REGIONAL EMPLOYMENT BOARD
OF HAMPDEN COUNTY, INC.

PRECISION MANUFACTURING REGIONAL ALLIANCE PROJECT (PMRAP)

MASSACHUSETTS CENTER FOR ADVANCED PRECISION MANUFACTURING TECHNOLOGY (MCAPMT)

THE FEASIBILITY STUDY

FINAL REPORT

December, 2010

Developed under the Precision Manufacturing Regional Alliance Project (PMRAP)

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Massachusetts Center for Advanced Precision Manufacturing Technology (MCAPMT)

The Feasibility Study- Final Report

Section I- Executive Summary

Technology enabled precision manufacturing is one of the most important industry clusters in Massachusetts and in the Pioneer Valley Region. With over 8,000 employees in more than 300 companies and a location quotient well above the national average, precision manufacturing is highly concentrated and a critical sector to the economic well-being of the region. The mostly small companies are contract manufacturers and are primarily engaged in supplying precision mechanical components and sub-assemblies for the aerospace, defense, medical device, and power generation markets, both in the United States and internationally. They are part of a supply chain for prime contractors or original equipment manufacturers who persistently demand that their suppliers maintain exacting quality standards at competitive and reduced pricing. A major new shift for businesses in this sector is the insistence that their supply chain become a value chain, accomplishing more value-added tasks, including assembly and final product work. As a result, the success of small businesses engaged in precision manufacturing in the US requires intensified collaborative activities, cost effective shared services, diversification of markets, infusion of new technologies aimed at targeted growth markets, increase in the talent pipeline, and an infrastructure that supports national or global innovation needs – the Massachusetts Center for Advanced Precision Manufacturing Technology (MCAPMT "the Center") aims to respond to these needs.

The Western Massachusetts Chapter of the National Tooling and Machining Association (WMNTMA), an organized group representing 37 precision machining companies employing 2,051 people (December 31, 2009), and industry leaders from the Pioneer Valley recognized that in order to compete in today's global economy, companies need to have not only highly skilled labor, but must stay at the forefront of manufacturing technologies and processes. The group, in conjunction with the Regional Employment Board of Hampden County (REB), received $500,000 in state funding in September 2008 through the Massachusetts Technology Collaborative-John Adams Innovation Institute. The grant for the Precision Manufacturing Regional Alliance Project (PMRAP) was aimed at achieving the following objectives:

- Develop a model for a center for advanced precision manufacturing technology, pilot and test major elements of the Center, and assess the feasibility for a sustainable organization.
- Validate approaches for new technology development and applications engineering support that will enhance local Small and Medium Size Enterprises' (SMEs) capability, strengthen their existing manufacturing platforms, and position them to be competitive in order to enter highly specialized growth markets including alternative energy, medical devices and precision instrumentation.
- Identify new workforce skills and develop creative avenues for labor force development at partner institutions.

PMRAP and the center assessment phase were managed by a Steering Committee representing regional stakeholders. The committee includes: The Regional Employment Board of Hampden County, Inc. (Lead Agency), Western Massachusetts Chapter of the National Tooling and Machining Association, Economic Development Council of Western Massachusetts, World Institute of Strategic Economic Research at Holyoke Community College, University of Massachusetts/Amherst, Springfield Technical Community College, and six technical high schools in Hampden, Hampshire and Franklin Counties.

As detailed in this study, building on the lessons from PMRAP will reduce the Center's startup risks and costs and accelerate the implementation of the planned activities. The MCAPMT will be established in phases to include the following functions and programs: Technical services and shared resources; Technology development; Workforce development/education programs; Early stage prototype development/pre-product pilot; Industry consortium and liaison; Facility and capital equipment for advance fabrication and test.

The Center's financial sustainability will include leveraging revenues from various sources, including: a) Federal and state grants, b) Fee for service, c) Grants from foundations looking to support workforce and industry development, d) Federal contracts, e) Private sector funding and cost sharing to various programs; and f) Royalties on new intellectual property resulting from technology development or technology transfer projects.

The feasibility and the implementation analysis for the advanced manufacturing center have already resulted in recognition that:

1. The Center can have significant impact on the competitiveness of local small companies, resulting in measurable job growth or job retention, and increased regional economic development.
2. The Center can provide value to the national R&D and procurement system through the infusion of new manufacturing technologies, resulting in cost reduction and improved reliability of performance.
3. The Center can be self-sustained by Year 5.
4. The Center can offer innovative levers to recruit and attract new industry in emerging technologies to western Massachusetts.

Building on the success of the PMRAP, the Steering Committee and the broad stakeholders have already constituted an article of organization for a center for advance precision manufacturing technologies as a 501(c) (3) Not For Profit Corporation in the Commonwealth of Massachusetts.

Highlights

- **Industry needs are real - A manufacturing technology center in western MA will strengthen and grow a key local industry cluster and a critical employment source**
- **Key components and leadership are already in place- PMRAP is a local program that is building the foundation for the Center through a State funded project**
- **The conceptual assumptions for the MCAPMT and the implementation were tested and analyzed offering confidence in the project, the opportunities and the outcomes**
- **Long term sustainability is feasible beyond Federal and State start-up support**

Section II- Overview

The Massachusetts Center for Advanced Precision Manufacturing Technology is an economic and business development strategic initiative that integrates technology development, education, and industry cooperation. Focusing on the special needs of small and medium size enterprises (SMEs) as primary employers of the manufacturing workforce and suppliers to the defense, aerospace, energy, and life sciences sectors, the Center will support technology based industry, ensuring that workers in precision manufacturing companies have the necessary technical skills, and the companies adapt competitive new and evolving manufacturing technologies as well as efficient, low cost operation methods. The Center will provide companies with shared engineering and marketing support and assist small companies to engage new/emerging markets. The desired outcomes of this initiative include job retention, job growth, and sustainable regional economic development, as well as better products and services primarily for the national defense enterprise.

MCAPMT Vision

The Massachusetts Center for Advanced Precision Manufacturing Technologies will act as a central node and catalyst for technical services and growth strategies that benefit the precision manufacturing industry in the Commonwealth. The Center still requires intensive development, however the following vision was validated by the current PMRAP project which implemented and tested major elements, piloted some of the initiatives, and assessed the feasibility for a sustainable organization.

The Center will provide the intersection and integration of the following elements:

Technology development- derived from research results at universities, industry, and global suppliers, with primary emphasis on "market pull."

Education consortium- programs aimed at skills required by new technology and markets as well as applicable innovative workforce development measures for incumbent and new workers and throughout the k-12 pipeline.

Industrial Affiliates- the Center's foundation is a collective of affiliated institutions/ companies. Therefore, its services and development programs will respond to the interest of multiple stakeholders.

MCAPMT Mission

The mission of the MCAPMT shall be to provide a precision manufacturing "focal point" that offers services, contributes to workforce development initiatives, and leads growth strategies in the following disciplines:

Technology Development- The Center will work with research and education institutions throughout the Commonwealth to monitor evolving manufacturing technologies relative to materials, tools and processes. Establish internal capabilities to develop and test new technologies identified by local precision manufacturing companies as a priority.

Engineering Services- The Center will establish engineering services that will assist precision manufacturing companies in developing more efficient manufacturing processes. Supplement applications engineering efforts at small, precision manufacturing shops in order to support them in meeting growth goals.

Skilled Labor Pipeline- The Center will coordinate training for incumbent workers in order to insure they stay abreast of evolving technologies and techniques. Facilitate educational programs for grades k-12, vocational high schools and community colleges to inform and insure that students and faculty are trained for the "jobs of tomorrow."

Marketing- The Center will develop programs to identify strategic markets for the Massachusetts precision manufacturing companies and initiate activities to promote the industry and region in those markets.

The Center will intensify local partnerships, and optimize collaborative links across the State. Such links are essential to effective integration and growth. Initiatives will be consistent and reinforcing so that regional activities in economic and workforce development are in harmony.

It is expected that MCAPMT will act as an operational infrastructure to support new programs which are attractive to sustainable investments.

MCAPMT Objectives:

The MCAPMT will focus on implementing the following objectives:

a. Undertake manufacturing technology development activities to assist industry in market diversification, competitiveness, quality and cost reduction measures:
   - Work with research and education institutions throughout the State to stay abreast of evolving manufacturing technologies relative to materials, tools and processes.
   - Establish internal capabilities in conjunction with university partners to develop and test new technologies as needed by local precision manufacturing companies.
   - Undertake collaborative initiatives in manufacturing technology development with research and industry partners.

b. Provide engineering services to industry partners:
   - Develop an engineering services team that can work with local precision manufacturing companies to develop more efficient manufacturing processes.
   - Supplement applications engineering efforts at small, precision manufacturing shops in order to assist them in meeting growth goals.

c. Improve and expand regional skilled labor pipeline
   - Provide training for incumbent workers in order to insure they stay abreast of evolving technologies and techniques.
   - Develop educational programs for grades 5-12 which educate youth about career opportunities in precision machining.
   - Work with Manufacturing Technology Programs at local vocational high schools and community colleges to insure that students and faculty are trained for the "jobs of tomorrow."

d. Establish marketing programs to promote partner industry and regional precision manufacturing capacity:
   - Develop programs to identify strategic markets for western Massachusetts precision manufacturing companies and coordinate activities to promote the industry and region in those markets.
   - Facilitate joint new product development projects between OEM/Prime contractors with marketing channels and local companies.

Assumptions for the Feasibility Assessment

The feasibility assessment was conducted based on the following assumptions:

a. The Center will be tailored primarily to service the precision machining industry, additional capabilities will be considered for other precision manufacturing (e.g. plastics and optics) as a lower priority.

b. Shared resources and facilities can be used effectively, overcoming proprietary issues and competitive pressures. These concerns can be resolved satisfactorily through operational policies and facility layouts.

c. Intellectual Property (IP) and technology commercialization will be provided by UMass Amherst as well as from other research institutions and private sources.

d. Market demands and new applications projections will be forecasted using current and publicly available estimations. Recognizing the large uncertainty that exists in such task, estimations will be a rough order of magnitude only.

e. Funding assumptions will be detailed as part of the budget development. Whenever possible, best-case/worse-case scenarios will be considered.

f. Industry "pull" side of the technology is the dominant factor in the design of the Center and the selection of functionality/implementation.

Criteria for Concept Development

The Criteria for selecting functionality and operation of the Center was determined by the needs of the industry, primarily the precision machining industry and secondarily the precision manufacturing industry. The criteria included the following elements:

- Fit with current strengths and maximizing response to present needs of the Precision Manufacturing industry in the region
- Maximize services for future needs (new markets/new technology/industry trends) of the Precision Manufacturing industry in the region
- Leverage education/workforce training capacity of local community colleges and universities
- Effectiveness/realism of possible operating procedures and policies (e.g. IP)
- Return on Initial Investment- TBD
- Self sustainability over time (early transition to self sustainability is high priority.)
- Maximize economic development benefits (business growth/retention or jobs creation)
- The Center's facilities and each of its associated operation (functional elements) shall have the potential to be a nationally recognized manufacturing services entity.
- Support of strong local champions (interest, knowledge and "clout")
- Indirect impact on Springfield and/or neighboring towns (e.g. service industry, education institutions, public infrastructure.)
- Facility recommendation- utilization of existing town infrastructure and fit within town growth plans.
- If phased implementation is considered, "built out" to steady state size/operations should be done as soon as practical but in not more than 7 years.

Section III- The Regional Precision Manufacturing Sector

The perception that the heyday of U.S. manufacturing is in the past, could not be further from the truth, especially for the precision manufacturing cluster in Massachusetts. As detailed in a 2006 National Association of Manufacturing (NAM) report, and is still correct today, there are various manufacturing "pillars" that support the viability of the manufacturing sector in today's U.S. economy[1]:

- It makes the **highest contribution to economic growth** of any sector;
- It is responsible for more than **70 percent of private sector research and development** and the center for a wide range of advanced technologies that cut energy use and lead to a cleaner environment;
- It achieves a **high productivity rate year in and year out**, increasing by more than 50 percent in the past decade;
- It contributes more than **60 percent of U.S. exports** or about $50 billion a month;
- It pays **wages and benefits that are about 25 percent higher** than in non-manufacturing jobs;
- It has a **large output multiplier effect of 2.43** - every $1 of manufacturing product sold to a final user, generates an additional $1.43 of intermediate economic output. Because manufacturing is using intermediate goods and services in its production process, it creates substantial economic activity at the intermediate level. More than half ($0.77) is outside the sector in other industries, and $0.66 is within the sector. By comparison, the Information Technology sector has a multiplier effect of 1.8 ($0.80 for every $1), and Education and Health Services has a multiplier effect of 1.7 ($0.70 for every $1 of service sold.) Additionally, the manufacturing sector has a large employment multiplier of 3.0 - as a result of the industry's purchases of goods and services, and the consumer expenditures by its employees, for every one (1) job in manufacturing two (2) more jobs are required by other firms.

However, manufacturing in the U.S. is facing many challenges, especially in the areas of **costs** and **attraction of young people to pursue a career in manufacturing**. Eighty one percent of respondents to the Institute/NAM 2005 Skills Gap survey said they could not find qualified workers to fill open positions. Structural costs such as taxes and health care add 31.7 percent to U.S. manufacturing costs, making it more difficult to produce from a U.S. base. The precision manufacturing sector in Massachusetts and the Pioneer Valley Region reflects the same general strengths and threats that face the US manufacturing sector. This feasibility assessment builds on the local cluster as representative of the industry both in Massachusetts and in the United States.

[1] NAM- The Facts About Modern Manufacturing, Oct 2006. Source of data: U.S Department of Commerce.

1. CLUSTER PROFILE

The Region

The feasibility study focused on the Pioneer Valley Region in Massachusetts – a general name for the region which encompasses the three counties of Franklin, Hampshire and Hampden –see orange colored section in figure 1. However, the Pioneer Valley section of Massachusetts is better characterized economically as part of the "Knowledge Corridor"- a highly inter- dependent region that straddles the border between western Massachusetts and northern Connecticut.

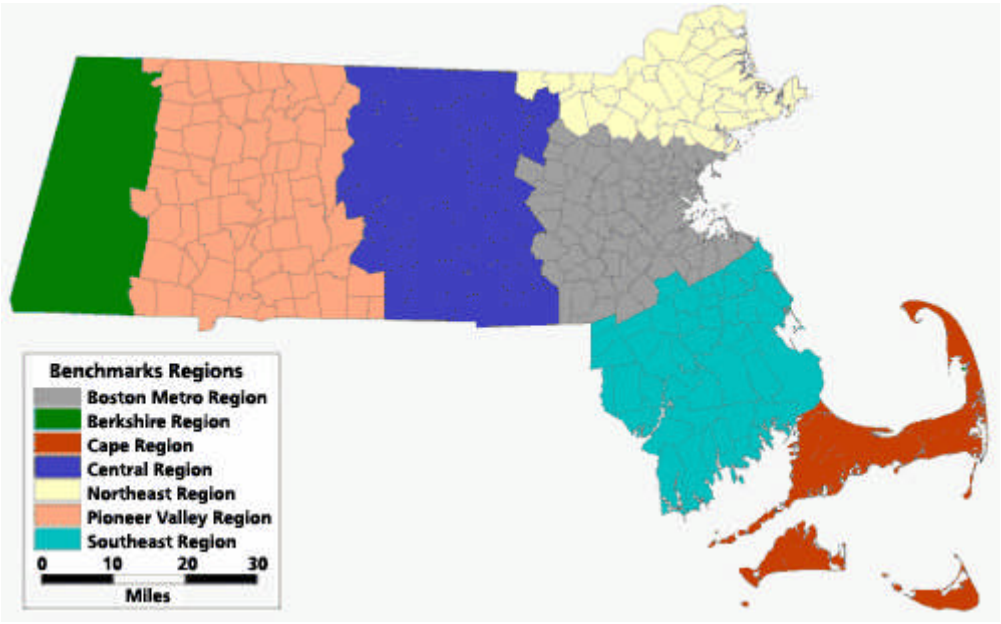


Figure 1- Massachusetts Regions[2]

The Knowledge Corridor encompasses the Hampden, Hampshire and Franklin Counties in Massachusetts and the Hartford County (See ***Attachment - B*** for map details.) in Connecticut.

Linked by Interstate 91, a shared international airport, and industrial and cultural heritage, and only 25 miles apart, the cities of Hartford, CT and Springfield, MA anchor a regional economy that constitutes the second largest population, education and economic center in the New England economy, located 90 minutes from both the New York City and Boston metropolitan areas. The Corridor's strengths include the quality and number of the educational institutions, the quality of the work force, a robust regional transportation network, and citizens' ready access to outstanding health care, cultural and recreational opportunities.

Precision Machining: An Industry within the Precision Manufacturing Sector

The region's precision machining cluster has a primary focus on the machining of metal products, and is part of the larger precision manufacturing sector that includes the additional manufacturing of products for the plastics, paper, machinery, instrument, and electronics industries. Accordingly, the precision manufacturing sector is best defined by NAICS codes

[2] University of Massachusetts Donahue Institute, Economic and Public Policy Research Unit http://www.massbenchmarks.org/publications/studies/pdf/EDA_SE.pdf

326X, 327X, 331X, 332X and 333X (and sometimes 339X) as detailed herein (see ***Attachment - C*** for a detailed breakdown):

3321- Forging and stamping (*)

3327- Machine shops and threaded product mfg. (*)

3328- Other fabricated metal product manufacturing (*)

3315- Foundries (*)

3332- Industrial machinery manufacturing (*)

3335- Metalworking machinery manufacturing (*)

333314- Optical instrument and lens manufacturing

3261-Plastics product manufacturing

3391- Medical equipment and supplies manufacturing

In general, Precision Machining is a subset sector within these industries, and is mainly present in the categories marked with (*) above. The Precision Manufacturing Regional Alliance Project (PMRAP), under which the feasibility study was done, focused on the precision machining sector and the innovation, technology development; work products and lessons learned from the project can be readily transferred to and shared with the companies in the larger precision manufacturing sector.

Definition of Precision Machining

Precision machining refers specifically to making parts and components to very tight tolerances and high surface finishes using advanced machines and innovative operations and processes. These requirements are maintained for a wide range of geometries, materials and applications. Precision machining requires high performance in areas such as: 1) machine geometry and construction, 2) motion control, 3) thermal and environmental control, 4) tooling selection and application, 6) machining strategy, and 7) real-time performance monitoring and correction.

