack of information about the available resources. The MMP has provided some incentives for companies, such as the financial subsidies to projects, broad area of services including the initial diagnosis and identifying the actual problem, and the networks with resources, such as universities and professional consultants. They may be the incentives for companies to use the MMP.

4.2. Performance of Company Projects

In this section, the performance of the technical assistance projects and their economic impacts on the regional economy will be examined. Because of the short history of the MMP activities, all of the economic impacts have yet to materialize. Thus, I will discuss the theoretical framework of project economic impacts on the company and regional/local economy first. Then, I will analyze the actual performance data to date.

4.2.1. Theory of Project Economic Impacts on the Company and Regional/Local Economy

Before turning to examine the company results, theoretical economic impacts to the company itself and regional economy should be briefly discussed.

As I discussed before, the technical assistance projects include a very wide range of project types, most of which could be categorized by the objective of the project as follows: increase of productivity/efficiency in operations, improvement of product (quality, material, design, etc.), improvement of marketing, and improvement of organization/ management/human resources. The outcome and economic impacts on regional economy would differ significantly, depending on these categories, whereas all of these projects are expected to have positive economic impacts on company's profit to some extent.

The generic framework of the project economic impact is outlined as follows. The project economic impacts could be

categorized in the following manner: the direct economic impact; the operational economic impact; the induced economic impact; and other indirect/secondary economic impacts.

First, there would be a direct economic impact on the region. A company project might generate certain investments, e.g., new computer and software investment for introduction of CAD/CAM system, by the company that otherwise would not take place. This investment would have some positive economic impacts on the regional economy to the degree that the investment is fulfilled within that region and if this investment does not replace any other investment that would otherwise take place. Because this economic impact is directly and immediately caused by the project, it can be called the direct economic impact of the project.

There is another type of economic impact: operational economic impacts, which is usually the objective of the project itself, such as the increase of productivity, the improvement of product, the improvement of employees skill level, and so on. Economic impacts of this type are expected to affect the company profit positively in either the short-run or long-run. Economic impacts to the region, however, are not as straightforward as the case of economic impacts on company's profit. A good strategy for a company is not necessarily always good for the regional economy. For example, if the sales increase of a certain company to other regions by the company project of the MMP just represents a switch from the other competing company's sales in the

region, the net increase of sales in this region is zero. Assuming the technologies used by these companies are identical, the net economic impact to that region is, therefore, zero. Thus, the economic impacts on the regional economy depend on the types of the operational economic impact (Table 4.10).

Another type of economic impact is an induced economic impact, which is an economic impact caused by the increases of personal income in that company and the region created by the company project.

In addition to these economic impacts, there may be the other type of indirect/secondary economic impacts that may not directly affect the company's bottom line, but rather affect the industry inter-firm relationship and the competition in the long run. For example, improvement of quality and development of new products may lead to an increase in the degree of intensity of competition among firms, which, in turn, may improve the competitiveness of local industry as a whole. Although the economic impacts from these types of projects may be profound in the long run, the economic impacts may vary substantially for various reasons, and they may be difficult to capture and quantify.

Table 4.10: Four Types of Project Economic Impacts

Project Impact	Characteristics	Time Realized
Direct Economic Impact	Investment activities.	Immediately after projects.
Operational Economic Impact	Improvement of Productivity, etc.	Short term or long term.
Induced Economic Impact	Impact by the increase of personal income.	Long term.
Indirect/ Secondary Economic Impact	Increase of intensity of competition, etc.	Long term.

Source: Author

Based on the above generic framework, I will discuss the alternative economic impacts created by the differences of the objective of the project, from the perspective of economic impacts on production input, production output, investment, and employment.

(a) Increase of productivity/efficiency in operation

As direct economic impacts, the projects targeting the increase of productivity/efficiency in operation may require a certain amount of investment as a direct result of a project.

In addition, as operational economic impacts, they would result in a decrease of lead time, set-up time, rework, scrap-rate, and workforce per output and so on. These economic impacts on productivity are likely to cause a

decrease of production cost per output. Thus, they may result in either an increase of output (through the price cut) or a decrease of input with a stable output, or both. It is noteworthy, therefore, that the number of employees and quantity of other inputs, such as material, can decrease because of the increase in productivity, if output does not increase enough to offset the increase of productivity. In the other alternative, a productivity increase may result in a price cut, which, in turn, may lead to an increase of sales and output, and in the input and employment. In both cases, as a result, the company profit is likely to increase. Thus, there may be certain induced economic impacts through the increase of personal income and/or increase of employment. Furthermore, if the competitor of that company is within the region and the increase of sales is merely the switch of sales, the regional economic impact is virtually none, as I discussed before.

In the long run, however, there may be positive indirect/ secondary economic impacts on the regional economy created by the productivity increase. This may occur because (1) more intense rivalry among companies may bring about a further improvement of the competitiveness of region as a whole, and (2) improvement of production and efficiency may accelerate the improvement of overall productivity in the user companies in the production linkage.

(b) Improvement of product (quality, material, design, etc.)

For the direct economic impacts, projects targeting the improvement of products in terms of quality, material, design, may require a certain investment at the outset, in order to accommodate the production line to the improved or developed products.

As operational economic impacts, it may cause a drastic change of the input to production in terms of quantity and substance, though it may entirely depend on the type of project. For instance, a new design product may require new material and parts to a greater degree than the case of the improvement of quality. In any case, as a result, an increase of sales and output may happen in the successful case.

Therefore, unless the newly developed or quality-improved products replacing the old product needs substantially less input and labor, the employment and input may also be expected to increase. Thus, there may be induced economic impacts.

Furthermore, in the same manner as the productivity increase, the more intensive competition may exert positive economic impacts on the overall competitiveness of regional economy.

(c) Improvement of marketing

Unlike the previous two types, projects targeting the improvement of marketing may not need any substantial amount

of investment nor change in product itself and production technology. Thus, the direct economic impact may be less than for the previous two types of projects.

Yet, the increase in sales is usually expected. Therefore, these projects may cause an increase of input and jobs. Thus, there may be certain induced economic impacts through the increase of personal income and/or increase of employment. as the induced effect.

As for the indirect/secondary economic impacts, there could be some from the development of new markets in the long run.

(d) Improvement of organization/management/human resource

A project targeting the improvement of organization and/or management skill and/or human resources may require a lower amount of investment, and it may have fewer economic impacts on company's profit than projects of the other categories in the short-run. In the long-run, however, projects of this category could have lasting economic impacts on companies' bottom-line, through strengthening the capability of company to keep its competitiveness.

Because projects of this category would not be necessarily followed by either investment or an input change or output increase for a while, the direct economic impact should be small and the operational economic impact on the company profit may also be small in the short-run. Thus, there may be little induced economic impact in the short-run,

although there will be certain operational economic impact in the long-run.

4.2.2. Performance Data Coverage[3]

Data on the performance of company projects are collected at the level of "company results," "economic impacts," and "customer satisfaction" survey.[4] "Company results" represent major indicators of productivity and quality change about manufacturing process and products, while "economic impacts" represent the changes of the bottom line for a company's financial statement including increase of sales, cost savings, and company investment in process, products, and employees. Economic impacts may not be directly connected to the company results: economic impacts may be influenced by factors other than the change of productivity and quality of products, such as the development of new products, better marketing practices, better financing practices, better business strategies, and so on.

It must be noted, however, that although these data of direct economic impacts and operational economic impacts are systematically collected on a monthly basis, there are a number of limitations as well.

First, the economic impacts attributable to the MMP are not distinguishable from the economic impacts by the projects. Because two-thirds of companies would have undertaken the projects even without the MMP, as I discussed in the previous section, the economic impacts attributable to

the MMP may have been smaller than the economic impacts by the projects. In other words, it is not clear how the MMP has affected the substance of the projects that would have been carried out even without the MMP.

Second, the economic impacts of the investment on the regional economy are not measured at all, although the amount of investment is known. The economic impacts on the regional economy may be determined by the substance and amount of the investment and the degree to which the investment is fulfilled within the region.

Third, because the MMP has only a few years of history, economic impacts of some type of projects that may need a longer time to materialize their economic impacts, such as human resources (workforce training, management system, etc.), cannot be observed. In addition, even if data were available, it would be extremely difficult to attribute a change of profit to a particular project without a direct causal relationship.

Fourth, the increase of sales does not necessarily mean a "net increase of sales" within the region. Thus, again, it may not have any positive economic impact on the region at all. Likewise, the cost saving, which is obviously positive from the company's perspective, could have negative economic impacts at the regional level. These regional level impact data are not available.

Fifth, the induced economic impacts and the indirect/ secondary economic impacts are not captured, although there

are a number of descriptive data on the qualitative economic impacts, answered by the client companies.

Lastly, it should be noted that these data may not be accurate. All of these data are from the questionnaire survey by the MMP answered by client companies; thus, they were not the data actually measured by a third party. In addition, the economic impacts data may not have been distinguished from the other economic factors, e.g., the macro economic fluctuation, the demand change by one time event in some industry, etc., although the question asks explicitly the economic impacts by the project.

In other words, we must keep in mind that (1) the economic impacts do not necessarily show the economic impacts attributable to the MMP; (2) the data are limited only to the direct economic impacts (investment), and the short-term operational economic impacts to company; and (3) they may not be accurate.

4.2.3. Overall Results

The statewide cumulative company results to date are as follows.

Regarding the direct economic impacts, the cumulative investment in the process, products, and people, through February 1994 to August 1996, was approximately 15.6 million dollars. The average amount of investment per project was 16.7 thousand dollars.

With respect to the operational economic impacts, the data show the drastic improvements in productivity and quality even in the relatively short period of time (Table 4.11). This result suggests that there would be a huge potential to improve the operation of production of small and medium-sized companies. However, the other types of operational economic impacts are unknown, such as the skill improvement by the human resource projects, market developments, and so on.

Table 4.11: Aggregate Company Results
(February 1994-August 1996)

Indicator	Average Change
Production Output	61.5%
Inventory Turns	35 days
Lead Time	-46.0%
Set-up Time	-20.2%
Scrap Time	-28.8%
Rework	-18.3%

Source: MMP, Center Progress Report, 1996.

Operational economic impacts on the company's profit were also positive. The total increase in sales was reported to reach nearly 18 million dollars to date, and approximately 44 million dollars more are anticipated in the future (Table 4.12). The MMP survey also shows that the cost savings has been approximately 3.7 million dollars. In terms of employment, nearly 240 jobs are reported to be generated to date, through these projects. Again, these economic impacts may have generated induced economic impacts on the regional economy.

Although all of these data show the positive economic impacts of the company projects, it is not clear whether or not these positive economic impacts will last long after the projects, and whether or not they will enhance the overall competitiveness of the region (Table 4.12).

Table 4.12: Operational Economic Impacts of Company Projects (February 1994-August 1996)

Indicator	Total Actual	Additional Anticipated	Per Project (including anticipated)
Increase in Sales	$17,781,358	$44,750,597	$66,736
Documented Cost Savings	$3,672,428		$3,919
Investment in Process, Products, People	$15,602,712		$16,652
Total impacts*	$81,807,095		$87,307
Jobs Created	237		0.25

Notes: The total number of projects is 937 as of 8/31/1996.
*: The total impacts include the anticipated sales.

Source: MMP, Center Progress Report, 1996.

The former information indicates the quantitative performance, while the customer satisfaction survey provides us information concerning more qualitative and comprehensive performance of services, though it may not be so objective as other indicators.

Thus far, the customer satisfaction survey results show the surprisingly high degree of satisfaction to the service (Table 4.13). Nearly all of the firms are either "highly satisfied"(49%) or "satisfied"(48%).

Table 4.13: Customer Satisfaction Survey Result: Overall Satisfaction (February 1996-October 1996)

Rating	# of Companies	Percentage
Highly Satisfied	34	49
Satisfied	33	48
Neither	2	3
Dissatisfied	0	0
Highly Dissatisfied	0	0

Source: MMP, Center Progress Report, 1996.