Description of the Precision Machining Cluster

High technology precision machining is one of the most important industry clusters in the Pioneer Valley Region. The precision machining companies in the Region, led by the Western Massachusetts Chapter of the National Tooling and Machining Association (WMNTMA), are contract manufacturers that are primarily engaged in supplying precision mechanical components and sub-assemblies to major commercial manufacturers, aircraft engine builders, and military equipment contractors in the United States and internationally. The companies perform value-added precision manufacturing processes and operations utilizing mostly software-controlled equipment and world class manufacturing technologies.

The precision machining companies represented by the WMNTMA are generally classified in NAICS 332B (primarily 3327.) The dominant NAICS classification and industry distribution of the Precision Manufacturing companies in the Pioneer Valley are illustrated in figure 2[3]

[3] Source of data: 2008 County Business Patterns (NAICS) http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl

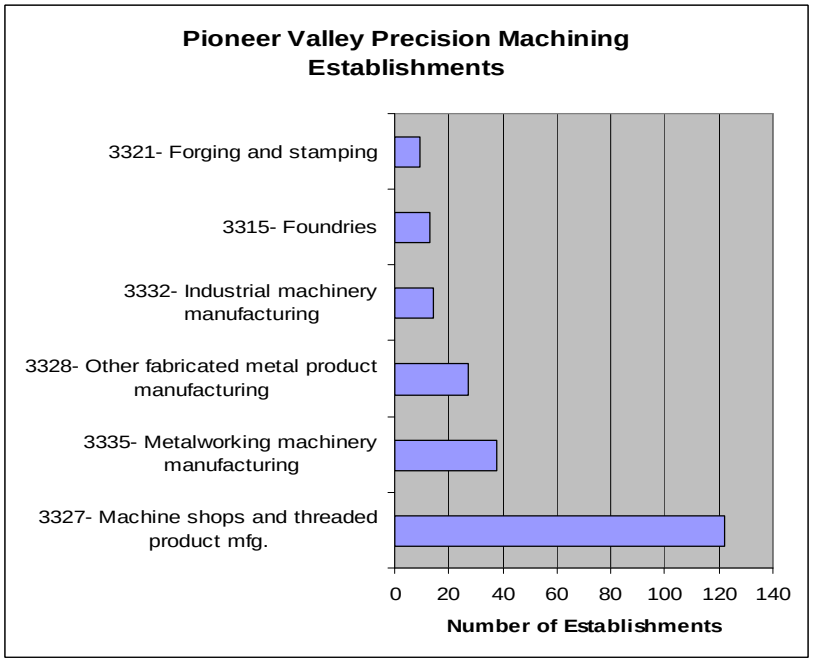


Figure 2

Most of the companies in the sector are small as illustrated by the number of employees, number of establishments and average size in the generalized categories in table 1[4]: However, as shown in Table 2, the region has a disproportionate share of the mid-sized precision manufacturing companies (100-499 employees) in the state.

Table 1- Pioneer Valley Precision Machining Companies

	# Employees	Establish-ments	1 – 4	5 – 9	10 – 19	20 - 49	50 - 99	100 -249	250-499	500-999
3321- Forging and stamping	154	9	1	1	4	2	1	0	0	0
3327- Machine shops and threaded product mfg.	2581	122	37	34	22	19	4	5	1	0
3328- Other fabricated metal product manufacturing	1666	27	11	6	4	2	0	3	0	0
3315- Foundries	122	13	5	2	3	2	1	0	0	0
3332- Industrial machinery manufacturing	232	14	4	3	2	4	1	0	0	0
3335- Metalworking machinery manufacturing	653	38	14	7	10	3	2	2	0	0
Total Precision Machining	**5408**	**223**	**72**	**53**	**45**	**32**	**9**	**10**	**1**	**0**

[4] Source of data: 2008 County Business Patterns (NAICS) http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl

The companies in the cluster have invested extensive resources in building their manufacturing capacity by improving operating processes and are heavily invested in the aerospace and defense industry. Since these markets are cyclical, the long term prosperity and growth of the precision machining firms as part of various supply-chains might be at risk and be jeopardized by global market changes. The sector faces a shrinking available workforce, increased competitive strains from off-shore suppliers, and market pressures that might put at risk businesses and employment in the Region.

Table 2- Number of Precision manufacturing firms by size MA and Pioneer Valley (4digit NAICS)[5]

	# Employees	Establish-ments	1 – 4	5 - 9	10 - 19	20 - 49	50 – 99	100 – 249	250 - 499	500-999
Total Pioneer Valley Precision Manufacturing	7884	293	89	64	53	41	19	21	5	0
Total MA Precision Manufacturing	54639	1869	623	353	317	318	141	87	24	3
PV as % of MA	14.4	15.7	14.3	18.1	16.7	12.9	13.5	24.1	20.8	0.0

2. MARKETS AND PROJECTIONS

The precision manufacturing industry in general and the precision machining sector specifically, are either active or are targeting future business opportunities in the following markets:

Aerospace
Defense, including Robotics
Medical Devices
Renewable Energy Devices
Laboratory Instrumentation

The following information and charts illustrate the opportunities and challenges of these markets:.

Sales Growth

As detailed in figure 3 for corporate R&D expenditures of publicly traded companies in Massachusetts, between 2003 and 2008, defense manufacturing and instrumentation had an average annual sales growth of over 7% (on a base of over $39B), while bio, pharma, & medical devices had an average annual growth rate of over 21% (on a base of over $18B.) Therefore, these two markets are attractive business development targets for the precision manufacturing sector in the Commonwealth.

R&D Expenditures

R&D investment by Massachusetts corporations in bio/pharma and medical devices, and in defense manufacturing & instrumentation is very high (see figure 4), putting pressure on suppliers to stay abreast of new technologies and be ready to assist in new product development.

[5] Source of data: 2008 County Business Patterns (NAICS) http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl

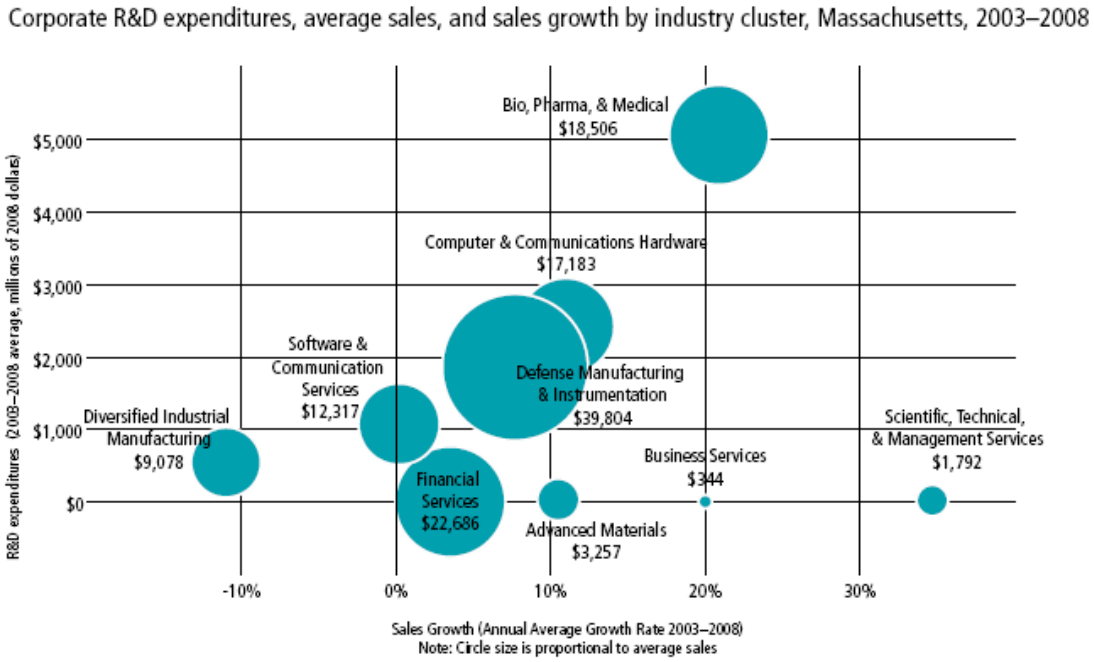


Figure 3[6]

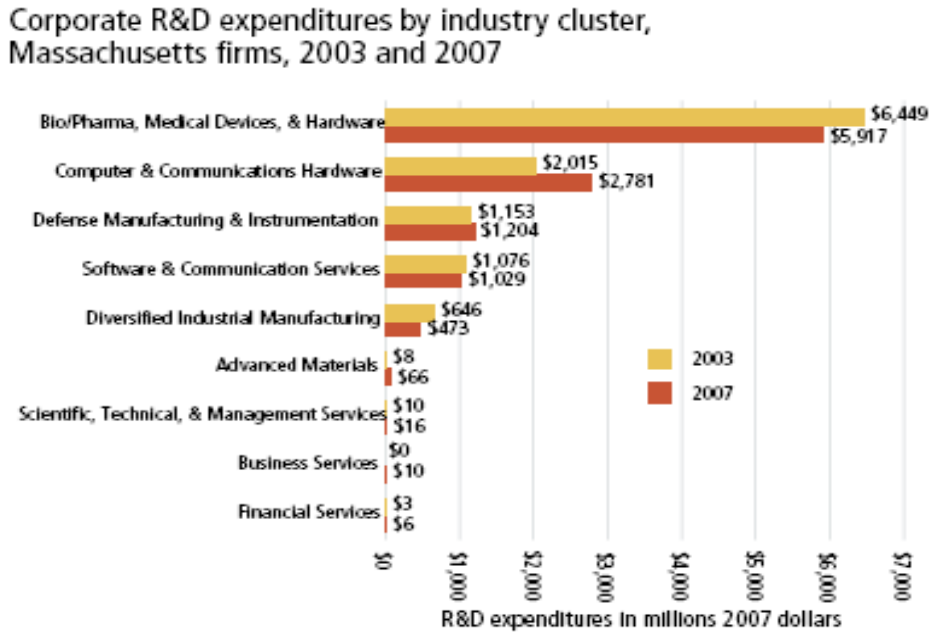


Figure 4[7]

[6] Source: Source: Standard & Poor's COMPUSTAT as compiled in the 2009 Index of the Massachusetts Innovation Economy- JAII/MTC
[7] Same

Exports

Medical instruments are the fastest growing export sector in Massachusetts (see figure 5 for 2002-2005 data) offering the precision manufacturing and machining suppliers new/growing opportunities for new applications/customers. Other target markets have growing exports as well.

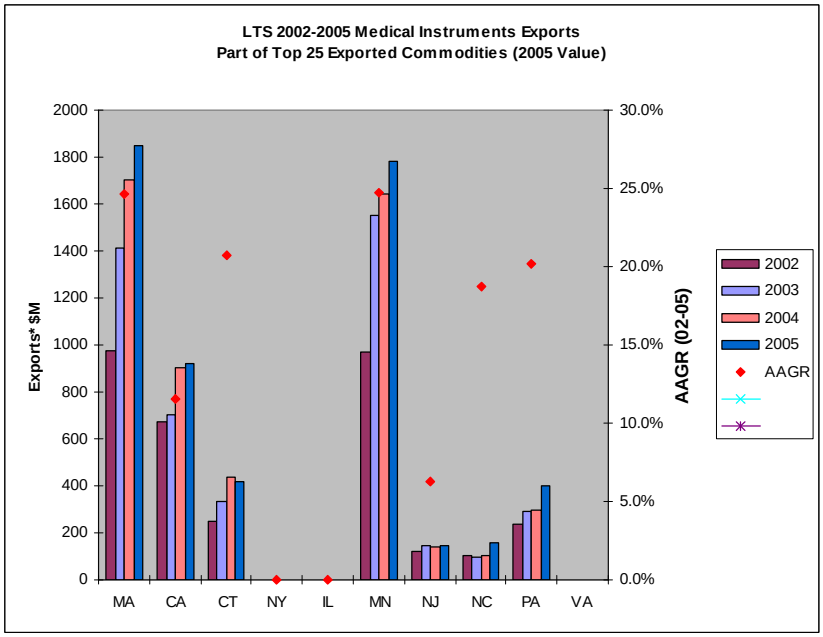


Figure 5[8]

3. LOCAL INNOVATION INSTITUTIONS

Western Massachusetts has outstanding research and education resources that offer pipeline for talented workforce as well as research /innovation results for the local manufacturing industry- UMass in Amherst, Springfield Technical Community College, and Western New England College, to name a few. However, in the broader context, the Knowledge Corridor boasts an extraordinary concentration of colleges, universities and graduate schools that is *10 times the national average*, serving more than 115,000 students annually. Thirty-two institutions, including two major land-grant universities, several state universities, community colleges, two major medical and dental schools and a number of top-tier liberal arts colleges are located in a compact geography within a 45-minute drive from Bradley International Airport. At least three (University of Massachusetts Amherst, University of Connecticut, and Yale University) have nationally recognized research programs that are directly relevant to our manufacturing and growth industries, including renowned nanotechnology research. These higher education facilities are one of the Corridor's most recognizable assets and a driver for its economic development strategies.

[8] Source: http://www.census.gov/foreign-trade/statistics/state/data.html

Section IV- The PMRAP - Summary and Relevant Outcomes

The Western Massachusetts Chapter of the National Tooling and Machining Association (WMNTMA), an organized group of more than 60 companies employing approximately 4,000 people, and industry leaders from the Pioneer Valley (The Group) recognized that in order to compete in today's global economy, companies need to have not only highly skilled labor, but must stay at the forefront of manufacturing technologies and processes. This objective has also been identified by the US Department of Defense (DoD) as it needs US companies with advanced manufacturing capabilities to be cost effective suppliers. The Group, in conjunction with the Regional Employment Board of Hampden County (REB) received $500,000 in state funding in September 2008 through the Massachusetts Technology Collaborative-John Adams Innovation Institute. The grant for a Precision Manufacturing Regional Alliance Project (PMRAP) was aimed at achieving the following objectives:

- Develop a model for a center for advanced precision manufacturing technology; implement and test major elements of the Center; pilot some of its functions, and assess the feasibility for a sustainable organization.
- Validate approaches for new technology development and applications engineering support that will enhance local SMEs' capability, strengthen their existing manufacturing platforms, and position them to be competitive in order to enter highly specialized growth markets including alternative energy, medical devices and precision instrumentation.
- Identify new workforce skills and develop creative avenues for labor force development at partner institutions.

1. THE PARTNERSHIP

The following organizations are partners with the REB in the implementation of the Precision Manufacturing Regional Alliance Project, and were integrally involved in the feasibility study to establish the Massachusetts Center for Advanced Precision Manufacturing Technology:

- Western MA Chapter- National Tooling and Machining Association (WMNTMA)
- University of Massachusetts- Amherst
- Springfield Technical Community College
- Economic Development Council of Western Massachusetts
- Holyoke Community College
- Seven Vocational Technical High Schools in the Pioneer Valley Region

The project team received direction and support from the PMRAP Steering Committee that represents the partners and other interested regional stakeholders. The Steering Committee provided critical business intelligence in the design of the framework and structure of the MCAPMT, and is committed to continue to assist the project team in constituting the Center and implementing its functional elements.

Table 3: PMRAP Steering Committee Members

Name	Company/Organization	Name	Company/Organization
James D. Capistran	UMass- Amherst	Allan W. Blair	Economic Development Council of Western MA
John William Ward	Regional Employment Board	Ed Leyden	Ben Franklin Design and Manufacturing Co.
Susan M. Kasa	Boulevard Machine & Gear, Inc	Michael Suzor	Springfield Technical Community College
Jeffrey P. Hayden	Holyoke Community College	Larry A. Maier	Peerless Precision Inc./NCDMM
Eric D. Hagopian	Hoppe Tool Inc. (Chair)	William Amanti	Advance Manufacturing
Alfred Carrier	Putnam Voc. Tech. High School	Ann Burke	Economic Development Council of Western MA
Craig Moore	Consultant		

The Precision Manufacturing Regional Alliance Project focused on the needs of the precision machining sector. The innovation, technology development, work products and lessons learned from the project have been transferred to and shared with companies in the larger precision manufacturing cluster. The proposed Massachusetts Center for Advanced Precision Manufacturing Technology has been structured to respond to the needs of the precision machining sector as a 'core' requirement. The broader precision manufacturing cluster was a desired target and part of the Center's conceptual tradeoffs.

The Western Massachusetts Chapter of the National Tooling and Machining Association

The high technology precision machining companies that are members of the Western Massachusetts Chapter of the National Tooling and Machining Association are contract manufacturers that are primarily engaged in supplying precision mechanical components and sub-assemblies in the aerospace, defense, medical device, and power generation markets, both in the United States and internationally. The companies perform value-added precision manufacturing processes and operations utilizing advance tools and world class workforce. In CY 2009, Regular Member companies of the WMNTNA had the following employment levels and estimated gross sales (Sales and employment data does not include Smith and Wesson, a WMNTMA Associate Member):

Table 4: Estimated Gross Sales of Regular WMNTMA Member Companies (Adjusted for Changes in Company Membership)

Year	No. of Companies	No. of Employees	Estimated Gross Sales
2005	24	899	$108 Million
2006	29	993	$155 Million
2007	33	1281	$229 Million
2008	39	1386	$252 Million
2009	36	1201	$222 Million
Change '08-'09	(-) 3	(-) 185 (15.4%)	(-) $30 Million (13.5%)
Change '05-'09	(+) 12	(+) 302 (33.5%)	(+)$114 Million (106%)

Note: WMNTMA member companies represent approximately 30% of the total Machine shops and threaded product manufacturing establishments (NAICS 3327) in the Pioneer Valley and 46% of the employees in this sector. When compared to the total Precision Machining sectors (see table 1 above) they represent 16% of the establishments, employing 22% of the total sector workforce.

The regional industry members invested heavily in new equipment and are implementing lean manufacturing processes in order to improve their productivity and competitiveness. Despite a difficult business and economic environment in CY 2009, the dollar added value per employee among the WMNTMA regular member companies was $184,846, which is 1.6% higher than it was in CY 2008, and 7.8% higher than the last reported (2006) state-wide average of $171,358. This level of productivity was achieved despite a 13.5% decrease of sales in the WMNTMA regular member companies from CY 2008 total sales levels. As detailed in Section III, the high multiplier effects of the precision manufacturing industry propagate through the companies' supplier and support network, benefiting a large part of the economic base of the region.

The Strategic Goals of the WMNTMA

In response to changing market environment, the WMNTMA, as the established industry association representing the precision machining industry, revised its strategic goals for FY '10 to more accurately reflect the realities of the marketplace. The companies were committed to implementing the following goals to develop and strengthen the precision machining industry in the Pioneer Valley Region. The attainment of these goals was an important consideration in conducting the feasibility study for the development of the MCAPMT:

Goal 1 - Increase industry-wide awareness of the Pioneer Valley Region as an innovative and agile high technology precision manufacturing region.