In terms of the improvement in competitiveness, approximately half of the client companies answered that their competitiveness improved substantially or more than moderately by the company projects (Table 4.14).

Table 4.14: Customer Satisfaction Survey Result: Improvement of Competitiveness (February 1996-October 1996)

	Percentage of Responses
1 Very Substantial Change	16
2	33
3 Moderate Change	32
4	4
5 No Change	16

Source: MMP, Center Progress Report, 1996.

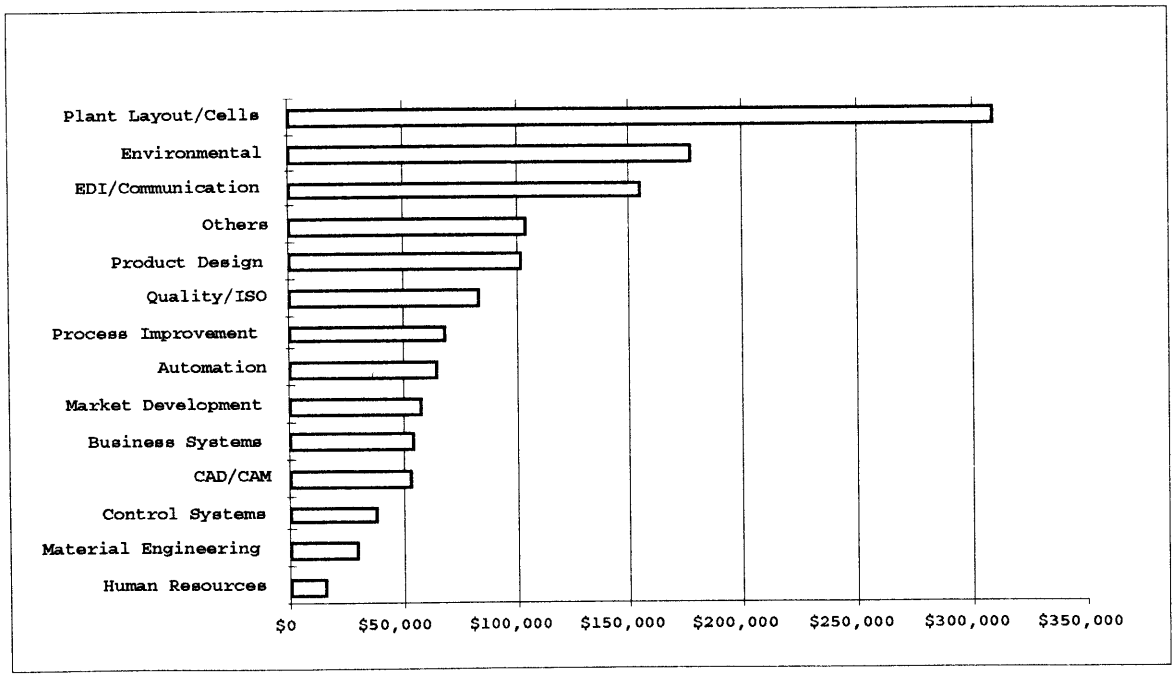
4.2.4. Performance by Project Type

As I discussed theoretically in the previous section, economic impacts of company projects may and should differ considerably by project types/objectives. Here, I will examine the actual results. It must be noted, however, that the following data should be interpreted carefully, because some of the project areas, such as CAD/CAM, automation,

material engineering, have fewer than five responses, and therefore the average numbers may not be reliable.

First, as for the direct economic impact of project, company investments in product, process, and people, among all types of projects, plant layout/manufacturing cells projects have the largest average investment impact, followed by environmental projects, EDI/communication/LAN projects, and so on (Figure 4.1). On the whole, projects for the improvement of productivity have a relatively large investment. In contrast, human-resources projects and market-development projects need a relatively small amount of investment. These data are basically consistent with the previous discussion.

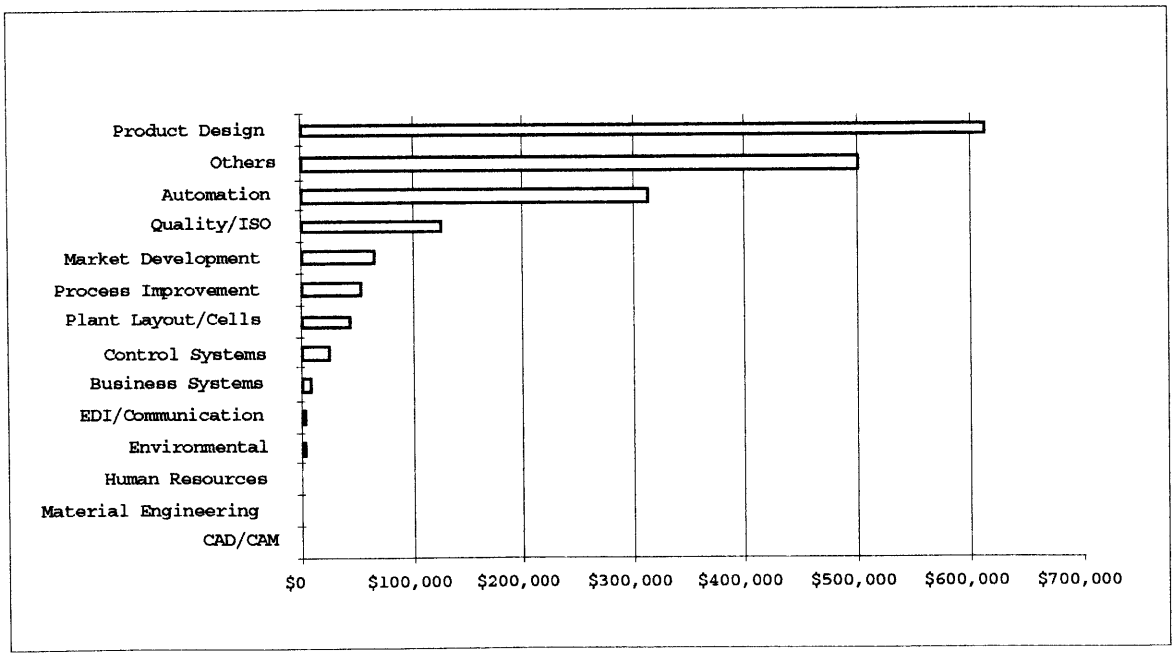
Figure 4.1: Average Investment Impact by Project Type (February 1994-August 1996)



Source: MMP, Center Progress Report, 1996.

Concerning the operational economic impacts, only limited data are available, as I discussed before. The average sales increase is the largest in product development and design projects with more than 0.6 million dollars a project, followed by automation/robotics projects, quality/inspection/ ISO projects, market-development projects and so on (Figure 4.2). Almost all of project types have positive economic impacts, more or less, in terms of the increase of sales. Again, although this result looks favorable as far as the company is concerned, it does not mean the net increase in the regional level. In addition, it does not mean that the human-resource projects, for example, are less effective in terms of the sales increase in the long-run.

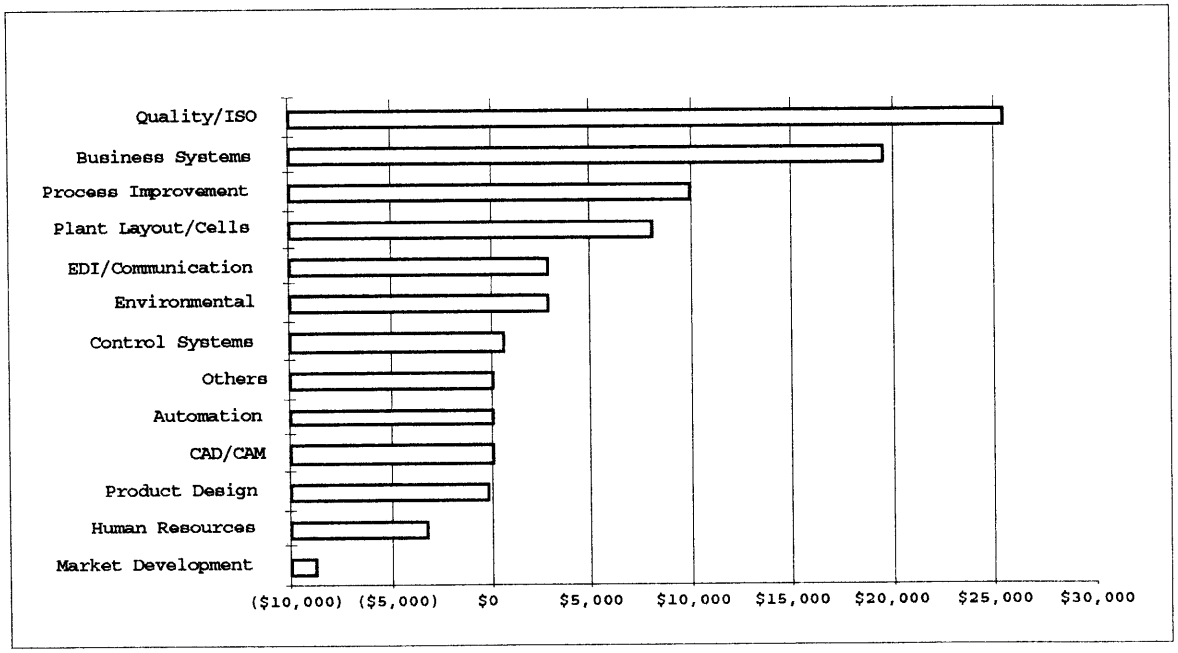
Figure 4.2: Average Increase of Sales by Project Type (February 1994-August 1996)



Source: MMP, Center Progress Report, 1996.

With respect to average cost savings, material-engineering projects have had extremely larger economic impacts than the other types of projects, with more than 0.6 million dollars cost savings per project (Figure 4.3). Yet, again, we need to be careful about this result, because the number of survey projects in material engineering is only three. Except material-engineering projects, however, the magnitude of positive economic impact by cost savings tends to be much less than that of the increase of sales.

Figure 4.3: Average Cost Savings by Project Type (February 1994-August 1996)

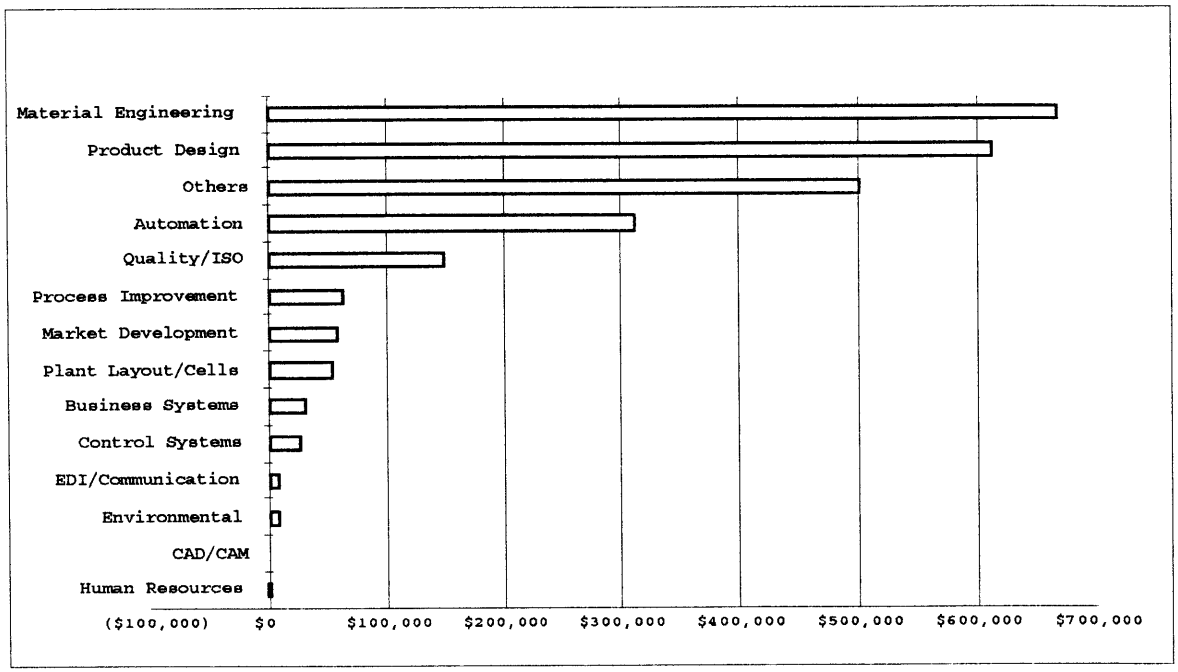


Note: The data of material-engineering projects is excluded.
Source: MMP, Center Progress Report, 1996.