- Collaborate with state and local officials to market for the Precision Manufacturing industry as a critical state-wide sector.

Goal 2 - Strengthen cluster development and increase business competitiveness

- Implement initiatives, activities and events that will strengthen companies' position in present markets, and identify new collaborative business strategies to increase penetration in new and emerging markets.
- Develop a Precision Manufacturing Legislative Agenda that defines sector needs.

Goal 3 - Build a well-educated, technologically skilled and highly adaptable STEM workforce.

- Build a more responsive and flexible education and training infrastructure that can meet the technical skills needed by new technology.
- Increase student enrollment and improve the graduation rate in all regional secondary Manufacturing Technology programs.
- Expand career pathway training programs and courses for incumbent employees.

Goal 4 - Transform industry capability to improve manufacturing processes and operations

- Continue to build partnerships with research universities to investigate new technology development that will improve the companies' productivity and competitiveness as suppliers.

2. PRECISION MANUFACTURING CENTER FEASIBILITY PILOTS

With the understanding that a precision manufacturing technology center would require intensive development, validation, and investment, PMRAP undertook a coordinated process that would implement and test major elements of the Center, pilot some of the initiatives, and assess the feasibility for a sustainable organization as well as study benchmark center models and collect stakeholders' opinion. The following (Figure 5) is the generalized model that was used as the conceptual framework for the PMRAP as a pilot and feasibility stage of the Center's vision.

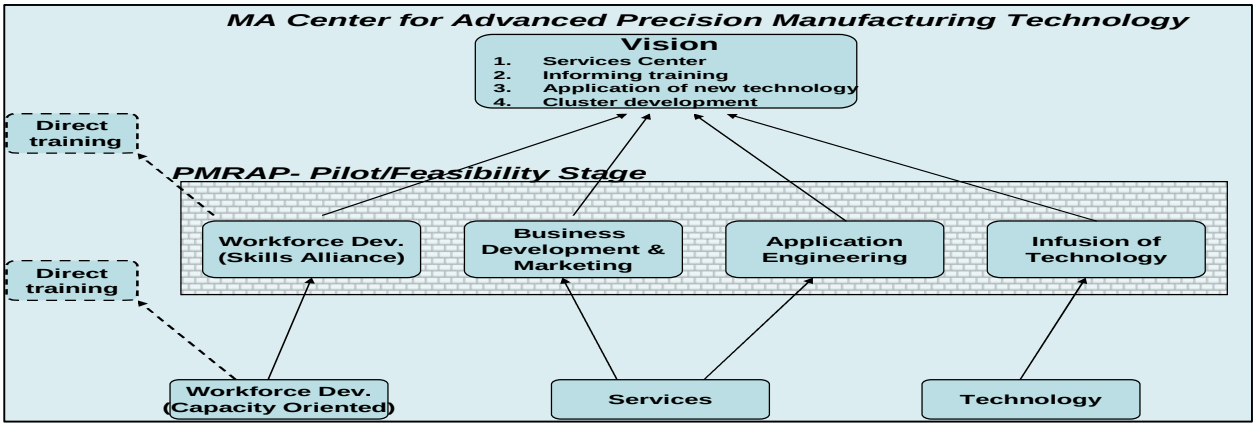


Figure 5

Accordingly, the Project had tested the following functional elements of the future center:

1. Shared services:
    - Technology Innovation and Application Engineer
2. Application/Infusion of new technology:
    - Technology Innovation Forums
    - Technology Transfer Projects
3. Cluster/Business development
    - Market Opportunities Forums
4. Workforce Development
    - Skills alliance / informed training

3. THE TECHNOLOGY INNOVATION AND APPLICATIONS ENGINEER (TIAE)

PMRAP has hired a degreed manufacturing engineer who served as a shared resource to the sector companies. The TIAE acted also as the technical liaison between the companies and the faculty researchers at UMass to facilitate the convergence of industry driven technology needs with applicable university research.

In order to better understand the work and responsibilities of the engineer, the project team, as part of the needs assessment referenced in Section V part 2, asked the companies to respond to the following:

a. Importance of a TIAE to their company
b. Examples of specific work and projected tasks for the Technology Innovation and Applications Engineer

The specific responsibilities/work tasks with which the TIAE can best assist industry were identified and were very similar to the categories of services, supports and activities that the companies

indicated they would require in order to move to more value-added manufacturing. This preliminary survey confirmed the following areas of high priority for shared technical services:

- New Materials Technology
- Tooling, Fixturing and Machining Technology
- Work Process Improvements
- Quality Assurance, Process Control and Inspection

The Technology Innovation and Applications Engineer began work in May 2009. During the first 60 days, the TIAE visited 80% of the WMNTMA member companies and prepared a report summarizing the visits. The report provided the following operational analysis of the industry, and sharpened the focus of the engineer's work going forward both with individual companies and the sector as a whole. See table 5 for summary:

Table 5: TIAE assessment summary of industry cluster

Strengths	Challenges	Strategic Planning Needs
Technical competence in machining operations is extremely high. Companies have highly skilled employees who, in most instances, are self directed. The equipment lists vary from business to business. Most companies have multi axis CNC lathes and Mills. The quantity and size of the CNC equipment is dependant on the size and financial strength of the company. There are selected companies that have lapping and grinding operations. There is some disparity in the CAD/CAM programs available to the smaller companies and is also correlated to the size and financial strength of the company.	Strategic planning and policy deployment seem to be weaknesses within the industry as a whole. There appears to be a lack of cost savings planning throughout the industry.	The goal of the industry is sustainable growth driven by innovation. The missing piece is the driver for innovation. The innovations adopted by the industry need to be driven by the needs of the industry. The needs of the industry have to be defined by the goals of the companies. The goals can then be reduced to strategic plans that are implemented and tracked. If the goals are stretch goals, then the pursuit in the attainment of these goals will ultimately drive innovation. The overall business model needs to be focused on developing a continuous improvement model in order to insure the driver for innovation. Adopting a continuous improvement model simplifies strategic planning and insures that organizations stretch, avoiding stagnation and outdated thinking. The continuous improvement process requires a measurement system that centers on Key Productivity Indicators. One set of KPI's are Safety, Quality, Delivery and Costs.

The TIAE has provided on-going engineering support to various companies ranging from tool design to manufacturing process re-engineering. Additionally, the TIAE worked with UMass and industry to identify manufacturing technologies of interest, resulting in identification of research in cryogenic

machining, rapid prototyping, robotics and more, as potentially promising processes for local machining industry.

The initial concerns regarding the utilization of shared resources in a very competitive environment, and the protection of trade-secrets or customers' information, were dispelled once the value of the services was recognized and a level of trust in the individual/s involved was confirmed. Therefore, we believe that in general, the application of shared manufacturing engineering services has been validated by the feasibility study and was demonstrated as valuable to the industry. It should be an integral part of the functional design of the MCAPMT.

4. THE TECHNOLOGY INNOVATION FORUMS

Industry access to new research and discovery, as well as the success of technology transfer from university to industry, are dependent on the quality and intensity of communications, geographic proximity, relevance/equivocality of research and motivation on both sides (see figure 6[9]).

Providing mechanisms that optimize these four factors will ensure success of research commercialization projects. We used Technology Innovation Forums as such a mechanism. In collaboration with UMass, the Forums allow participants to start mapping near-and long-term needs, and begin to identify solution/approaches to meet those needs.

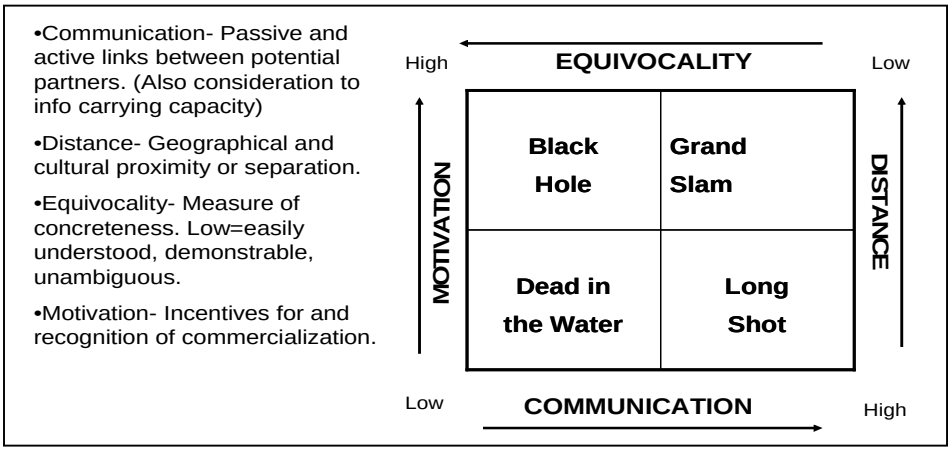


Figure 6

Early in the process, a Technology Development Needs survey of the WMNTMA companies was conducted (See Section V part 2), focusing on the following:

- Identifying broad-based technology development needs.
- Identifying and analyzing Supply Chain risks, and mitigation steps.
- Developing roadmap documents with time-based goals, requirements, and tasks to address identified short and long term high-priority needs.

PMRAP undertook a process to analyze the technology needs of the companies that responded to the survey and matched them with current and relevant research being conducted in the Polymer Science and Engineering (PSE), the Mechanical & Industrial Engineering (MIE) departments and

[9] R. Smilor, D. Gibson "Technology in multi-organizational environment: The case of R&D consortia" IEEE Tran. On Engr. Management, Vol. 38, No. 1, Feb. 1991.

the Isenberg School of Management at UMass. The results of this process were the identification of opportunities for faculty researchers to partner with companies to develop new innovative research based on the demonstrated technology needs of the companies. The Technology Innovation Forums proved to be an effective venue to create this collaborative synergy. Six (6) such Forums between company owners/representatives and faculty researchers from the PSE and the MIE departments, and the Isenberg School of Management- School of Finance and Operations Management were conducted between July 2009-June 2010.

The Forums provided an opportunity for the precision machining companies and researchers at UMass to exchange information about technology needs and relevant research/discoveries. The Forums served as the point of interaction between the industries' technology "pull" and the researchers' innovations "push". The information exchange informed industry with potential opportunities for products/services diversification relevant to new growth markets, as well as offered avenues for improved competitiveness in existing markets. The forums series engaged twenty one different precision machining companies and sixteen faculty researchers from the three UMass departments (***Attachment - D***). The following are the subjects of the Technology Innovation Forums:

1. Non-Metallic Materials – Machining and Processing Technologies
2. Manufacturing Process Optimization
3. Metals and Composites Interfaces
4. Cryogenic Machining
5. Operational Process Improvement in a Changing Manufacturing Supply Chain
6. Cooperative Business Networks

The Innovation Forums resulted in the following observations:

a. Small precision manufacturing companies are very interested in applied research results that can provide them with a competitive advantage, or access to new markets.

b. The interaction between small companies and university researchers must be facilitated in order to overcome cultural differences and resolve conflicting priorities.

c. The gap between basic research and technology that is at a level of maturity to be a relevant or applicable to the precision manufacturing industry is very wide and requires technical foresight and imagination that does not exist at this industry or in the university. There is a need for a "bridge" organization that can provide "translational research" or technology development/prototyping services.

d. The Forum is an effective way to enhance communication and brainstorm opportunities. Dialogue at the forums resulted in numerous projects that were initiated collaboratively by industry and faculty members.

e. Technology sourcing (as reflected in the Innovation Forum process) should tap into research in multiple locations, such as universities, industry (primarily machine tool or materials companies) or government laboratories. Sustained collaboration between such organizations will provide the necessary familiarity of needs, capabilities, and individual relationships necessary to the success of the technology "mining" process.

The interest of SMEs in the precision manufacturing sector in adopting new manufacturing technologies and the use of the Innovation Forums as a vehicle to identify such technology were validated by the feasibility study. MCAPMT can act as a facilitator of Technology Innovation Forums, and as the "bridge organization" between research institutions and industry to accelerate technology commercialization.

5. THE TECHNOLOGY TRANSFER PROJECT

The transfer of technology from the research institution to a manufacturing company, primarily a small precision manufacturing shop with limited engineering resources, is a difficult task. However, we recognize its importance and view potential innovation based new products, services or production processes as critically valuable to new jobs creation.

In the continuum of research to market and its application to the precision manufacturing industry, the commercialization process is especially vital and problematic for SMEs and needs to be studied and perfected in order for us to achieve our long term goals- primarily the area straddling the proof of concept, early stage technology development and the start of product development (see figure 7[10])

The Innovation Forums resulted in the identification of a manufacturing technology transfer project in Cryogenic Machining that was a collaborative initiative led by the Technology Innovation and Applications Engineer and included faculty from the UMass Department of Mechanical and Industrial Engineering, and faculty from the Mechanical Engineering Technology Department at Springfield Technical Community College. The technology transfer project began in April 2010 and is expected to continue through October 2010.

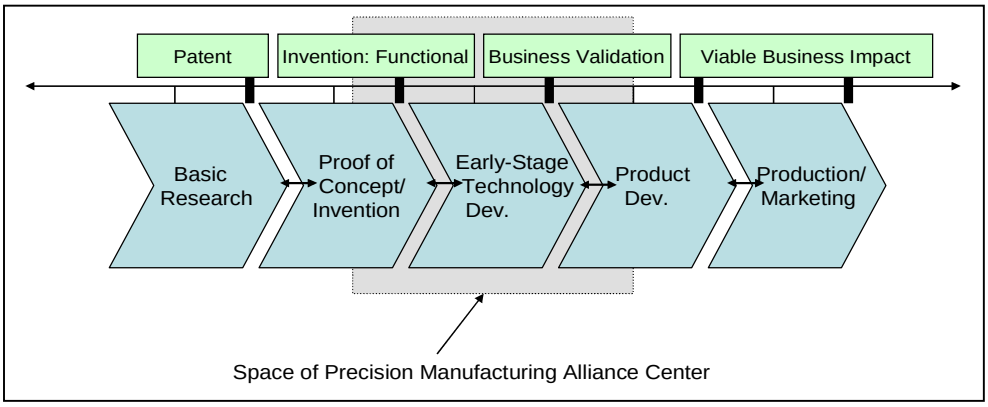


Figure 7

In addition, the Forums have generated four (4) additional projects between individual faculty researchers from UMass and companies that participated in one or more of the Technology Innovation Forums with a potential of providing technology transfer opportunities. These industry driven projects are on-going and will continue beyond the expiration of the PMRAP on December 31, 2010. The following potential technology transfer projects have resulted from the Technology Innovation Forums:

1. Roll to Roll embossing of micro and nano features onto polymeric films
2. Machinable polymer-metal interface
3. Machining of polymeric gels
4. New implant materials for total knee and hip replacement surgery

[10] [10] The literature on technology management contains many variants on this diagram. A good example is in NIST GCR 02-841, Between Innovation and Invention. Branscomb and Auerswald, Harvard University.

The technology transfer projects, in the various stages of implementation or realism, have validated the need for a center such as the MCAPMT as a resource for communication, trained technical personnel and facilities with appropriate equipment to execute manufacturing technology and innovation development and/or prototyping/demonstrations. In the absence of the center, technology transfer project are much more complicated and face a threshold for success that is much higher, thus risking the benefits industry can gain from new manufacturing technologies.

6. MARKET OPPORTUNITIES FORUMS

During the course of executing PMRAP, the business and economic environment for the companies changed dramatically, and highlighted the need to implement strategies to assist the companies in new business development, primarily the diversification of markets for the regional precision manufacturing industry. Based on the October 8, 2008 survey of the companies, the project team planned to conduct four (4) Market Opportunity Forums focused on the following business markets:

- Aerospace and Defense
- Medical Device
- Renewable Energy
- Robotics and Instrumentations

The objective of the forums was to provide the cluster of precision machining companies with information regarding:

- Profile of the market- growth in past years, strategic imperatives, major players, etc.
- Supply chain demands- expectations of suppliers by prime contractors, competition, value proposition, contractual terms, etc.
- Operation processes- potential market/customer impact on manufacturing processes, special quality assurance requirements, specific government regulations, etc.
- New technology- new materials, tooling and manufacturing requirements
- Workforce Development- new skills and training needs
- Best Practices- what makes a successful/competitive supplier?

The forums were conducted in an interactive panel-audience format. The panelists for each forum included the following:

1. Representatives of Prime Contractors/OEMs familiar with market trends and purchasing practices.
2. Industry association leaders who provided insight about the industry in Massachusetts as well as projections about growth, markets, exports, etc.
3. Consultants who specialize in each market and study opportunities/trends and can provide analysis.
4. Personnel from a precision manufacturing company that is already engaged in the target market.

In addition to the owners of the precision machining companies, faculty from UMass and Springfield Technical Community College, and economic development officials attended the forums and participated in the discussion that ensued from the panel presentations.

The first two forums on Aerospace and Defense and Medical Devices were attended by 63 people representing the cross section described above. The forums were well received, resulted in a comprehensive exchange of useful information, and initiated the process of connecting the companies and several public and private support organizations that could provide business intelligence to the companies in the specific markets covered by the forums. As of April 2010, the first two forums have been completed.

Note: In reviewing the feedback from the companies attending the forums, the project team decided to conduct a forum that focused on prime contractors/OEM's, and move away from the original forum focused on Renewable Energy. To this end, Massachusetts based prime contractors/OEM's that local companies are part of their supply chain network are being identified. In addition, we are working to develop a modified matchmaker event that would be held in conjunction with this Market Opportunity Forum. This would allow interested companies the opportunity to meet with the representatives from the primes/OEM's that would be participating as panelists at the forum.

The Market Opportunities Forums highlighted a number of issues relevant to MCAPMT feasibility:

a. There is an interest among several regional WMNTMA member companies engaged in precision machining to diversify and move into new markets (primarily medical devices and clean technology.)

b. In order to enter into the supply chain of the new markets, companies need to look for a "hook" that provide them a competitive advantage. New technology was identified as one of the possible hooks.

c. Aggressive prime contractors/OEM's are engaged in heavy R&D and new products introduction and are expecting their suppliers to be part of their R&D base- investing in it and bringing new capabilities that will assist the resulting new products capture new markets.

d. In order to reduce risks, costs and management load, OEM's look to reduce the size of their supply chain and transfer more responsibility to suppliers, viewing them as 'partners' throughout the product life cycle, including in the R&D phase.

These market inputs and needs validated the functional importance of the MCAPMT as an advanced technology resource as well as a business development facilitator for small and medium size companies in this sector.

7. WORKFORCE DEVELOPMENT / SKILLS ALLIANCE

On-going workforce development is a business need and the common thread that permeates the regional precision machining cluster. The highly regulated and quality driven OEM's prefer to work with proven suppliers relying on relationships established over time. Additionally, supply chain members' capability to respond to new requirements and their facility to perform work applicable to growth markets, is predicated on their ability to be creative, and have a workforce that is:

- Capable of adapting to new technologies.
- Knowledgeable in applications engineering and modern manufacturing practices.
- Appropriately sized and trained to high quality standards.

The availability of an agile, appropriately sized, and well trained workforce is what distinguishes these companies form their competitors, and was an important consideration in the feasibility study for the MCAPMT. Currently, due to the economic downturn, the workforce demands challenge has been replaced by the clusters need to maintain its sales levels and to generate work. Without sufficient work coming to the factory floor, the workforce issue takes on less significance to the companies. Despite this present condition however the companies realize that the market moves in cycles, and at some point, workforce availability will again become the burning issue.

During the time frame of the feasibility study, the project team, using other funds, coordinated programs that provided skills enhancement courses to the incumbent employees in the region. In addition, using funding from the Commonwealth's Workforce Competitiveness Trust Fund, the team coordinated the delivery of new pipeline training programs for unemployed/underemployed individuals in order to prepare them for future employment positions in the precision machining sector. It is essential to include workforce development as a major functional element in the MCAPMT and continue to utilize the existing training infrastructure and delivery system to offer courses and programs for both incumbent and new pipeline employees. The workforce development function at the MCAPMT can be best characterized as a coordinator and not as a primary training venue. However, it is clear from the experience of the PMRAP that such coordination will have to focus on bringing industry needs together with the education and training enterprise in order to assure that the workforce of the future in the precision manufacturing sector has the right skills. This goal can be achieved through the MCAPMT.

PMRAP has piloted and successfully validated:

1. **Mining of research results and formation of university/industry collaboration- Technology Innovation Forums with UMass**
2. **Utilization of shared technical resources by small companies- Technology Innovation and Application Engineer**
3. **Manufacturing technology development- Cryogenic Machining**
4. **Marketing assistance- New Market Opportunities Forums, exports opportunities studies, and cluster marketing initiatives**
5. **Workforce development innovation- Education collaborative agreement**

The project and the implementation analysis for the advanced manufacturing center have already resulted in recognition that:

- **The Center can have significant impact on the competitiveness of local small companies, resulting in measurable job growth or job retention; and increased regional economic development**
- **The Center can provide value to the national R&D and procurement system through the infusion of new manufacturing technologies, resulting in cost reduction and improved reliability of performance**

Section V- The Context for MCAPMT

Technology intensive precision manufacturing is one of the most important industry clusters in the Pioneer Valley. With over 15,000 employees in more than 700 companies and location quotients of 1.5-3.5, precision manufacturing is highly concentrated and a critical sector to the economic well-being of the region. The mostly small companies are part of a supply chain for prime contractors or original equipment manufacturers (OEMs), which persistently demand that their suppliers maintain exacting quality standards at competitive and reduced pricing. MCAPMT and its strategic objectives support these customers' demands and are derived from an assessment of the sector's innovation needs, aiming to sustain growth in the region and throughout the Commonwealth.

1. THE SWOT ANALYSIS

The MCAPMT feasibility study began in October 2008 with a SWOT analysis of the precision machining industry in the Pioneer Valley Region as representative of the Massachusetts precision manufacturing cluster as a whole. Using interviews, data from various sources, and discussions with the members of the PMRAP steering committee, the following is an assessment of strengths, weaknesses, opportunities and threats:

Table 6: Precision Manufacturing Industry SWOT

Strengths	Weaknesses	Opportunities	Threats
♦ Broad industry ♦ Reputation for high quality ♦ Continued investment in modern equipment and facilities ♦ Easy access to large regional industry centers. ♦ Long term/recognized DoD suppliers ♦ Low cost structure (relative to MA) ♦ Strong and committed leadership ♦ Partnerships with educational institutions for workforce training ♦ Strong relationships with state and local government	♦ Dependent on success/ growth of OEMs/prime contractors ♦ High Costs compared to off shore competitors ♦ Commodity services providers- no proprietary position ♦ Small companies with limited resources ♦ Lacks local customers ♦ Capacity for internal innovation is inconsistent and varies by company size.	♦ Core capabilities are applicable to emerging/ growth markets- medical devices, renewable energy, and instrumentation ♦ Opportunities for international sales and export growth ♦ Indications of possible new vertical markets ♦ Links to technology sources in the region (UMass) ♦ Collaboration across segments of the Precision Manufacturing industry	♦ A&D market very competitive & cyclical, ♦ New (disruptive) technologies might impact supply chain ♦ Intense R&D in key markets (A&D, Medical Devices) might make capabilities obsolete ♦ Aging workforce-loss of expertise ♦ Sustaining internal capability requires on going investment and training ♦ Volatile/un-predictable economy in US and overseas

The SWOT analysis, reviewed and approved by the PMRAP steering committee, is used to develop strategies that leverage strengths, address weaknesses, prepare for opportunities and heads-off threats.

2. THE INDUSTRY NEEDS ASSESSMENT

At the start of the project, the project team conducted a survey of the WMNTMA companies. The questionnaire asked the companies to identify the manufacturing services that they were expected to deliver by customers which create the need to access manufacturing engineering support or new technology development, and enabling them to respond to such demands or to be more competitive.

The questionnaire also asked the companies to identify specific technical assistance, supports, or activities that would be of most value to them in making the transition to more value-added manufacturing. The project team was particularly interested in identifying what industry needed internally to improve productivity and competitiveness as suppliers in their present markets as well as needs to gain access to new growth markets such as medical devices, laboratory instrumentation and alternative energy.

Based on a summary of the responses to the survey, the following categories of interest and desired support emerged:

- New Materials Technology
- Tooling, Fixturing and Machining Technology
- Work Process Improvements
- Quality Assurance, Process Control and Inspection
- Value Added Assembly Processes
- Customer Technical and Contractual Demands
- Employee Training
- Marketing and New Business Development

Identified industry needs were charted against these categories to get a clearer perspective of priorities. The following table summarizes that perspective (1- low response, 7- high response for need.) PMRAP used this indication of priorities in selecting activities and initiative for implementation and testing:

Table 7: Industry needs and priorities

Categories of services / Needs	New Materials Tech.	Tooling, Fixturing and Machining Tech.	Work Process improve-ments (cost/sch-edule reduction)	Q.A. Process Control and Inspection	Value Added Assembly Processes	Customer Technical and Contractual Demands	Employee Training	Marketing /New Business Develop-ment
Needs imposed by suppliers/cust-omers	1	2	3	4	1	3		

Categories of services / Needs	New Materials Tech.	Tooling, Fixturing and Machining Tech.	Work Process improve-ments (cost/sch-edule reduction)	Q.A. Process Control and Inspection	Value Added Assembly Processes	Customer Technical and Contractual Demands	Employee Training	Marketing /New Business Develop-ment
Needs to transition to value added and new markets	1	4	5	2	1	3	1	
Need to improve competitiveness in current market		7	6				2	
Need for internal capacity to grow business in new markets	1	3	1	1			2	2

An analysis of the survey indicates the following:

a. In order to respond to current customers and improve competitiveness, the most valuable services to be provided by the MCAPMT (shared resources or manufacturing technology development) were in the area of Q.A processes/quality improvement, innovations in tooling, fixturing and machining technologies, and processes improvements aimed at cost or schedule reductions.

b. In order to facilitate transition to new market or to acquire added value operations, the most valuable services the MCAPMT can provide are related to process improvement (cost/schedule), innovations in tooling and machining and support in workforce development and marketing. We estimated that once the new markets were better defined and the barriers better understood, the technology and marketing (primarily in match-making with prime/OEM suppliers) would get stronger emphasis.

Based on the SWOT analysis and the needs assessment, the following four (4) strategies for the development of the MCAPMT emerged:

1. Create a center as a precision manufacturing "focal point" that will provide services, contribute to workforce development initiatives, and lead growth strategies in: technology development, engineering services, skilled labor pipeline, marketing, and new business development.

2. Strengthen local partnerships, and optimize collaborative links across the region.

3. Build an infrastructure to support new manufacturing technologies that is capable of attracting outside investment for sustainability.

4. Provide innovation to position industry as suppliers to new markets such as medical devices, laboratory instrumentation and alternative energy.

3. CONCEPTUAL CONSIDERATIONS FOR THE MCAPMT

A precision manufacturing technology center should take into consideration the following basic elements (see figure 8[11]):

Applied Research Base – The R&D element should be considered independently of specific university academic departments, thus allowing the Center the flexibility of leveraging applied research and technology agenda that fits best: industry requirements, market needs and funding sources, without regards to the source.

Technology and Education Consortium – Manufacturing technology development should leverage contributions of research results from an available source (universities, industry, etc.) with primary emphasis on "market pull" rather than "push" by research institutions or other suppliers. Education element will consider skills required by emerging technology and markets as well as applicable innovative workforce development measures throughout the K-12 pipeline.

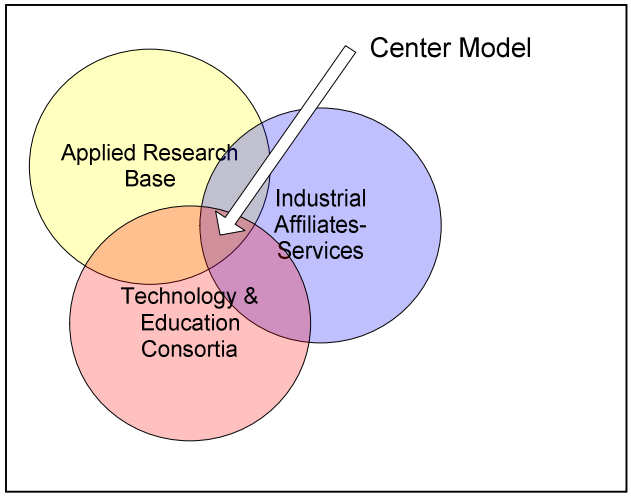


Figure 8

Industrial Affiliates – The Center should be structured as a collective of affiliated institutions/companies. Therefore, its services and technology development programs should respond to the interest of multiple stakeholders rather than to an individual client.

In order to support the underlying objectives of the Center and allow for a trade-off and decisions that takes into consideration local parameters, our conceptual development began by extending the vision for the Center to be as broad as possible and not limited to advanced technology only. This approach allowed for consideration of a technical center associated with a university (or universities) as well as a university-industry cooperative technology application and commercialization center, a services center, etc. The evaluation looked at the full range of concepts and provided a recommendation for an implementation plan that is based on multiple frameworks and various conditions. The following strategic functionality emerged from the evaluation:

1) Services to precision manufacturing companies in the following categories:
   - Develop new manufacturing technologies
     - Work with research and education institutions throughout the State to stay abreast of evolving manufacturing technologies relative to materials, tools and processes.
     - Build-up internal capabilities in conjunction with UMass to develop and test new technologies as identified by local precision manufacturing companies.
     - Increase collaborative initiatives in technology development with UMass
   - Engineering Services:
     - Develop an engineering services team that can work with local precision manufacturing companies to develop more efficient manufacturing processes.
     - Supplement applications engineering efforts at small, precision manufacturing shops in order to assist them in meeting growth goals.

[11] Managing the Industry/University Cooperative Research Center. Denis Gray, George Walters, Battelle Press. Adapted

- Skilled Labor Pipeline
  - Provide training for incumbent workers in order to insure they stay abreast of evolving technologies and techniques.
  - Develop educational programs for grades 5-12 which educate youth about career opportunities in precision machining.
  - Work with Manufacturing Technology Programs at local Vocational High Schools and Community Colleges to insure that students and faculty are trained for the "jobs of tomorrow."
- Marketing
  - Develop programs to identify strategic markets for Western Massachusetts precision manufacturing companies and coordinate activities to promote the industry and region in those markets.
  - Facilitate joint new product development projects between OEM/Prime contractors with marketing channels and local precision manufacturing companies.

2) Increase sector communication, coherence, and commitment to collaborate in developing a broad consensus on the final functional elements of the Center. Develop a realistic implementation timetable that is both aggressive and reflective, but one that moves the decision making process forward in a deliberate and timely manner.
3) Leverage the research capabilities from a broad range of regional and national institutions to insure that the sector's needs can be addressed in a comprehensive manner. The industry "pull" side of the process must clearly dominate the final design of the Center's functions.
4) Insure that the marketing requirements of the sector, as identified in the needs survey, are included in the final design of the Center.

Section VI- Implementation Considerations

1. RESEARCHING OTHER TECHNOLOGY CENTER MODELS

In developing the conceptual framework for the Center and assessing local capabilities/ needs, cluster environment and sustainability strategies, we looked at various examples of similar centers as models in the following categories:

- Education and Workforce Development Center
- Industry Affiliation for Technology Development Services
- Manufacturing Service Center
- Technology Transfer and Research Partnering Center

The Manufacturing and Technology Centers that were evaluated were (see ***Attachment- F*** for detailed description of each of the centers):

a. The Center for Aerospace Manufacturing Technologies (CAMT) at the Missouri University of Science and Technology (Missouri S&T)

b. Institute for Plastics Innovation at UMass/Lowell, Massachusetts

c. The Advanced Technology and Manufacturing Center (ATMC) at UMass/Dartmouth, Massachusetts

d. The Aerospace Manufacturing Technology Centre (AMTC) in Canada

e. The National Center for Defense Manufacturing and Machining (NCDMM) in Pennsylvania

f. Manufacturing Technology Center (MTC) in Wytheville, Virginia

g. The Metal Processing Institute at WPI in Worcester, MA

Our investigation of these existing centers, including meetings, phone calls, and internet research resulted in useful insights and identification of lessons learned in the following areas:

(1) Sustainability models and considerations

(2) Federal funding and support contracts

(3) R&D programs

(4) Services to target industry

(5) Functional Operation and resources

(6) Management

(7) Industry relations

Such insights were derived primarily from the following organizations:

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
The Center for Aerospace Manufacturing Technologies (CAMT)	⊗	⊗	⊗	⊗	⊗	⊗	⊗	
Institute for Plastics Innovation			⊗	⊗			⊗	
The Advanced Technology and Manufacturing Center (ATMC)	⊗				⊗	⊗		
The Aerospace Manufacturing Technology Centre (AMTC)			⊗					
The National Center for Defense Manufacturing and Machining (NCDMM)	⊗	⊗		⊗	⊗	⊗	⊗	
Manufacturing Technology Center (MTC)					⊗		⊗	
The Metal Processing Institute			⊗	⊗	⊗		⊗	

⊗ - Useful insights

As a result of the study of the above sample of centers we have identified practices and lessons that were used in the recommended implementation; however, we have concluded that with regards to the MCAPMT mission:

- Developing, evaluating and demonstrating advanced technologies to the manufacturing industry- No center has a critical focus on small companies.
- Disseminating R&D results to the manufacturing supply chain through direct technology transfer- No center is offering such dissemination through strategic integration of shared resources and commercialization process.
- Engaging in workforce development- No center is performing such service in conjunction with technology development and partnerships with education institutions to align the educational infrastructure, increase the talent pipeline, and enhance the skills of incumbent employees.

2. THE CONCEPTUAL ANALYSIS FOR CENTER DEVELOPMENT

The feasibility study began with an assessment and analysis of background/context information related to the desired technology center. The context analysis (market needs, competition, existing strengths/gaps, technology trends, etc.) that we used was as broad as possible. Therefore, in our information collection and analysis we looked at the basic building blocks of a successful Research and Technology Center model (see figure 9[12].)

The assessment of this broad model, the decision what to include and how to accomplish the selected functions was guided by the following considerations:

1) Agreed upon selection criteria
2) Models of existing organization with similar mission and track record of success
3) Success/lessons learned from pilot projects undertaken under PMRAP (e.g. shared technical resources, innovation forums, technology transfer, etc.)