Other things being equal, the total of average increase in sales and average cost savings would be increase of profit from company's perspective. Material-engineering projects

have the largest economic impacts on the company profit to date on the average thanks to the huge cost savings, followed by product design and development, automation/robotics, quality/ISO projects and so on (Figure 4.4). Again, it is not appropriate to conclude that a human-resource project would have less economic impact on company profit than a material-engineering project in the long run. Depending on the nature of project types, the timing of having an economic impact by project may differ substantially.

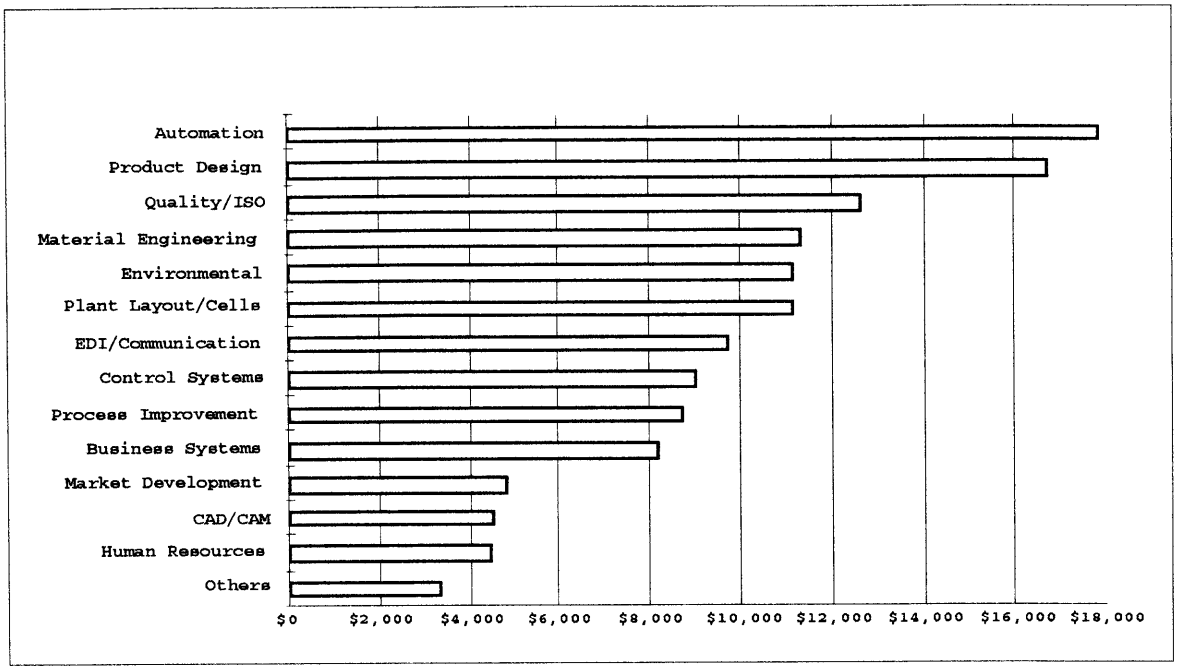
Figure 4.4: Total Increase in Sales and Cost Savings by Project Type (February 1994-August 1996)



Source: MMP, Center Progress Report, 1996.

The project costs also vary depending on the project type. Average automation/robotics projects costs most, followed by product development and design, quality/ inspection/ISO project (Figure 4.5).

Figure 4.5. Average Project Cost by Project Type (February 1994-August 1996)



Source: MMP, Center Progress Report, 1996.

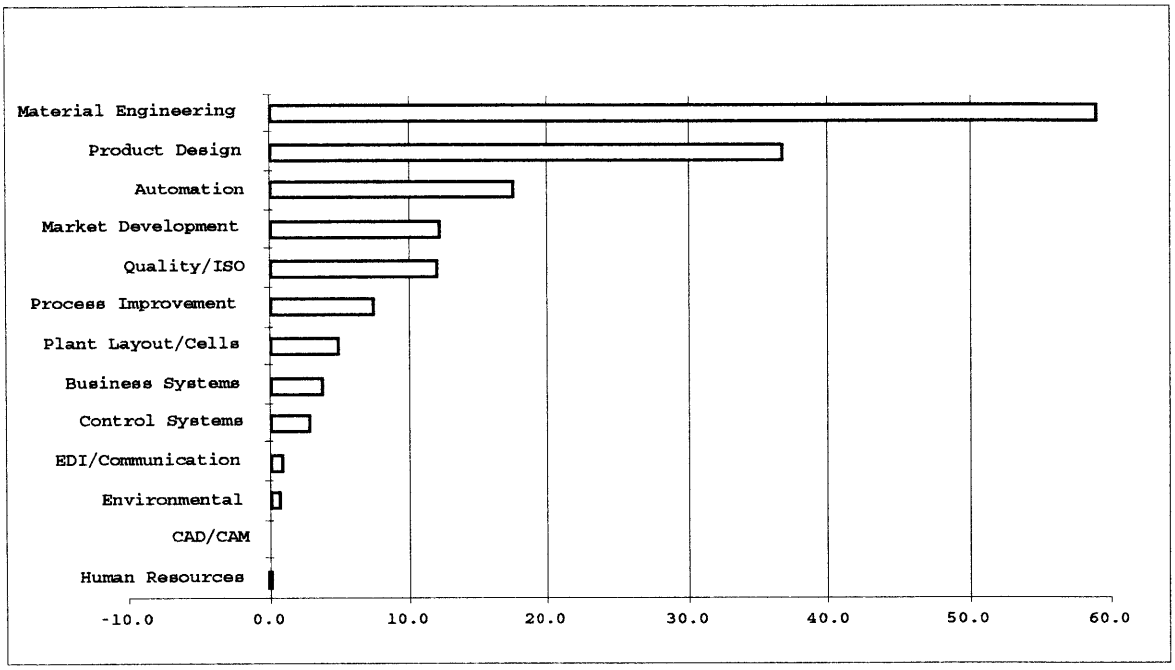
Figure 4.6 shows the impact/cost ratio by project type, which indicates the degree of effectiveness of projects within certain time period. This ratio is calculated as follows.