[12] Managing the Industry/University Cooperative Research Center. Denis Gray, George Walters, Battelle Press. Adapted. Adapted

4) Realism of extending the lessons from PMRAP (focused on precision machining) to a broader precision manufacturing cluster
5) Available resources and Return-on-Investment (including long term sustainability)
6) Regional leadership- preferences and commitment

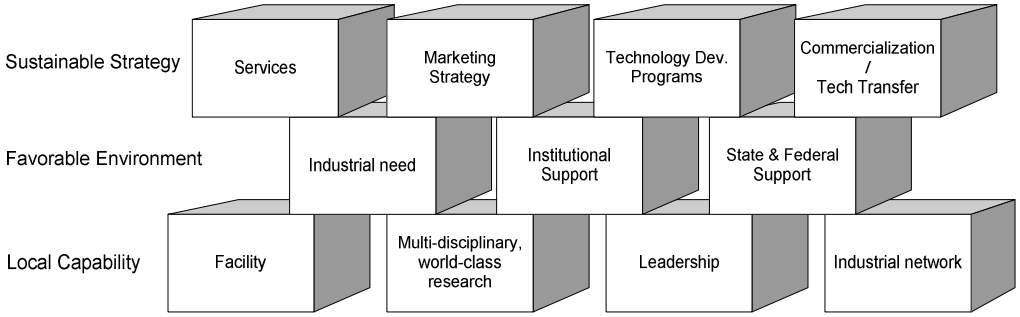


Figure 9

3. FUNCTIONAL DESCRIPTION OF THE CENTER (STRATEGIC RESPONSE TO NEEDS)

The project team concluded that the Center should be organized as an enabler and distribution/ clearinghouse for relevant technologies developed at other institutions, and would facilitate technology and innovation transfer directly to small and medium size companies. The Center's business model would be focused on strengthening the regional industry and addressing national needs by implementing the following functions:

1. Technical Services
2. Manufacturing Technology Development
3. Workforce Development
4. Early Stage Prototyping
5. Advanced Fabrication and Test Facilities

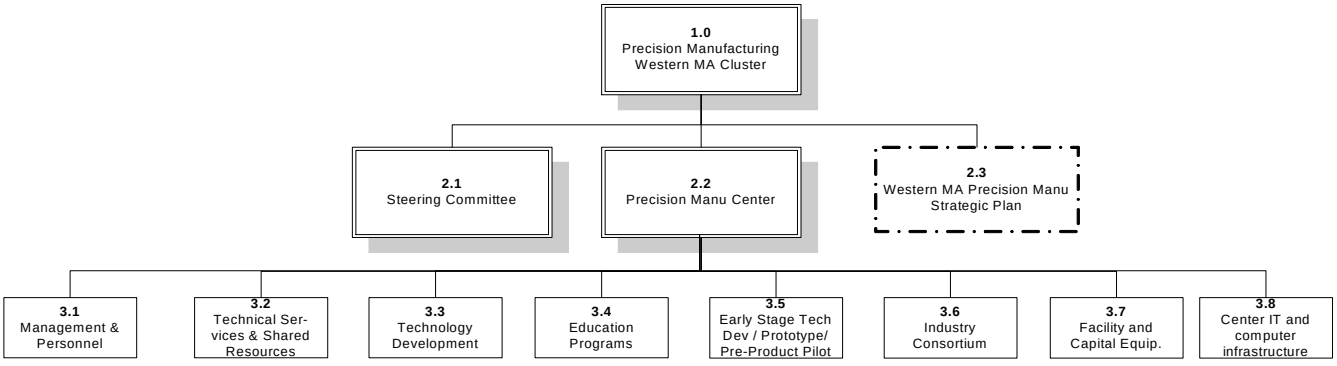


Figure 10

The recommended functional elements of the Center include (as detailed in figure 10 and ***Attachment- E***):

1. Management and Personnel Services
2. Technical Services & Shared Resources
   - Shared Manufacturing Engineering
   - Shared Marketing /Business Development
   - Technology Services
3. Technology Development
   - In-house Technology Dev. Projects
   - University Research Partners
   - Development tools/ equipment
4. Workforce Development/Education Programs
   - Incumbent Employees Training
   - New Skills Training
   - Gr.8-12 STEM Partnership
   - Industry-Education Partnership.
5. Early Stage Tech Dev / Prototype/Pre-Product Pilot
   - Engineering & Tech Personnel
   - Fabrication and Test Facility
   - Special Test Equipment/Tooling
6. Industry Consortium
   - Industry Members
   - Policies
   - Industry liaison/ management
7. Facilities and Capital Equipment

4. PMRAP PROTOTYPING OF CENTER'S FUNCTIONAL ELEMENTS

As detailed in Section IV above, PMRAP has implemented various activities that piloted and tested critical parts of the MCAPMT. The program validated functional and operating elements as follows:

Functional and Operational Elements	PMRAP Validation/Prototyping Activities
3.2 Technical Services & Shared Resources	
3.2.1 Shared Manufacturing Engineering	1. Technology Innovation and Application Engineer – Provides engineering services to companies

Functional and Operational Elements	PMRAP Validation/Prototyping Activities
3.2.2 Shared Marketing /Business Development	1. Market Opportunities Forums
	2. Export and commodity data analysis and shared information on WMNTMA web site- (HCC)
	3. Marketing and promotional support and trade show linkages- (EDC)
	4. Pioneer Valley Precision Manufacturing Collaborative
3.2.3 Technology Services	1. Technology Innovation and Application Engineer
3.3 Technology Development	
3.3.1 In-house Technology Dev. Projects	1. Cryogenic Machining Project (led by Application Engineer)- will conclude with Technology Transfer
3.3.2 University Research Partners	1. Technology Innovation Forums (UMass)
	2. Cryogenic Machining Project (UMass & STCC)
	3. MOU with UMass, STCC and HCC, Vocational Schools
3.3.3 Development tools/ equipment	As required in 3.3.1 and 3.3.2
3.4 Workforce Development/Education Programs	
3.4.1 Incumbent Employees Training	1. MOU with STCC.
	2. New Certificate program at STCC
3.4.2 New Skills Training	
3.4.3 Gr.8-12 STEM Partnership	Middle School (Gr. 8) career awareness program and counseling network
3.4.4 Industry-Education Partnership.	Regional Precision Manufacturing Technology Advisory Council.
3.5 Early Stage Tech Dev / Prototype/Pre-Product Pilot	
3.5.1 Engineering & Tech Personnel	1. Cryogenic Machining Project- Innovation & Application Engineer + UMass and STCC staff.
3.5.2 Fabrication and Test Facility	1. Cryogenic Machining project
	2. Rapid Prototyping services
5.5.3 Special Test Equipment/Tooling	1. Cryogenic Machining project
3.6 Industry Consortium	
3.6.1 Industry Members	1. Steering Committee
	2. Tight collaboration with WMNTMA
3.6.2 Policies	1. IP policy
	2. NDA policy
3.6.3 Industry liaison/ management	MOU with Precision Machining Companies

5. THE MCAPMT IMPLEMENTATION CONSIDERATIONS

The feasibility assessment is looking at an optimal configuration and functional structure of the Center that is in the intersection of four driving forces: Real short and long term industry needs, Regional context and SWOT driven strategies, Lessons from PMRAP validation, and implementation realism such as funding and sustainability (see figure 11.)

The following tables summarize information and insights gathered for the functional elements of the conceptual structure relative to each of these four driving forces.

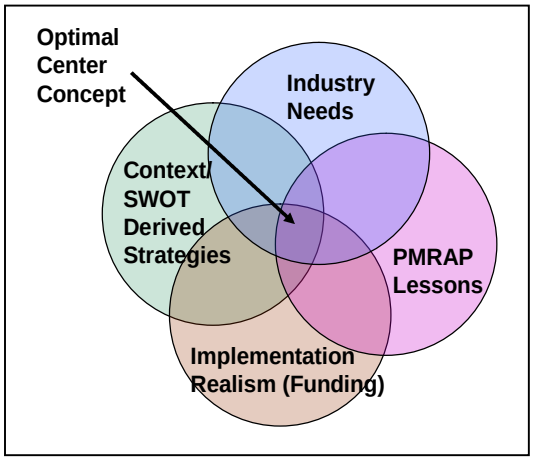


Figure 11

Table 8: Technical Services & Shared Resources

Functional and Operational Elements	Industry Needs	Context / SWOT Derive Strategies	PMRAP Lessons	Implementation Realism (Funding, etc.)
3.2 Technical Services & Shared Resources				
3.2.1 Shared Manufacturing Engineering	Assistance in: 1) Customers' Technical and Contractual Demands 2) Improvements in Q.A. Process Control and Inspection 3) Work Process improvements (cost/schedule reduction) 4) Tooling, Fixturing and Machining Technology	Provide technical support and training to allow companies to move up the supply chain	There is a critical industry need for a technology Innovation and Applications Engineer (TIAE) services in following areas: - Evaluating current manufacturing processes and providing recommendations for improvements in productivity - Facilitating strategic planning and continuous improvement - QA system- There is a real opportunity to use six sigma tools for all the companies, however, there have been no request for service in this area and there is a need to build fundamental awareness of possible improvements. (Note: Quality systems are virtually all appraisal, very little work is being done on the prevention side. Companies for the most part don't characterize their quality data.) - Standard tooling and fixturing is being handled internally by all of the companies. There might be need/opportunity in introduction of new technology related to non-standard tools/fixtures.	Implementation of a shared manufacturing engineers can be realized by: a. Funded projects by industry members (pay for service) b. State multi-year earmark c. Grant or contract for services (e.g. DoD) from Federal agency (through earmark?) d. Grant from foundation

Functional and Operational Elements	**Industry Needs**	**Context / SWOT Derive Strategies**	**PMRAP Lessons**	**Implementation Realism (Funding, etc.)**
3.2 Technical Services & Shared Resources				
3.2.2 Shared Marketing /Business Development	Promotional and Marketing Plan for new business development	1) Provide training , sales and technical resources to allow companies go up the supply chain 2) Support new opportunities to advance sales to international customers and exports to Europe and Asia 3) Introduce and support opportunities to enter into new/growth markets	- There is a critical industry need for coordinated marketing. PMRAP experience and implication to Center: a. Shared Resource with EDC b. WISER Licensing Agreement- c. Partner in State-Wide Cross-Cluster Innovation Plan - There is a need for a dedicated resource (Center employee?) to coordinated marketing and undertake initiatives.	Implementation of shared marketing/ business dev. can be realized by: a. Grant from the state as part of regional cluster development b. Membership fees c. Funded projects by industry members (targeted marketing to specific companies.)
3.2.3 Technology Services	Assistance in: 1) Customers' Technical and Contractual Demands 2) Improvements in Q.A. Process Control and Inspection 3) Work Process improvements (cost/schedule reduction) 4) Tooling, Fixturing and Machining Technology	Introduce and support opportunities to perform value-added work in present markets. Introduce and support opportunities to enter into new/growth markets	There is a clear and critical industry need for introduction (infusion) of new technology for manufacturing processes and improved products. This need can be addressed through: - Periodic Technology Innovation Forums at UMass and other universities - TIAE in collaboration with university/college faculty and introduction of new technology to industry - WMNTMA Web site	Implementation of shared marketing/ business development can be realized by: a. Funding from Federal or State Grants b. Membership fees c. WMNTMA

Table 9: Technology Development

Functional and Operational Elements	**Industry Needs**	**Context / SWOT Derive Strategies**	**PMRAP Lessons**	**Implementation Realism (Funding, etc.)**
3.3 Technology Development				
3.3.1 In-house Technology Dev.	New technology development to transform industry capacity	Create "bridge" with technology sources and provide tech transfer which	There is an industry need for introduction (infusion) of new technology for manufacturing processes and improved products. This need can be achieved through	Implementation of in house technology development projects can be realized by:

Functional and Operational Elements	**Industry Needs**	**Context / SWOT Derive Strategies**	**PMRAP Lessons**	**Implementation Realism (Funding, etc.)**
3.3 Technology Development				
Projects	and capabilities	enhances competitiveness and new market opportunities.	in-house (in-Center) development as follows: a. Technology "acquisition" and transfer by the center, upgraded/refined for match to industry need and/or sale to member company b. TIAE in collaboration with university/college faculty and companies or markets (primes/OEM's) will identify new technology to industry which will be undertaken by Center c. Demonstration and application of new manufacturing technologies (machines, processes, etc.) at the Center.	a. Funded projects by industry members (pay for service) b. State multi-year earmark c. Grant or contract for services (e.g. DoD) from Federal agency (through earmark?) d. SBIR/STTR e. Grant from foundation
3.3.2 University Research Partners	Improve competitiveness through application of research and identification of new technologies	Create links with technology sources and provide tech transfer which enhances competitiveness and new market opportunities.	- Technology sourcing and research partners address need for introduction (infusion) of new technology for manufacturing processes and improved products. - Partners must include multiple universities (not limited to UMass) - Innovation Forums can be an effective way to integrate partners and identify overlapping research interests. - Industry-Faculty-Student Research Projects - Technology Transfers projects through the Center's internal technology development capacity	Implementation of partnerships with universities and related projects can be realized by: a. University strategic need for partnerships (e.g. land-grant universities.) b. NSF research grants (e.g. ERC, PFI projects) c. Funded projects by industry members (pay for service) d. State multi-year earmark e. Grant or contract for services (e.g. DoD) from Federal agency (through earmark?) f. SBIR/STTR g. Grants from foundations
3.3.3 Development tools/ equipment *(Derive from and dependent on 3.3.1 and 3.3.2 above)*	*Derive from and dependent on 3.3.1 and 3.3.2 above)*		*Derive from and dependent on 3.3.1 and 3.3.2 above)*	

Table 10: Workforce Development/Education Programs

Functional and Operational Elements	**Industry Needs**	**Context / SWOT Derive Strategies**	**PMRAP Lessons**	**Implementation Realism (Funding, etc.)**
3.4 Workforce Development/Education Programs				
3.4.1 Incumbent Employees Training	Employees Training	Leverage vocational schools, Community Colleges and University/Colleges to prepare new employees and re-train incumbent employees	- Cluster career pathway precision machining programs resulting in skills credentials being conducted in September and January cycles using STCC, 6 Voc. Tech high schools, Smith and Wesson. - On-going sustainability funding must be reviewed beyond existing grants.	a. Burk Fund b. Sunderland Fund c. WMNTMA Golf Fund d. Workforce Training Fund (NEW) e. Due to funding limitations, might need to begin charging employees and/or companies.
3.4.2 New Pipeline Training	Employees Training	Leverage vocational schools, Community Colleges and University/Colleges to prepare new employees and re-train incumbent employees	- PMRAP- development of new 1 year Certificate program in Mechanical Engineering Technology at STCC for fall 2010 for new pipeline and incumbent employees. - Curriculum to reflect future technology needs of companies. Outcomes of Innovation Forums, work of TIAE, and industry survey results driving decision making on content of new certificate program.	a. WIA- ITA's b. Grant/Stimulus Training Funds c. Sunderland And Burk Scholarship funds to support employee tuition and fees.
3.4.3 Gr.8-12 STEM Partnership	Capacity building initiatives		- PMRAP MOA in force - PMRAP-Regional Precision Manufacturing Technology Advisory Council. - MTT Program Advisory Board Representation - Coordinated Middle School (Gr. 8) Career awareness program in place. - Coordinated middle school counseling network in place	Funding required to transport students. (Current funding has expired and will need to be reviewed.)
3.4.4 Industry-Education Partnership .	Capacity building initiatives	Leverage vocational schools, Community Colleges and University/Colleges to prepare new employees and re-train incumbent employees	- PMRAP MOA in force. - PMRAP-Regional Precision Manufacturing Technology Advisory Council.	New funding required

Table 11: Early Stage Tech Dev / Prototype/Pre-Product Pilot

Functional and Operational Elements	**Industry Needs**	**Context / SWOT Derive Strategies**	**PMRAP Lessons**	**Implementation Realism (Funding, etc.)**
3.5 Early Stage Tech Commercialization / Prototype/ Pre-Product Pilot				
3.5.1 Engineering & Tech Personnel	Not understood yet (we intend to revisit with participants of Innovation Forums and Steering Committee.)	Create links with technology sources and provide tech transfer which enhances competitiveness and new market opportunities.	- There is an industry need for introduction (infusion) of new technology for manufacturing processes and improved products. This need can be achieved through in-house (in-Center) development or through identification of early technical discoveries (at universities/ other partners) and commercialization at the Center, as follows: a. Technology "acquisition" and prototyping by the center, upgraded/refined for match to industry need and/or sale to member company b. TIAE in collaboration with university/college faculty and companies or markets (primes/OEM's) will identify new technology to industry for which commercialization and product development will be undertaken by Center c. Demonstration and application of new manufacturing technologies (machines, processes, etc.) at the Center. - Technology sourcing and transfer can be performed for a single "customer" on a proprietary basis (funded project by industry member.)	Implementation of in house technology development projects can be realized by: a. Funded projects by industry members (pay for prototype and data package) b. State multi-year earmark c. Grant or contract for services (e.g. DoD) from Federal agency (through earmark?) d. SBIR/STTR e. Grants from foundations
3.5.2 Fabrication and Test Facility		Translate invention at technology sources and simplify tech transfer which enhances competitiveness and new market opportunities.	Prototype fabrication, testing and demonstration can be done at the Center unitizing a combination of subcontract of parts and in house capabilities. Technical data package can be validated in house.	Fabrication and testing of prototypes as part of early stage commercialization can be realized by: a. Funded projects by industry members (pay for prototype and data package) b. State multi-year earmark c. Grant or contract for services (e.g. DoD) from Federal agency d. SBIR/STTR

Functional and Operational Elements	Industry Needs	Context / SWOT Derive Strategies	PMRAP Lessons	Implementation Realism (Funding, etc.)
3.5 Early Stage Tech Commercialization / Prototype/ Pre-Product Pilot				
3.5.3 Special Test Equipment &Tooling *(Derived from and dependent on 3.5.1 and 3.5.2 above)*				

6. IMPLEMENTATION ALTERNATIVES FOR MCAPMT FUNCTIONAL OPERATING ELEMENTS

The implementation of the various functions of the center must take into account available start-up funding, inter-dependence of functions, sustainability models, realism of time-line, minimum functionality for operational effectiveness/critical mass, etc. In looking at the various alternatives we considered:

a. Fully functional start-up with a very quick ramping of facilities, equipment and personnel.

b. A phased start-up implementing first operating elements that do not require heavy capital investment but offer sufficient functionality for successful operation from the start. Additional equipment, personnel and facilities are implemented in future phases to add functionality and capabilities.

c. A distributed operation where some functions are executed by existing regional organizations and only "core" functions are maintained at the Center.

The recommended implementation of the functional elements of MCAPMT is a realistic and cost-effective combination of options b. and c. above, as detailed in Section VII herein and graphically in ***Attachment - E***.

7. SUSTAINABILITY CONSIDERATIONS

The sustainability of the MCAPMT will depend on its ability to receive funding from a combination of multiple sources. The Center will have to constantly look for new opportunities, and much like a for-profit organization will have to dedicate resources and aggressively pursue business development avenues.

As part of the feasibility assessment we have looked at the realism of different funding sources and tested various cases to verify applicability for such Center as follows:

a. State and Federal Appropriation

During the feasibility assessment the team conducted numerous meetings and discussions with State and Federal agencies (including congress people) to evaluate the possibility of budget appropriations. Various mechanisms were discussed for funding levels of up to $4M. The general sense is that it will be very hard to achieve the high funding levels. State or Federal

appropriation might be viable at low levels in the initial phases, and once the organization has some demonstrable accomplishments, funding might increase. As a result, this feasibility study is putting forward a funding plan that is phased (see section VII, part 6.)

In consideration of the feasibility of state funding, we looked at a number of past and present technology centers in Massachusetts as a possible precedence. The centers included: The Advance Technology and Manufacturing Center (ATMC), The Chelsea Center for Recycling and Economic Development, The Massachusetts-NREL Wind Technology Testing Center, The Massachusetts Marine Fisheries Institute (MFI), The Cranberry Association, and the Massachusetts Medical Device Development Center. The purpose of this review was to look at examples of technology centers/institutions in the Commonwealth for the start-up process and steps undertaken for initial funding. These examples of precedence were evaluated in ***Attachment- G***. The resulting analysis identified the following factors as critical to receiving state support:

(1) Association with or engagement with academic institutions
(2) Third party initial funding (grant, loan, federal earmark, etc.)
(3) Strong local industry leadership and public advocacy
(4) Political championship
(5) Special circumstantial conditions (major dislocation, natural disaster, tec.)
(6) Strong economic development rationale

b. Federal Contracts

Various sources of federal contracts can be used for funding manufacturing technologies. Most notably are DoD's programs such as the Manufacturing Technology Program (ManTech)[13] which is aimed at responding to the national defense need for an industrial base with advanced manufacturing technologies, as well as processes that reduce costs and lead times in the production and the support of fielded military systems. ManTech and other such Federal programs are funding on-going manufacturing technology R&D projects that can fit well the Center's mission. In addition, DoD has funding opportunities related to planed product improvements/cost reduction, and is constantly looking for ways to apply new technologies, especially in manufacturing, to reduce life-cycle cost of system components. Some of these programs are directly with the Defense Logistics Agency and others are through prime contractors. Therefore, for realistic sustainability, MCAPMT will have to engage prime contractors, possible as members, and demonstrate to them the value it can offer.

c. Center Membership

Various models of membership fees were considered. This may be of somewhat limited value given the fact that the planned membership is primarily small companies (typical precision manufacturing cluster population.) However, with the functional structure that is planned and the technology development agenda that can be undertaken, it is expected that membership might include large prime/OEM companies and the anticipated value of the services will attract membership of SMEs as well. The discussions with other technology centers supported such an assumption.

d. Event Fees and Sponsorships

[13] https://www.dodmantech.com/index.asp

The Center will undertake various activities and organize events that will provide some fee collection and sponsorship; however, it is expected to have minimal impact on the operating budget of the MCAPMT.

e. Foundations Funding

Initial conversations were undertaken to test the feasibility of foundations' funding. The consensus was that due to the importance of small businesses and manufacturing jobs in the Commonwealth, the Center's contribution to workforce development, and the location in western Massachusetts, foundation funding is feasible.

f. Grants (STTR, SBIR, etc.)

Extensive review of technology granting opportunities indicate that sources such as SBIR/STTR from various agencies can be considered (in partnership with small businesses), as well as sources of manufacturing technology development funding (e.g. NIST/TIP, NSF/GOALI, USDOL/WIRED, NSF/ATE or the EDA.) The partnership with industry and research institutions positions the MCAPMT to be an ideal organization to bridge the technology transfer 'divide' and offer attractive avenues for conducting applied R&D relevant to federal agencies such DoD, DoE, and others.

g. Facilities & Equipment Use Fees

The functional concept for the MCAPMT includes facilities that can act as a resource to industry and academic institutions, as well as capital equipment (advance machining technologies) that will be made available to partners in industry or research institutions for demonstrations, testing, training and small production projects. Such services will be offered for a fair fee which will assist in carrying the costs of the facility.

h. New Revenue Sources- IP, Licensing

Intellectual property resulting from in-house R&D or federally funded research will be protected by patents and will be offered for licensing. The feasibility study reviewed IP policies and considered such operations in other manufacturing center. The analysis concluded that once the "start-up" phase is done, it is reasonable to assume that IP revenues will start growing and can become an important funding source for the Center. As a result, the functional concept and the operational modes of the Center will have to be aligned tightly with intellectual property management procedures, and undertake aggressive marketing of IP.

i. Subcontract for services

The MCAPMT will offer services for sale. Such services will include manufacturing engineering knowhow and design, management or organization consultation, or operations subcontracting. The Center will not compete with for-profit companies in these services, but will look for niches that are specialized to the precision manufacturing sectors, primarily SMEs in the region. Accordingly, the staffing plan for MCAPMT includes a sales manager (to pursue grants, federal contracts and subcontract opportunities.)

Section VII-The Massachusetts Center for Advanced Precision Manufacturing Technology, Inc.

1. The Incorporation of the Massachusetts Center for Advanced Precision Manufacturing Technology, Inc.

In order to advance the formation of the Center and allow initial investigation of funding sources, the PMRAP Steering Committee decided to incorporate an organization with similar mission. The Steering Committee, at its meeting on November 5, 2009, reviewed the required documents necessary to constitute the Massachusetts Center for Advanced Precision Manufacturing Technology (MCAPMT) as a 501 c 3 non-profit corporation. On November 13, 2009, the Steering Committee approved the final version to be submitted to the Massachusetts Secretary of State. On November 24, 2009, the Massachusetts Center for Advanced Precision Manufacturing Technology (MCAPMT) was approved as a 501 c 3 non-profit corporation.

2. The Governance of the MCAPMT

The Center has been incorporated as a 501 c 3 non-profit corporation, and will be led by a Board of Directors. The Board of Directors has been constituted and interim Officers have been elected by the Board.

3. The Business Model

The newly formed MCAPMT is a transitional technology center and will evolve to its final configuration and business model once funding for start-up is made available. The Center's mission is to be a focal point for identifying the new and innovative machining technologies, processes, and methodologies needed to serve prime contractors/OEM's, identifying solutions to emerging problems, and facilitating the transfer of those solutions to small and medium sized manufacturing shops, resulting in cost reduction/avoidance and improved reliability of performance.

The Center's business model will follow the recommendations in Section VI above, and will be focused on strengthening the regional industry and addressing national needs by implementing the following interrelated functions:

1. Technical services and shared resources
2. Manufacturing technology development
3. Workforce development/education programs
4. Early stage prototyping/pre-product pilots
5. Facility and capital equipment for advance fabrication and test

4. The Expected Outcomes

The implementation of the MCAPMT is expected to produce the following interrelated outcomes that will improve the sustainment, readiness and responsiveness of the precision manufacturing

companies in the Commonwealth, and position them to gain a competitive edge in today's global marketplace- see figure 12.

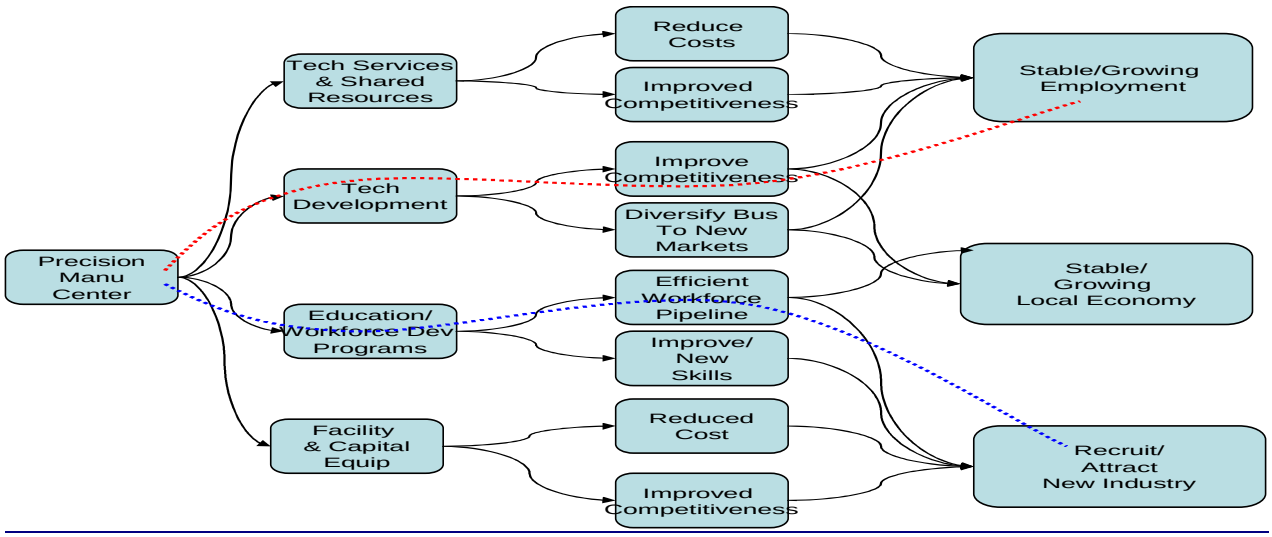


Figure 12

We believe that the Center will result in the following outcomes:

- **New cost effective and technologically enhanced manufacturing methods for Prime Contractors and government procurement of precision machined goods**
- **Competitive, steady and growing manufacturing employment (jobs retention/creation)**
- **Secure and growing local economy (directly and indirectly related to precision manufacturing)**
- **New levers to recruit and attract new industry to western Massachusetts.**

We believe the Center will achieve industry's strategic objectives for:

1. **Highly Trained and Adaptive Workforce**
2. **Competitiveness in New Markets**
3. **Superior Manufacturing Services**
4. **Operational Effectiveness**

5. The Implementation Plan

As discussed in the implementation considerations/options, a phased-in implementation is the most realistic and recommended approach. Additionally, the Center should not duplicate functions that already exist in the region and can be easily and effectively leveraged for use by the precision manufacturing industry in the Commonwealth (e.g. there are multiple education and training institutions, such as Springfield Technical Community College, that offer professional training, therefore, the MCAPMT will not duplicate such services, but rather will offer the function of

facilitator of training collaboration, developer of training needs and promoter of new workforce skills required by emerging technologies. The three-phase time table and the lead entity to implement the functional and operating elements of the Center are described in table 12.

Table 12: Implementation Summary

Functional and Operational Elements	Implementation Phase	Center	STCC	University & Research Institutions	Partner Companies	Schools
3.2 Technical Services & Shared Resources	1	X				
3.3 Technology Development	2	X		•		
3.4 Workforce Development-Education Programs	1	•	X	•	•	X
3.5 Early Stage Tech Dev Prototype/Pre-Product Pilot	2	X			•	
3.6 Industry Consortium	1	X		X	X	
3.7 Facility and Capital Equip.	3	X		•	•	
3.1 Management & Personnel	1					

Phase 1- Year 1 **X- Lead Implementer** **• Support**

Phase 2-Years 2-4

Phase 3- Years 5-8

6. PROFORMA BUDGET FOR SUSTAINABLE MCAPMT

The PMRAP Steering Committee at its meeting on February 11, 2010 approved the preliminary Performa operating budget for the MCAPMT covering the first seven (7) years of operation. See ***Attachment - H*** for detailed budget line items. The following is a summary of the Center's preliminary projected revenues and operating expenses during the aforementioned time period.

Table 13: Preliminary Budget Summary ($ in 1000's)

	FY1	FY2	FY3	FY4	FY5	FY6	FY7
Revenues							
State and Federal Appropriation- Start-up	$500	$500	$1,200	$1,000	$1,000	$150	$150
Sustainable Revenues	$22	$67	$244	$264	$534	$944	$1,104
Total Revenues	$522	$567	$1,444	$1,264	$1,534	$1,094	$1,254
Expenses							
Center Programmatic Activities	$320	$360	$595	$495	$565	$735	$835
Capital Equipment	$0	$0	$700	$450	$680	$90	$140
Management & Program Services	$152	$174	$220	$220	$245	$280	$296
Total Expenses	$472	$534	$1,515	$1,165	$1,490	$1,105	$1,271
Ending Fund Balance	*$50*	*$83*	*$12*	*$111*	*$155*	*$144*	*$127*
Head Count FTE	*5*	*6*	*7*	*8*	*9*	*10*	*11*

As discussed earlier, sustainability can be realistically achieved through multiple funding sources. The sustainability plan includes the following elements: Fee for service, private foundation support, Federal contracts (e.g. DOD value engineering on machined parts), State funding, private sector funding and cost sharing to various programs, and royalties on new intellectual property for technology development or technology transfer projects. The ramp-up of funding from these sources is planned for the first five years after start-up, achieving a self supported balanced budget in years 7.

MCAPMT is not envisioned to be a large operation. Starting with a staff of five (5) people, the MCAPMT, at a sustainable level of full functionality, is planning on employing eleven (11) staff, including engineers, technicians, business management/administration and development personnel.

7. MEETING THE CRITERIA FOR CONCEPT DEVELOPMENT

- **Fit with current strengths and maximizing response to present needs**- The conceptual development of the MCAPMT was based on a detailed SWOT analysis and review of needs of the Precision Manufacturing industry in the region. The considerations and development were monitored on an on-going basis by the PMRAP Steering Committee.

- **Maximize services for future needs**- A critical part of the feasibility study was a review and analysis directed at understanding new markets, new technologies and assessment of industry trends for the Precision Manufacturing industry in the region. The proposed functional operations of the MCAPMT will respond to the identified needs.
- **Leverage education/workforce training capacity**- The feasibility study has engaged local community colleges and universities to optimize and leverage local capacity. The recommended Center will not duplicate existing education/workforce training, but rather facilitate identification of needs and ensure delivery of services by existing organizations.
- **Effectiveness/realism of possible operating procedures**- The proposed MCAPMT benefits from the experience of some of the 'pilot' programs tested under PMRAP. This experience, and the excellent information received from other centers, provides a strong foundation for effective and realistic Center operating procedures.
- **Return on Initial Investment**- the feasibility study did not quantify ROI due to the very preliminary nature of the financial assumptions and analysis. However, the expected outcomes detailed in section 4 above provide a sense of assurance that once the Center is up and running, there will numerous returns that will justify the investment.
- **Sustainability** - The feasibility study included a detailed review of potential funding sources, and the testing of some Federal programs for applicability to center sustainment. This evaluation and the discussions with leaders of other centers allowed the development of a proforma budget that demonstrates an early transition to self sustainability.
- **Maximize economic development benefits**- The selection of the Center's functionality was driven by needs assessment and economic development strategies, resulting in a concept which offers business growth, and jobs creation/ retention in the Region and the Commonwealth.
- **Potential for nationally recognized manufacturing services**- The Center's functionality, facilities and targeted technology development programs/funding sources offer a potential for MCAPMT to be a nationally recognized manufacturing services entity.
- **Local Champion**- PMRAP was led by a strong steering committee representing all the stakeholders of the precision manufacturing industry in the Pioneer Valley, all with strong knowledge of industry and a "clout" in their respective communities. These individual demonstrated very strong interest and support for the MCAPMT. We are confident that such support will continue once the Center is launched.
- **Impact on Springfield and/or neighboring towns** (e.g. service industry, education institutions, and public infrastructure) - The feasibility study did not quantify the impact on Springfield and/or neighboring towns due to the very preliminary nature of the assumptions and start-up options. Precision manufacturing companies are spread across most of the region (with location quotients exceeding 2.5), and provide direct and indirect employment (with high multiplier number) to all the communities in the Pioneer Valley.
- **Facility recommendation**- The feasibility study did not look at a specific facility, mostly because it is not considered a critical part of the operation and the Center does not impose unique requirements on the selected facility. A few options were consider in Springfield and in neighboring towns to provide the assurance that finding an appropriate facility will not be a major hurdle.
- **Phased implementation**- Implementation trade-off resulted in a recommended phased start-up. The proposed MCAPMT will be "built out" to steady state size/operations within six (6) years.

Conclusions

Technology enabled precision manufacturing is highly concentrated and is one of the most important industry clusters in Massachusetts and in the Pioneer Valley Region. The mostly small companies are contract manufacturers and are primarily engaged in supplying precision mechanical components and sub-assemblies to major commercial manufacturers, aircraft engine builders, and military equipment providers in the United States and internationally.

The Precision Manufacturing Regional Alliance Project (PMRAP) has demonstrated that the formation of the Massachusetts Center for Advanced Precision Manufacturing Technology, Inc., as a focal point and catalyst for technical services and growth strategies, responds to the business needs of the precision manufacturing industry in the Region and in the Commonwealth as follows:

1. Workforce Development- Building a more responsive training infrastructure and leveraging and aligning existing education and training programs through the Center will provide a productive pipeline of new employees and create opportunities for incumbent workers to gain career-long skills development.
2. Competitiveness in New Markets- Infusion of new technology and sources of innovations will enable the precision manufacturing companies to move up the supply chain in their present markets, position them to respond to demands in emerging domestic and international markets, and develop new marketing strategies and collaborative business-to business relations that will accelerate regional economic growth.
3. Superior Manufacturing Services- The Center will provide value to the national R&D and procurement system through the adoption of new manufacturing technologies (process, materials and products), resulting in cost reduction, and shorter lead time and improved reliability of performance.
4. Operational Effectiveness- Assist small and medium businesses assess and acquire tools, software, services and best practices to achieve cost-effective and competitive operations

We are confident that the successful implementation of the functional elements of the Center will strengthen/grow the cluster, transform industry capabilities, and build a responsive talent pool for these businesses. The Center's operation model is sound, has been uniquely assessed and validated, and reflects a sustained commitment by the precision manufacturing industry to meet the evolving technological requirements posed by current and future customers.

The Center will have a significant impact on the competitiveness of local small companies, resulting in sustainable business growth, measurable job creation or retention, and increased regional economic prosperity.