Impact/cost ratio = (Increase in sales + Cost savings) / Project cost

The ratios of project types actually differ significantly. These differences may result partly from the differences of the time-horizon of the project impacts and/or the effectiveness of projects. For example, material-engineering projects have the largest ratio with nearly 60, followed by product design and development, automation/robotics, market development, and so on. On the

other hand, the impact/cost ratios of quality/ISO, process improvement are much less. The ratio of human-resource projects (training) is even negative. However, these numbers do not necessarily indicate that these types of projects are less effective than material engineering, product design, and automation/robotics projects.

Figure 4.6. Impact/Cost Ratio by Project Type (February 1994-August 1996)



Source: MMP, Center Progress Report, 1996.

In addition to these quantitative economic impact data, the MMP survey asks "other economic impacts" that are not captured by the indicators we analyzed above. The answers provide us with some of the characteristics of the indirect/ secondary economic impacts I discussed before. Although answers to those questions are descriptive, it is possible to categorize them into the following major areas (Table 4.15).

Table 4.15: "Other Impacts" in the Customer Survey

IMPROVEMENT OF THE CUSTOMER INTERACTION/RELATIONSHIP
Customer interaction is improved, most of them are in ISO market or have those systems in place. Customer interaction is also better in terms of our quality. Q2: Labor costs were decreased by1% of shipped.
More quotations per hour. Positive image and perception from customers ($10,000).
Marketing and exposure. Scrap will be reduced by 5 million pounds. Contact is expecting an increase in jobs of about 20 employees, mostly machine operators, also engineers and technicians.
Opened up additional customers -- have more large customers. Added to potential leads (customers). Expanded customer base and potential customers.
We had very positive feedback from customers as far as appearance of the shop-- can not quantify.
Attention to customers
Anticipate gaining new customers
More of a marketing tool for this company. Makes more viable to the public. Has also helped interal operations flow smoothly.
Additional improvement in image and perception from customers ($4000 per unit).
Customer exposure.
Our best customer has agreed to renew and add new business for exporting. In reference to Q#8a: plan to purchase $50,000 in new equipment by 6/30/96.
New Customer Potential
Improvement in customer satisfaction -- attributed to quality and delivery times
Starting to attract foreign business because of the certification. Expect more.
An additional (2) sales may also occur as a result of the project, these are inquiries that would not have occurred without the project. The company was recently certified and expect additional positive results after the ISO certification is advertised
Involved with Massport--export work as a result of this project. A lot of benefits in general from this project.
Customers are pleased that we are working on ISO. Expect to see increase in sales after adverstise.

IMPROVEMENT OF AWARENESS TO MARKET, TECHNOLOGY, INTERNATIONAL STANDARDS
This project provided us with an awareness of international standards and their importance to Americam manufacturers that we had lacked. It is hard to put a dollar value to, but very important.
Now we are more knowledgeable about how a small company should operate and we work better as a team.
It has impacted everything. Awareness particularly impacted.
Total quality awareness, more than anything else. Quality is now on the fore front of employees initiatives.
Greater awareness of ISO quality system
Better understanding of ISO 9000

IMPROVEMENT OF MORALE OF EMPLOYEES, ORGANIZATIONAL CULTURE
Leadership; Team Leaders have more confidence in their leadership abilities

Our trouble shooting time is reduced. Our employees are feeling much more involved. Their on the job skills are enhanced and they can now accept and utilize new technologies. We expect to see other impacts that may come out on your twelve month survey.
Increased education , communication with employees. Set up time was reduced by 15%.
Positive impact on individual performance and professional growth.
Company morate is a lot better. There was an increase in jobs of 25-30%. Invested more than 250,000 in plant, equipment, etc.
Goal of project was to engender better training through improved communication skills. Improved employees learning capacity, made them more trainable. Also regarded as a motivational tool to show employees the company cares, as language skills necessa
"Better morale, more involvement of everyone throughout the company, more information sharing"
Employee morale was improved dramatically and quality. Financial benefits to productivity. Set up time was reduced by 30%. Materials Handling was reduced by 35%.
The team learned that they could make their lives better . The project had a small impact plant wide, but a large impact for the team .
"Improved attitude of workforce. Referring to Q#2B, there was a 10% reduction in labor costs. Referring to Q#9, there was a 20% , 10%, and 5% reduction in set up time, material handling time, and scrap rate, respectively."
"Positive attitude among employees, profitability--- but not a real handle on the quantitative aspect."
The employees have a good sense of accomplishment. Received order from a medical manufacturer that we would not have gotten if we weren't ISO registered.
Communication has been enhanced between departments-- training has facilitated communication, as well. Increase in morale is apparent. People are thinking about what they are doing and not just "doing it."
Nonquantifying impacts-quality in the company mission and employee morale.

NETWORKING WITH RESOURCES, I.E., CONSULTANTS, ETC.
Identification of excellent consulting resource very valuable. Has led to our working with him again on a new scheduling project. Connecting with new resources is very valuable. We
Networking and good contacts
Got to know some great people.

Source: MMP customer survey results as of February 1997

These qualitative positive economic impacts may be related to the survey result that half of client companies gain the competitiveness very substantially or more than moderately, through the company projects, as we discussed before. A number of client companies mention the following.

First, there are positive economic impacts on the internal management and organization, especially on the increase of employees' morale, regardless of the types of projects. This increase of morale is expected to lead to an increase of productivity in the future and so on, although it is difficult to be quantified.

Second, there is the improvement of the customer relations and marketing activities in terms of perception and image, by the increase of product quality, especially by the ISO certification. It is expected to make the customer relationship more stable and make the marketing easier.

Third, there is the positive economic effects caused by the greater awareness to the market demand, the importance of quality, international standards (ISO), and so on. Because one of the barriers for small and medium-size companies is the lack of awareness to the market and technology, as discussed in the previous chapter, these positive effects indicate the strength of the MMP's service.

Lastly, the positive economic impacts by knowing the resources, i.e., consultants, etc. Although only a few companies mention this impact, it indicates the long lasting

economic impacts of the MMP on the strengthening of industrial networks.

4.2.5. Conclusion

The company projects are expected to have a wide variety of economic impacts on the company and the regional economy. They are categorized as follows: direct economic impacts, operational economic impacts, induced economic impacts, and indirect/secondary economic impacts. Depending on the project type, the economic impact caused by a project will differ significantly. Because of the short history of the MMP, however, the performance data of the MMP survey are limited to the short-term direct economic impacts and short-term operational economic impacts of limited types. In addition, it should be noted that all of the economic impacts may not be attributable to the MMP.

Through the analysis of the actual performance data of the MMP company projects in this section, I find the following characteristics. First, the overall economic impacts to date are positive and generally consistent with the expectations. Especially, the economic impacts on the productivity and quality are very drastic. With respect to the project type, economic impacts caused by projects differ substantially, depending on the nature of the project type. Human resource projects, for example, have little quantifiable impacts to date, although they may have positive impacts in the long-term.

Second, the descriptive data indicate that there are other economic impacts on the internal management and organization, especially on the employees' morale, the improvement of the customer relations and marketing, the improvement of the awareness to the market and technology, and identification of the potential resources, i.e., university professors, consultants, etc. These economic impacts suggest the MMP has succeeded, to some extent, in removing the barriers for the small and medium-sized companies to cooperate and collaborate with the resources.

Finally, given the nature of the company projects, it may take a longer time for the economic impact on company and regional economy to materialize. Thus, it is necessary to track the companies to analyze the more complete economic impact data.

Notes.

1 All of the information is based on the information provided by Mr. Russ Green at the MMP and MMP, Center Progress Report, February 1994-August 1996: Three Years of Service to Massachusetts Manufacturers. (Boston: Corporation For Business, Work, and Learning, 1996); S. Ellis, I. Ladd, and E. Heller, Donahue Institute, University of Massachusetts, Year Three Evaluation of the Massachusetts Manufacturing Partnership: A Comprehensive Review of MMP Projects, Customers, and Outcomes (Boston, University of Massachusetts, Forthcoming); the interview with Jan Pressler, director, MMP (March 24, 1997); and the interview with Jerry Rubin, executive director, Greater Boston Manufacturing Partnership (April 7, 1997).

2 With respect to the definition of these areas of projects, please see the APPENDIX: DEFINITION OF PROJECT TYPES BY MMP.

3 All of the information is based on the data provided by Mr. Russ Green at the MMP and MMP, Center Progress Report, February 1994 - August

1996: Three Years of Services to Massachusetts Manufacturers. (Boston: Corporation For Business, Work, and Learning, 1996).

4 The customer satisfaction surveys are carried out by the Donahue Institute, whereas the other two are by the MMP itself. The survey data are collected by a telephone survey process, immediately after the project completion.

Chapter 5

CONCLUSION

5.1. Findings of the Study

The discussion and key findings of this research can be summarized as follows. In the beginning, I discuss today's competitive environment in general, in which productivity improvement and innovation are the major focus of competition. I also examine the economic rationale of cooperation and collaboration among firms and between firms and public institutions, universities, consultants, etc., as strategic practices for improving the competitiveness in today's global economy.

However, in reality, the case of small and medium-sized manufacturers in Massachusetts illustrates that it may not be easy for them to cooperate and collaborate with outside resources, i.e., consultants and universities. My research shows that they seem to have some barriers, such as the lack of internal resources (financial, technical, time, organizational, etc.), the lack of awareness to the changes in the market and/or technology, and the lack of information and networks about the resources. Because the actual performances or track records of the resources are not usually disclosed, companies have very little information about the expertise and quality of them. Moreover, most of university laboratories and professors are not accessible to small and medium-sized companies without particular

connections. Thus, it may be very difficult for companies to make rational choices of resources, which, in turn, may make companies hesitate to cooperate and collaborate with these resources. In addition, companies often fail to define their own problems clearly and correctly. In short, because of these various kinds of barriers, the resources may be underutilized by firms, and cooperation and collaboration between firms and resources may not become well developed.

The MMP was established as a public/private partnership entity to improve the competitiveness of small and medium-sized manufacturers in Massachusetts. The MMP puts its emphasis on the cooperation and collaboration with the resources, while it also facilitates the interfirm cooperation and collaboration, in conjunction with two other units in the CBWL. The MMP is supposed to provide several incentives for small and medium-sized companies, such as financial subsidies to the projects, broad base services including the initial diagnosis and the identification of the problems, and the information and networks with the consultants, universities, etc.

However, in actuality, the achievements of the MMP to date are limited and ambiguous, because of the following reasons, although the performances of the projects are generally positive. First, the MMP services may not be applicable to every industry. Indeed, there is a wide variation of the penetration ratios among industries. Although I have not reached a definite explanation, this

variation indicates that the actual demand for cooperation and collaboration may vary significantly across industries, depending on a couple of factors at industrial and individual company levels, such as the industry infrastructure, corporate culture, and so on.

Second, the MMP seems to have difficulties to reach small companies, compared to medium-sized companies, despite their importance in the economy.

Third, the MMP services may not be appropriate to support such areas as the innovation, product design and development, which are thought to be critical components in today's competition. It may be partly because companies do not have enough "trust" to expose their key technologies, which are their own key sources of competitiveness, to an outsider as the MMP.

The MMP projects are expected to have broad economic impacts, not only on the client company's profit, but also on the regional economy. However, only limited types of impacts in the relatively short-term are collected systematically. In addition, we should bear in mind that all of the economic impacts of the projects may not necessarily be attributable to the MMP.

According to these data, the overall economic impacts on company's profits are positive on the average. The quantifiable economic impacts to date differ significantly by the project types. Generally, the projects that affect the production process directly have relatively larger economic

impacts than the more indirect projects, such as human-resources projects, as expected. It may be partly attributable to the fact that all of the economic impacts have yet to materialize.

In addition to these quantitative economic impacts, there seem to be other qualitative economic impacts as well. Such impacts include the improvement of morale of workers, improvement of awareness of the market and technology, better customer relationships, the establishment of networks with consultants and universities, etc. Although these economic impacts cannot be quantified, they may be even more important than the quantifiable economic impacts in the long run. These qualitative economic impacts indicate that the MMP has succeeded in removing the barriers, to some extent, for firms to cooperate and collaborate with resources.

Based on these findings, the following topics may be raised for future research questions.

The first issue is the effectiveness of the MMP model for such areas as product development and design. As I discussed in the previous chapter, the MMP model may not be the right vehicle to support these areas. If the MMP is not the appropriate model in these areas, what model may be the right vehicle as a regional economic policy?

The second issue is the applicability of the MMP model in other regions with other economic contexts. The positive performances of the MMP may certainly be attributable to the rich technology and engineering resources and the diverse

industrial activities of Massachusetts. Thus, it is questionable if the MMP model would work well in other areas with poor resources and/or less diverse industry activities.

The third issue is the evaluation of the MMP and other units in the CBWL as the vehicle to facilitate the interfirm cooperation and collaboration, which may also be very important from the viewpoint of the regional economic development policy. If the MMP model is not effective in the interfirm cooperation and collaboration, what model may work better?

The last issue is the applicability of the MMP model in other types of industries, such as the service industry. What aspects of the MMP model may be applicable in other industries?

5.2. Policy Implications

Based on the findings I analyzed in the previous section, I will discuss the policy implications to the MMP.

First, the MMP should develop a coherent industry-targeting strategy, by integrating and coordinating the regional level strategies developed by the regional offices. In that way, the MMP staff could concentrate their efforts, while being able to respond to the particular industry needs in each region, despite the financial cutback in the future.[1]

Second, the MMP should keep and improve its strength. Especially, the MMP staff should accumulate data and information on the project performances by consultants and

universities systematically. Thus, the more the MMP undertakes the projects, the better MMP's information on the resources become, which make the MMP's service more attractive for companies.

Third, the MMP staff should develop long-term relationships with client companies, consultants, and universities to establish the "trust," so as to support them to cooperate and collaborate in the broader areas, such as the innovation, product development and design.

Finally, the MMP staff should collect more extensive and long-term economic impacts data, so as to make the economic impacts evaluation more comprehensive and accurate, because the project economic impacts evaluation is a critical marketing tool for the public investors of the MMP. Currently, the economic impact data collected are limited mainly to the direct economic impacts (investment) and the short-term operational economic impacts to the client company. Especially, the MMP should collect the information about the benefits of using the MMP in those projects that would have been undertaken even without the MMP. By so doing, the economic impacts attributable to the MMP could be distinguished from the total projects economic impacts. Thus, for example, in the questionnaire, the MMP should ask how the MMP's assistance actually changed the project substance and outcome. The MMP also should conduct another economic impact survey a couple of years after the end of the project (currently one year after the project), because the

project economic impacts of some projects areas may take a long time to materialize. Moreover, the MMP should collect data on the non-assisted companies as a control group to make an accurate comparison between the assisted companies and non-assisted companies.

Through these various policies, the MMP may achieve greater economic impacts on the client firms and the regional economy, and it may play a larger role as the infrastructure for the cooperation and collaboration among firms.

Note.

1 According to Pressler (1997), funds for the MMP are going to decrease in the fourth year (1997) from the previous year.

APPENDIX: DEFINITIONS OF PROJECT TYPES BY MMP

CAD/CAM/CAE

Any computer based technology related to design, engineering, automated manufacturing and the necessary interchange of data between computer, vendors, and suppliers.

CAD: Computer Aided Design
CAM: Computer Aided Manufacturing
CAE: Computer Aided Engineering

EDI/Communication/LAN

Computer to computer communications across local area networks, over any communications networks linking computer facilities, or vendor-supplier electronic data interchange.

EDI: Electronic Data Interchange
LAN: Local Area Network

Business Systems/Management

Manual or computer systems dealing with business information and logistics flow within an enterprise. Includes materials management, inventory planning and control, factory orders, routings, bills of materials, cost management, procurement, billings, order entry, and other related systems.

Environmental

Assessment of hazardous materials, discharge, waste products, and other environmental effects within a manufacturing operation.

Quality/Inspection/ISO

The process by which a product is determined to meet specifications. This includes quality planning, procedures, procurement, inspection, failure analysis warranty rework, and all other factors which are part of the cost of quality.

ISO: International Standard Organization

Plant Layout/Manufacturing Cells

The methodical evaluation and analysis of a plant's products to determine the most efficient means of manufacturing or assembly through reorganization of the process flow through the facility.

Automation/Robotics

The design, development, or application of automation and robotics technology to manufacturing or assembly.

Control Systems/Integration

The application of monitoring and measurement devices, data collection, and automation gauging to a manufacturing process to provide automatic or semi-automatic feedback for

the control or the process. This includes machine controllers, programmable logic controllers, and computers for feedback, analysis, and control mechanisms.

Market Development

Utilization of marketing information such as on-line databases to formulate marketing strategies and/or determine opportunities for new or enhanced products.

Material Engineering

Evaluation and analysis of current applications to determine failure causes, wear patterns, or other desired parameters. Also, the development of new materials for a product.

Process Improvement

Evaluation of a manufacturing process to determine time wasting activities and eliminate them from the process.

Product or Design Improvement

The creation or enhancement of a product, including the necessary plans, drawings, and material lists for implementation.

Human Resources

This includes work organization, employee involvement and empowerment, compensation and benefits, communications, management methods, and organizational culture. This also includes all types of training, such as technical skills, use of new technologies, basic workforce skills, teamwork and problem solving, etc.

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