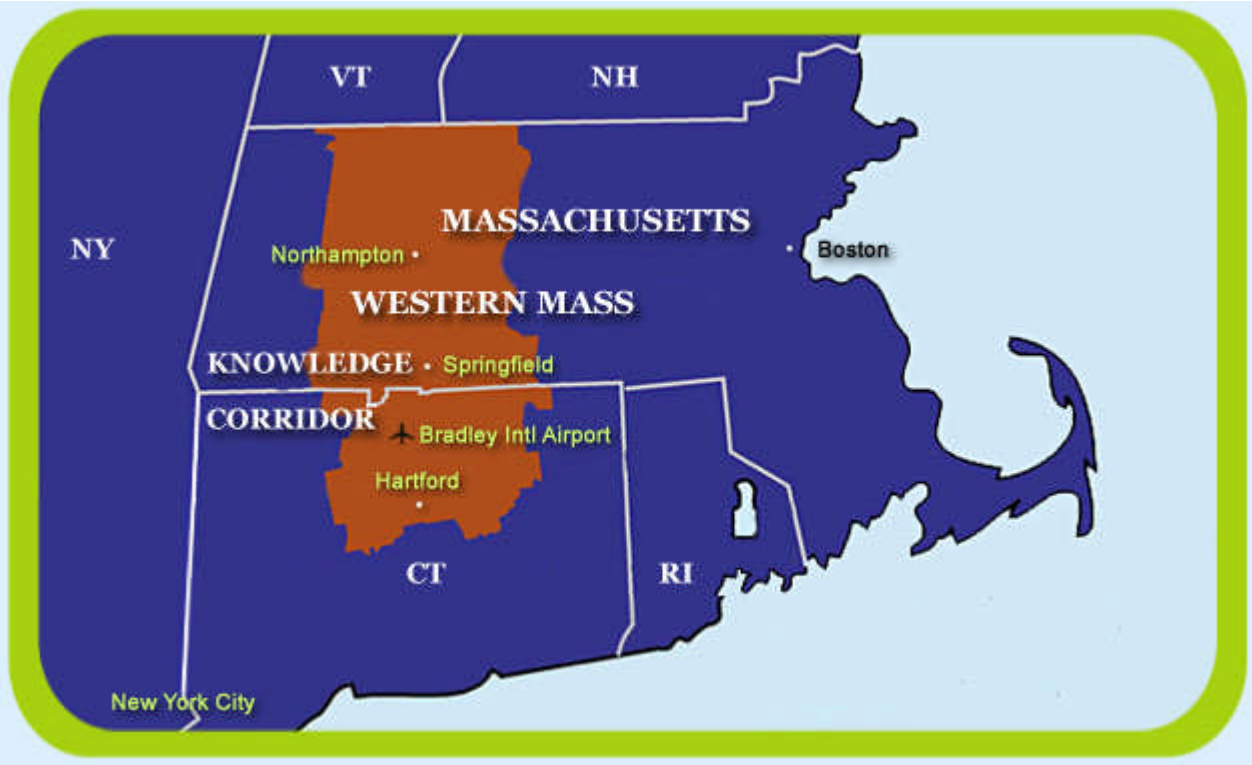
ATTACHMENT - A

FEASIBILITY STUDY MILESTONES

Date	Review Action
October 2, 2008	Needs assessment conducted with WMNTMA companies
October 22, 2008	DRAFT of functional framework of the MCAPMT sent to WMNTMA companies
March 26, 2009	Steering Committee reviewed revised DRAFT of major functional elements of the MCAPMT
March 26, 2009	Revised DRAFT of major functional elements of the MCAPMT sent to companies
April 7, 2009	Companies approved the major functional operating elements of the MCAPMT
April 7,2009	Steering Committee notified of companies approved approval
June 11, 2009	Steering Committee authorized the project team to begin work to constitute the MCAPMT as a recognized legal entity
September 24, 2009	DRAFT of Implementation Phase for MCAPMT presented to Steering Committee
September 30, 2009	DRAFT of Implementation Phase for MCAPMT REVISED by project team
October 2, 2009	DRAFT of Sub- Functional elements of MCAPMT finalized by project team
November 5, 2009	DRAFT of legal documents to incorporate the MCAPMT reviewed by the Steering Committee
November 13, 2009	DRAFT of legal documents to incorporate the MCAPMT approved by the Steering Committee
December 1, 2009	MCAPMT approved as a 501 (c) 3 non-profit corporation
February 11, 2010	DRAFT of initial MCAPMT operating budget approved by Steering Committee

ATTACHMENT - B

KNOWLEDGE CORRIDOR- LOCATION



Source[14]

[14] Economic Development Council of Western Mass. http://www.westernmassedc.com/Data__Demographics/location/

ATTACHMENT - C

PRECISION MANUFACTURING INDUSTRY CODES (NAICS)[15]

3260 Plastics and rubber products manufacturing
- 326110 Plastics packaging materials, film and sheet
- 326120 Plastics pipe, fittings, and profile shapes
- 326130 Laminated plastics plate, sheet, and shapes
- 3261A0 Foam product manufacturing
- 326160 Plastics bottle manufacturing
- 326192 Resilient floor covering manufacturing
- 32619A Plastics plumbing fixtures and all other plastics products
- 326210 Tire manufacturing
- 326220 Rubber and plastics hose and belting manufacturing
- 326290 Other rubber product manufacturing

3315 Foundries
- 331510 Ferrous metal foundries
- 33152A Aluminum foundries
- 33152B Nonferrous foundries, except aluminum

3321 Forging and stamping
- 332111 Iron and steel forging
- 332112 Nonferrous forging
- 332114 Custom roll forming
- 33211A All other forging and stamping

3322 Cutlery and hand tool manufacturing
- 332211 Cutlery and flatware, except precious, manufacturing
- 332212 Hand and edge tool manufacturing
- 332213 Saw blade and handsaw manufacturing
- 332214 Kitchen utensil, pot, and pan manufacturing

332A Ordnance and accessories manufacturing
- 33299A Ammunition manufacturing
- 332994 Small arms manufacturing
- 332995 Other ordnance and accessories manufacturing

332B Other fabricated metal product manufacturing
- 332500 Hardware manufacturing
- 332600 Spring and wire product manufacturing
- 332710 Machine shops
- 332720 Turned product and screw, nut, and bolt manufacturing
- 332811 Metal heat treating
- 332812 Metal coating and nonprecious engraving
- 332813 Electroplating, anodizing, and coloring metal
- 332910 Metal valve manufacturing
- 332991 Ball and roller bearing manufacturing
- 332996 Fabricated pipe and pipe fitting manufacturing

[15] http://www.bea.gov/regional/pdf/rims/RIMSII%20Industry%20Codes%20V3.pdf

332997 Industrial pattern manufacturing
332998 Enameled iron and metal sanitary ware manufacturing
332999 Miscellaneous fabricated metal product manufacturing

3332 Industrial machinery manufacturing
333210 Sawmill and woodworking machinery
333220 Plastics and rubber industry machinery
333291 Paper industry machinery manufacturing
333292 Textile machinery manufacturing
333293 Printing machinery and equipment manufacturing
333294 Food product machinery manufacturing
333295 Semiconductor machinery manufacturing
333298 All other industrial machinery manufacturing

3333 Commercial and service industry machinery
33331A Automatic vending, commercial laundry and dry-cleaning machinery
333313 Office machinery manufacturing
333314 Optical instrument and lens manufacturing
333315 Photographic and photocopying equipment manufacturing
333319 Other commercial and service machinery manufacturing

3334 HVAC and commercial refrigeration equipment
333411 Air purification equipment manufacturing
333412 Industrial and commercial fan and blower manufacturing
333414 Heating equipment, except warm air furnaces
333415 AC, refrigeration, and forced air heating

3335 Metalworking machinery manufacturing
333511 Industrial mold manufacturing
333512 Metal cutting machine tool manufacturing
333513 Metal forming machine tool manufacturing
333514 Special tool, die, jig, and fixture manufacturing
333515 Cutting tool and machine tool accessory manufacturing
33351A Rolling mill and other metalworking machinery

3336 Turbine and power transmission equipment manufacturing
333611 Turbine and turbine generator set units manufacturing
33361A Speed changers and mechanical power transmission equipment
333618 Other engine equipment manufacturing

3339 Other general purpose machinery manufacturing
333911 Pump and pumping equipment manufacturing
333912 Air and gas compressor manufacturing
333913 Measuring and dispensing pump manufacturing
333921 Elevator and moving stairway manufacturing
333922 Conveyor and conveying equipment manufacturing
333923 Overhead cranes, hoists, and monorail systems
333924 Industrial truck, trailer, and stacker manufacturing
333991 Power-driven hand tool manufacturing
333992 Welding and soldering equipment manufacturing
333993 Packaging machinery manufacturing

333994 Industrial process furnace and oven manufacturing
333995 Fluid power cylinder and actuator manufacturing
333996 Fluid power pump and motor manufacturing
33399A Scales, balances, and miscellaneous general purpose machinery

3391 Medical equipment and supplies manufacturing
339111 Laboratory apparatus and furniture manufacturing
339112 Surgical and medical instrument manufacturing
339113 Surgical appliance and supplies manufacturing
339114 Dental equipment and supplies manufacturing
339115 Ophthalmic goods manufacturing
339116 Dental laboratories

ATTACHMENT - D

INNOVATION FORUMS PARTICIPANTS

Technology Innovation Forums

July 23, 2009-June 10, 2010

Forum # 1: Non-Metallic Materials – Machining and Processing Technologies
University of Massachusetts- July 23, 2009

Name	Company/Institution	Position
Joseph Peters	Universal Plastics	President
Steve Hicks	Thorn Industries	General Manager
Chris Araujo	Creative Machining and Molding Corp.	President
Ed Leyden	Ben Franklin Design and Manufacturing	President
John Hayden	Hayden Corporation	Chairman
Shaw Ling Hsu	UMass-PSE	Professor and Department Chair
David Hoagland	UMass-PSE	Professor
Alfred Crosby	UMass-PSE	Associate Professor
Ryan Hayward	UMass-PSE	Assistant Professor
Allan Lesser	UMass-PSE	Professor

Forum # 2: Manufacturing Process Optimization
University of Massachusetts- August 26, 2009

Name	Company/Institution	Position
Ed Leyden	Ben Franklin Design and Manufacturing	President
Bill Amanti	Advance Manufacturing	Vice-President
Mike Kurkulonis	Poplar Hill Machine	President
James Bernotas	Amherst Machine	President
Joe Giffune	Mechanical Drive Components	President
Sundar Krishnamurty	UMass- MIE	Director, E-Design Center
Ian Grosse	UMass- MIE	Associate Professor
Kourosh Danai	UMass- MIE	Professor
Byung Kim	UMass- MIE	Professor
Don Fisher	UMass- MIE	Professor and Chair
Tiefu Shao	UMass- MIE	Post Doctoral Research Fellow

Forum # 3: Metals and Composites Interfaces
Hayden Corporation- December 3, 2009

Name	Company/Institution	Position
Joseph Peters	Universal Plastics	President
Steve Hicks	Thorn Industries	General Manager
Chris Araujo	Creative Machining and Molding Corp.	President
Ed Leyden	Ben Franklin Design and Manufacturing	President
John Hayden	Hayden Corporation	Chairman
Shaw Ling Hsu	UMass-PSE	Professor and Department Chair
James Capistran	UMass-PSE	CUMIRP Director
Alfred Crosby	UMass-PSE	Associate Professor
Ryan Hayward	UMass-PSE	Assistant Professor

Forum # 4: Cryogenic Machining
B&E Tool Group, LLC- November 18, 2009

Name	Company/Institution	Position
Chris Haddad	Tell Tool, Inc.	Vice President-Operations
Jack Plotnikiewicz	Berkshire Industries	Engineering Manager
Ed Leyden	Ben Franklin Design and Manufacturing	President
Larry Maier	Peerless Precision Inc.	President
Joe Beavis	Peerless Precision Inc.	Process Engineer
Phil Vecchiarelli	O-A, Inc.	President
Dick Patterson	B&E Group, LLC	Vice President, New Business Development
Paul Wilander	B&E Group, LLC	Programming Engineer
Sundar Krishnamurty	UMass- MIE	Director, E-Design Center
Tiefu Shao	UMass- MIE	Post Doctoral Research Fellow
Douglas Eddy	UMass- MIE	Doctoral Student
John LaFrancis	Springfield Technical Community College-MET	Professor
Megan Piccus	Springfield Technical Community College-MET	Professor
Clem Fucci	Westfield Vocational Technical High School	Department Chair

Forum # 5: Operational Process Improvement in a Changing Manufacturing Supply Chain
University of Massachusetts - February 12, 2010

Name	Company/Institution	Position
David Smith	Tell Tool, Inc.	President
Jason Roberts	Tell Tool, Inc.	Operations Manager
Susan Kasa	Boulevard Machine and Gear	President
Chris Zawacki	Pelican Products, Inc.	Director of Manufacturing
Mark Perreaualt	Mazak	District Sales Manager
Steve Capshaw	Valley Steel Stamp	President
Larry Maier	Peerless Precision, Inc.	President
Tony Iglesias	Peerless Precision, Inc.	Foreman
Senay Solak	UMass- SOM-FOM	Assistant Professor
Anna Nagurney	UMass- SOM-FOM	John F. Smith Memorial Professor of Operations Management
Alan Robinson	UMass- SOM-FOM	Professor
Michael Malone	UMass	Vice Chancellor for Research and Engagement
Ahmed Ghoniem	UMass- SOM-FOM	Assistant Professor
Kwong Chan	UMass- SOM-FOM	Assistant Professor

Forum # 6: Cooperative Business Networks
Scibelli Enterprise Center-STCC Technology Park – June 10, 2010

Name	Company/Institution	Position
Joe Giffune	Mechanical Drive Components	President
Susan Kasa	Boulevard Machine and Gear	President
Chris Araujo	Creative Machining and Molding Corp.	President
Steve Hicks	Thorn Industries	General Manager
Karen L. Utgoff	Karen Lauter Utgoff Consulting	President
Lyne J. Kendall	UMass-MA Small Business Development Center Network	Senior Business Analyst
James Capistran	UMass-CUMIRP	Director
Nicholas DeCristofaro	UMass-Commercial Ventures & Intellectual Property	Director

Highlights

- Total Individual Participants: 52
- Total Participants: 71
- Total Individual Precision Manufacturing Companies: 18

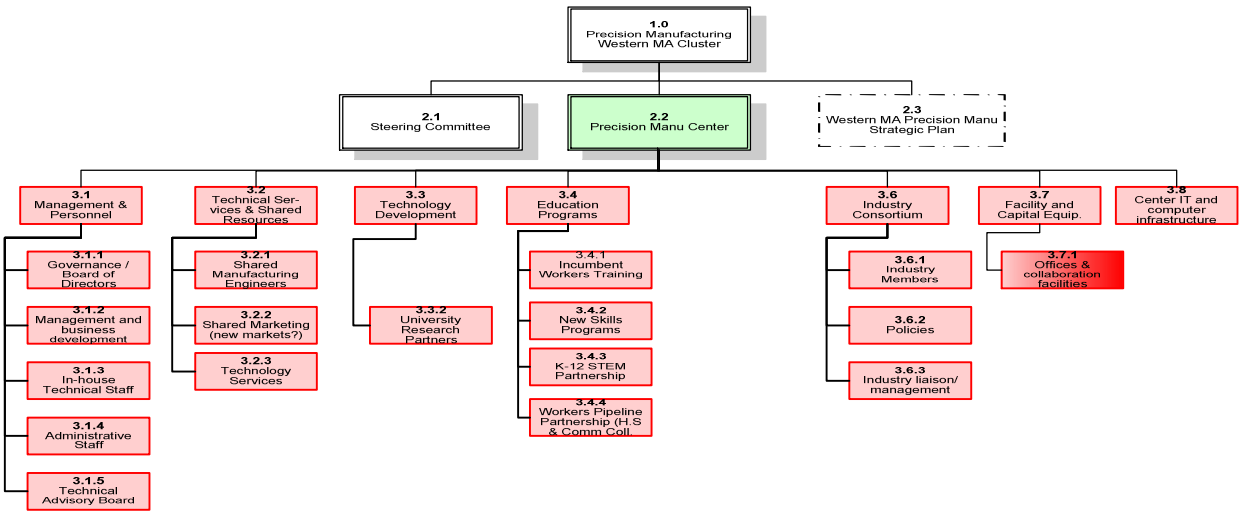
June 2010

ATTACHMENT - E

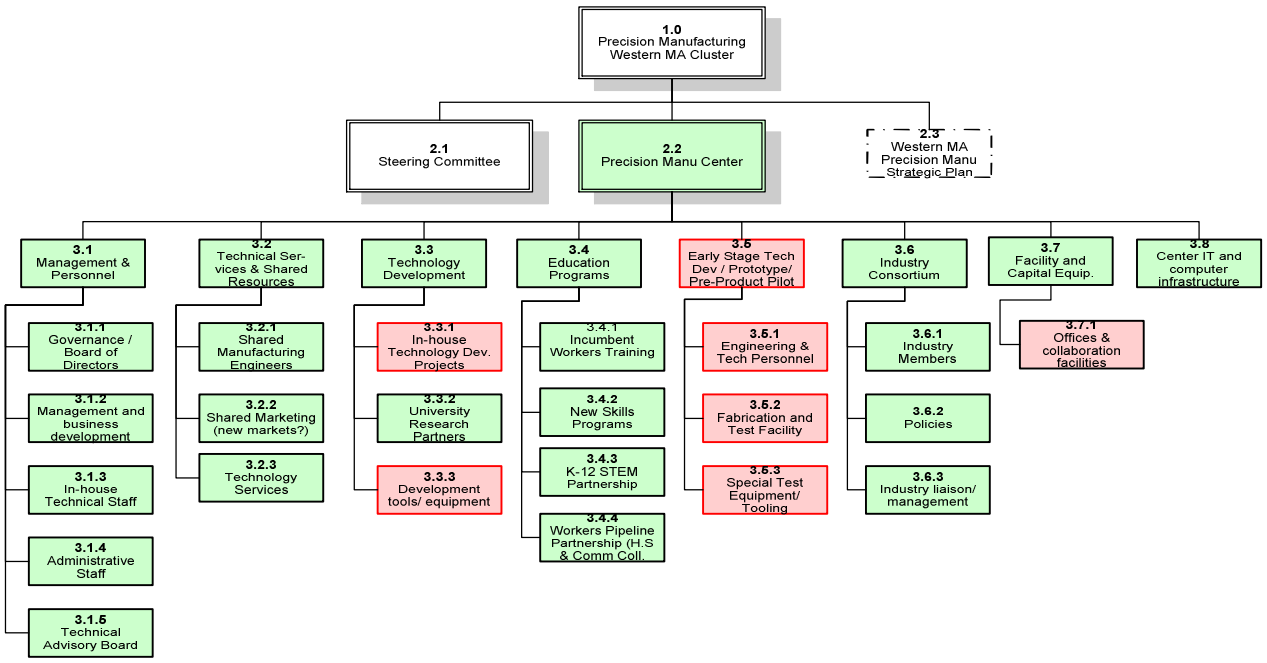
FUNCTIONAL IMPLEMENTATION PHASES

The functional operating elements of the MCAPMT will be implemented in three interrelated phases:

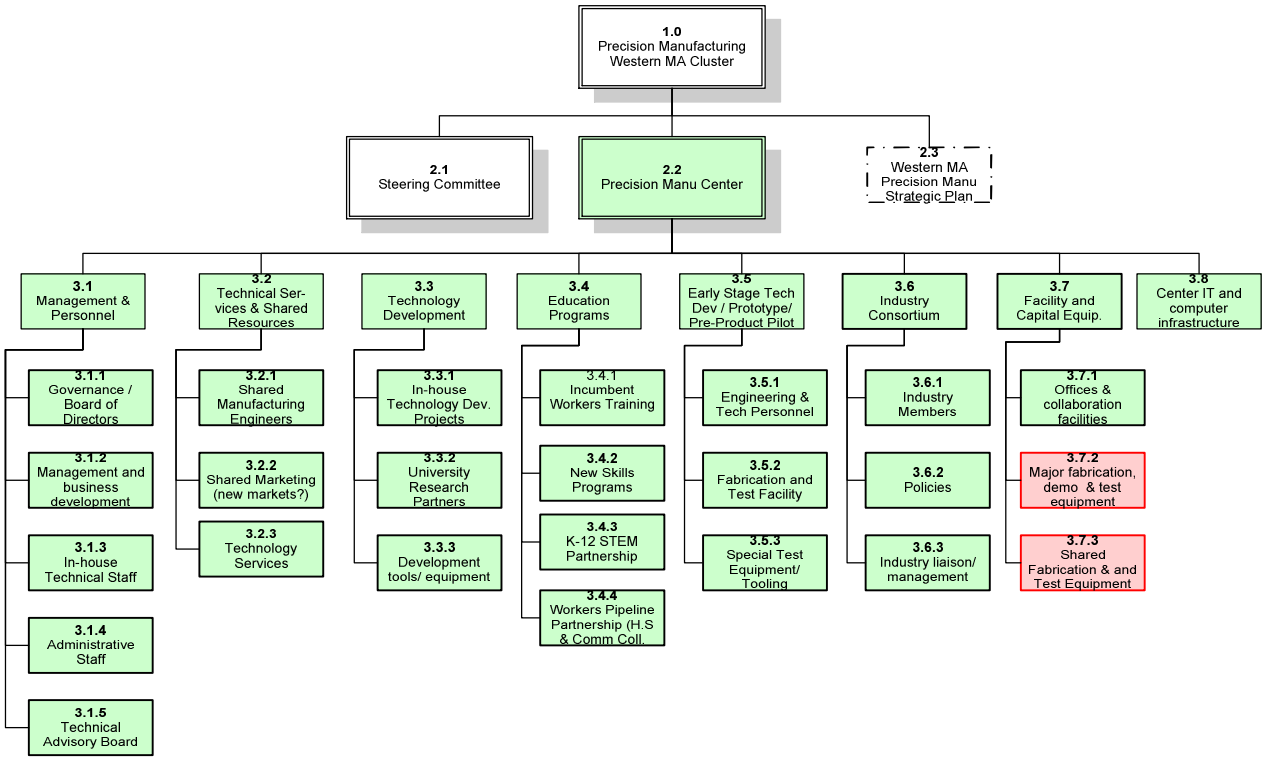
Phase 1



Phase 2



Phase 3


1.0
Precision Manufacturing
Western MA Cluster
2.1
Steering Committee
2.2
Precision Manu Center
2.3
Western MA
Precision Manu
Strategic Plan
3.1
Management &
Personnel
3.2
Technical Ser-
vices & Shared
Resources
3.3
Technology
Development
3.4
Education
Programs
3.5
Early Stage Tech
Dev / Prototype/
Pre-Product Pilot
3.6
Industry
Consortium
3.7
Facility and
Capital Equip.
3.8
Center IT and
computer
infrastructure
3.1.1
Governance /
Board of
Directors
3.1.2
Management and
business
development
3.1.3
In-house
Technical Staff
3.1.4
Administrative
Staff
3.1.5
Technical
Advisory Board
3.2.1
Shared
Manufacturing
Engineers
3.2.2
Shared Marketing
(new markets?)
3.2.3
Technology
Services
3.3.1
In-house
Technology Dev.
Projects
3.3.2
University
Research
Partners
3.3.3
Development
tools/ equipment
3.4.1
Incumbent
Workers Training
3.4.2
New Skills
Programs
3.4.3
K-12 STEM
Partnership
3.4.4
Workers Pipeline
Partnership (H.S
& Comm Coll.
3.5.1
Engineering &
Tech Personnel
3.5.2
Fabrication and
Test Facility
3.5.3
Special Test
Equipment/
Tooling
3.6.1
Industry
Members
3.6.2
Policies
3.6.3
Industry liaison/
management
3.7.1
Offices &
collaboration
facilities
3.7.2
Major fabrication,
demo & test
equipment
3.7.3
Shared
Fabrication & and
Test Equipment

ATTACHMENT – F

TECHNOLOGY CENTERS –REFERENCE

The Center for Aerospace Manufacturing Technologies (CAMT) at the Missouri University of Science and Technology (Missouri S&T)[16]

The Center for Aerospace Manufacturing Technologies (CAMT) was established in May 2004 by the Missouri University of Science and Technology (Missouri S&T) in partnership with Boeing Phantom Works in St. Louis, Missouri and the Air Force Research Laboratory in Dayton, Ohio. The mission of the Center is to serve as a center of excellence: 1) to research, develop, evaluate and demonstrate new and optimal methodologies and tools for the rapid and cost-effective manufacture of aerospace components and products; and 2) to promote new education and training programs for the evolving aerospace manufacturing workforce; resulting in significant technological advancement and national economic impact. Major funding for CAMT has been through the Air Force Research Laboratories. The Center has received AFRL funding totaling ~$18.7 million in the past four years.
CAMT has an array of technologies devoted to advancing manufacturing fabrication and assembly. Over thirty-five faculty members and more than sixty research staff and students from several academic disciplines perform multi-disciplinary research.
The Center's programs are aimed to: Research, develop, evaluate, demonstrate, and transfer advanced technologies of critical importance to the aerospace defense and commercial manufacturing industries in the United States; Create knowledge, methodologies and tools that can improve affordability, rapidity, quality, productivity, reliability, and safety in aerospace manufacturing; Disseminate the knowledge, methodologies, and tools developed by the Center to the aerospace manufacturing industry through direct technology transfer as well as the development of education, training, and outreach activities; Serve as a role model of university-industry-government collaborative partnership.
An Industrial Consortium has been formed by the Center starting in July 2007, with the goal that the Center's research can benefit all members of this consortium and its R&D activities can be directed by the consortium members. CAMT Industrial Consortium currently has 9 members.

Institute for Plastics Innovation at UMass/Lowell, Massachusetts[17]

The Institute for Plastics Innovation (IPI) offer members of the plastics industry the knowledge and tools to stay in the forefront of research and development. The IPI provides an environment where start-up companies can develop into technology and manufacturing employers in Massachusetts.
The Center's primary objectives are:
1) To be partner with companies to develop economically significant intellectual property.
2) To transfer, license, and support current patents and intellectual property to partner companies.
3) To provide an incubation space for companies which are synergistic with the expertise of the Institute.
The applied research center at IPI fills a 28,000 sq. ft. industrial building that is located within walking distance of the university campus and Lowell National Historical Park. The institute pools the resources of multi-disciplinary university and industry experts, where necessary collaborative research is utilized to solve current challenges impeding the advancement of plastics manufacturing technology. New manufacturing technologies are developed with many of these new technologies being a direct result of multi-disciplinary interactions between university and industry personnel.

[16] http://campus.mst.edu/camt/
[17] http://ipi.eng.uml.edu/

The results of the research are used directly by participating companies, thus ensuring that laboratory research is adaptable to the true manufacturing setting.
As an example, the Institute of Plastics Innovation carries out exploratory and fundamental research on biodegradable polymers to support the technological interests of its members. To realize this objective, the IPI has been organized to merge expertise in microbial production of polymeric materials, organic transformations, plastics processing, materials characterization, biodegradation testing and environmental impact analysis.

The Advanced Technology and Manufacturing Center (ATMC) at UMass/Dartmouth, Massachusetts[18]

The University Of Massachusetts Dartmouth Advanced Technology & Manufacturing Center (ATMC) is located in the South Coast Research and Technology Park, near the intersection of Rt. 195 and 24 in Fall River. The state-of-the-art 60,000 sq. ft. facility is located on 17 acres of land. The Center is designed to foster economic development in the region. The goal of the ATMC is to provide advanced technology and manufacturing solutions through industry and university partnerships and to meet current and future business needs. To this end, the Center has the following operations/functions:
1. Technology Venture Center- Provides infrastructure for emerging companies; Supports business planning and raising capital; Provides access to state-of -the-art R&D facilities; Offers access to technical and business expertise and support services; Allows industry to leverage university resources to enhance their competitive position; Provides access to experienced UMass Dartmouth faculty, the university's state-of-the-art R&D facilities, and student interns; Offers the services of the full time professional ATMC staff who specialize in innovation of technology.
2. Conference Center- Provides flexible meeting space; Organizes business & strategy sessions; Facilitates networking events and receptions; Manages technology symposiums and workshops; Provides video conferencing facilities.
3. Research & Partnering Laboratories- Allows industry to leverage University resources, enhancing the industry's competitive position; Engages faculty expertise and an educated student workforce to meet member industry (in the Venture Center) schedule and budget commitments. The research topics in the laboratories can include: • Acoustics • Biomedical • Environmental Chemistry • Materials• MicroFluidics • Optics/Photonics. Core Support Labs offer facilities applicable for development of computer/software systems, electronics assembly & test and prototype manufacturing.

The Aerospace Manufacturing Technology Centre (AMTC) in Canada[19]

The Aerospace Manufacturing Technology Centre (AMTC), one of five laboratories at the Canadian NRC Institute for Aerospace Research (NRC Aerospace), is an initiative resulting from a partnership between the NRC and Canada Economic Development for Québec region. Located on the campus of the University of Montreal, its aim is to develop core competencies and demonstrate modern aerospace manufacturing technologies that have the potential for significant cost savings, while also maintaining high levels of quality, reliability and performance.
AMTC R&D activities mobilize existing facilities and programs at NRC Aerospace and at other related NRC institutes and programs across Canada to help industry implement advanced, cost-effective, manufacturing methods for aerospace. A major focus is to facilitate the transition to next-generation manufacturing, particularly among small and medium-sized enterprises (SMEs).

[18] http://www.atmc.umassd.edu/welcome.cfm
[19] http://www.nrc-cnrc.gc.ca/eng/facilities/iar/amtc.html

The Centre employs approximately 100 people (including staff and guest workers from industry and universities) who investigate technologies in four major research areas: 1) forming and joining of metallic products; 2) fabrication and joining of composite structures; 3) automation, robotics and intelligent manufacturing systems; and 4) advanced material removal.

Metal forming research aims to develop forging and hydroforming processes for aerospace component production. Technologies for joining metal alloys, such as laser, electron beam, linear friction and friction stir welding, are also investigated, as is the application of cladding technologies for engine component repairs.
Composite structures fabrication and joining studies look to improve liquid composite molding technologies through use of flexible tooling and to advance thermoset composites production through the application of automation and online cure monitoring. Other investigations include use of automated fiber placement in aircraft component manufacturing, and development of new joining technologies for composite materials, such as resistance welding of thermoplastic composites.
The Center has the facilities and personnel to undertake projects in automation, robotics, and intelligent manufacturing systems. A large gantry system equipped with two multi-axial industrial robots enables development of automated systems for assembling aircraft structures. Intelligent surface treatment and automated surface finishing technologies are also investigated. Modeling and simulation capabilities support these activities.
The Advanced material removal research is aimed at developing high-performance, high-speed machining technologies to facilitate production of high-complexity parts, thin-walled structures, and aerospace materials. These include laser and vibration assisted machining, super-abrasive grinding, dry machining, and machining under minimum quantity lubrication. Other work is carried out to enhance machine tool accuracy and cutting tool performance as well as optimize machine processes.

- ***The National Center for Defense Manufacturing and Machining (NCDMM) in Pennsylvania[20]***

The National Center for Defense Manufacturing and Machining (NCDMM) was established in 2003 to address and support the broad manufacturing and machining needs of the U.S. Department of Defense (DoD) and its suppliers. Since its inception, the NCDMM has worked with numerous DoD organizations and their industrial supply base. Through these interactions, the NCDMM has developed and delivered innovative solutions under broad contracts with the Defense Logistics Agency and/or US Army laboratories.
NCDMM Mission is to deliver optimized manufacturing solutions that enhance the quality, affordability, maintainability, and rapid deployment of existing and yet-to-be developed defense systems. In collaboration with government, industrial, and academic organizations it promotes the implementation of best practices at key stakeholders' facilities through the development and delivery of disciplined training, advanced technologies, and manufacturing methodologies.
To achieve its mission, the Center has developed relationships with a network of partners- a variety of U.S. technology providers that contribute to projects/contracts undertaken for the DoD, as well as maintaining state-of-the-art demonstration capabilities in its Testing and Development Laboratory. These capabilities include: 5-axis machining; High-speed machining (up to 50,000 RPM); Portable coordinate measuring/inspection; High-accuracy fixed bed coordinate measuring with laser, white light and touch probe; High-accuracy optical visual inspection equipment; Scanning Electron Microscope (SEM) and other state-of – the- art equipment and software.

[20] http://www.ncdmm.org/index.cfm

NCDMM also offers contract CNC programming services to all industries. The center has a record of providing optimized machining programs that reduce overall cycle times and drastically reduce the cost of machined components.

Of special interest is the strong political support the NCDMM maintains which is part of its sustainability model. Its Board of Directors includes:
Dean L. Bartles- Vice President & General Manager, Large Caliber Ammunition, General Dynamics - Ordnance and Tactical Systems Division
Lawrence P. Farrell, Jr.- Lieutenant General, USAF (Ret.), President and CEO, National Defense Industrial Association (NDIA)
Mark Gordon- Director, National Center for Advanced Technologies
Mark F. Huston- Vice President, Research, Development and Engineering (MSSG), Kennametal Inc.
Jeffrey S. Kelly- Chief Executive Officer, Hamill Manufacturing Company
Larry A. Maier- President & Owner, Peerless Precision, Inc.
Edward A. Morris- Director, Hardware and Manufacturing, Corporate Engineering and Technology, Lockheed Martin Corporation
Philip H. Weihl- Vice President Integrated Supply Chain Logistics, Kennametal Inc.
Douglas K. Woods- President, Association for Manufacturing Technology (AMT)

Manufacturing Technology Center (MTC) in Wytheville, Virginia[21]

The Mission of the MTC is to be a technical resource for Southwestern Virginia's business community to enhance economic growth and vitality, while maintaining the quality of life of its citizens. The Manufacturing Technology Center is part of the Manufacturing Extension Partnership (MEP) network. MEP is a nationwide network of not-for-profit centers in nearly 350 locations nationwide, whose sole purposes are to provide small and medium sized manufacturers with the services they need to succeed. The centers, serving all 50 States and Puerto Rico, are linked together through the Department of Commerce's National Institute of Standards and Technology. Centers are funded by federal, state, local and private resources to serve manufacturers. That makes it possible for small firms to tap into the expertise of knowledgeable manufacturing and business specialist all over the United States.
Each center works directly with area manufacturers to provide expertise and services tailored to their most critical needs, which range from process improvements and worker training to business practices and applications of information technology. Solutions are offered through a combination of direct assistance from qualified center staff and outside consultants. A MEP organization is active in Massachusetts as well, and much like MTC, can be a good model for professional and technical consulting services to manufacturing SME's.

The Metal Processing Institute at WPI in Worcester, MA[22]

The Metal Processing Institute (MPI) is an industry-university alliance dedicated to advancing the state of the art in the metal processing industry. Through its focus on metal processing, the institute looks to advance the fundamental understanding of existing processes, develops new methods, and addresses technology and business issues. The interdisciplinary agenda of MPI is developed in close collaboration with its member companies. Research focus is ensured by addressing the fundamental

[21] http://www.mtcofswva.org/
[22] http://www.wpi.edu/academics/Research/MPI/?utm_source=shorturl&utm_medium=shorturl&utm_campaign=Short%2BURL&utm_content=mpi

issues facing near-net-shape manufacturing industries through the primary three centers of the Metal Processing Institute: Advanced Casting Research Center (ACRC), the Center for Heat Treating Excellence (CHTE), and the Center for Resource Recovery & Recycling (CR3). The centers pursue three kinds of research projects: 1) Precompetitive fundamental research funded by the members, 2) Large-scale projects funded by the federal government or foundations leveraging the research agenda of the centers, and 3) Specific and proprietary research conducted for the consortium members, when appropriate.
Each of the research centers conducts projects selected by its steering committee, as well as proprietary projects sponsored by individual companies. The centers also conduct basic research on emerging technologies of vital importance to its particular industry. These are typically funded by the federal government and/or foundations. Results of research projects are presented to the consortium members at two annual workshops, one in the spring and one in late fall. The workshops also provide a forum for discussion of issues facing the industry. Each spring a technical symposium is held on a topical issue. Programs and seminars are organized for participating industrial members. Customized continuing education courses and technical education programs are offered at the industrial site. Participation in industrial and government forums include presentations at technical conferences, industry associations and government agencies.

Each research center is a consortium that includes WPI and its industrial partners. Various segments of the industry are represented within the consortium--primary and secondary producers of metal, equipment manufacturers, suppliers, manufacturers and processors (casters, parts producers, heat treaters), and end users. Thus, MPI benefits from input and engagement across the spectrum of the metal processing industry and the technology supply chain is fully represented by the institute's corporate partners.
MPI has also established relationships and liaisons with other national and international research centers and researchers, specifically, Massachusetts Institute of Technology, Oak Crest Institute of Science, Northwestern University, University of Connecticut, Ohio State University, RWTH Aachen University (Germany), Norwegian University of Science and Technology (Norway), the University of Queensland (Australia), Northwestern Polytechnic University, Lanzhou University of Technology, Tsinghua University (China), University of Cyprus (Cyprus), Ecole des Mines de St-Etienne and L'Ecole Nationale Superieure des Mines de Nancy (France), and University of Padua (Italy).
As an example, the Advanced Casting Research Center (ACRC) consortium performs basic and developmental research relevant to the metal casting industry focusing on light metals, non-ferrous alloys, and semi-solid processing. The Consortium provides a forum, where the industrial and academic sectors jointly address the technological problems encountered in the metal casting industry. ACRC also serves as an educational center, disseminating results and developing courses and continuing education programs serving the industry.

ATTACHMENT – G

TECHNOLOGY CENTERS - PRECEDENCE IN MASSACHUSETTS

Chelsea Center for Recycling and Economic Development

The Chelsea Center for Recycling and Economic Development was founded by the Commonwealth of Massachusetts in 1995 to create jobs, support recycling efforts, and help the economy and the environment by working to increase the use of recovered materials by manufacturers. The Chelsea Center was created at UMass Lowell's Center for Environmentally Appropriate Materials as part of the STEP Program, the Strategic Envirotechnology Partnership, a partnership of the Executive Office of Environmental Affairs and the University of Massachusetts. The Center ceased its operation in 2003.

The Center's goal was to help create an infrastructure for a sustainable materials economy in Massachusetts, where businesses will rely on locally discarded goods as their feedstock and that minimize pressure on the environment by reducing waste, pollution, dependence on virgin materials, and dependence on disposal facilities. The Chelsea Center worked with manufacturers to help them overcome technical and business barriers to increasing their use of recyclable feedstocks; worked with municipalities to help them recognize the value of their waste materials and to turn them into new products; and worked with economic developers and other business service organizations to educate them on the value and importance of working with the recycling industry.

The Center relied on state and federal financing; for example, in fiscal year 1999, its budget was slightly over $1 million. The Center receives the majority of its funding from the state legislature through the STEP program and through the Clean Environment Fund (CEF), which consists of unredeemed deposits from the bottle bill. The Chelsea Center also used funds granted from the US Environmental Protection Agency, Region 1. STEP funds, administered through UMass Lowell, were used to pay salaries, fringe, and expenses for three staff – the Executive Director and the Directors of Business and Technical Programs. STEP funds also covered overhead such as rent, phones, and office supplies and systems. CEF funds were used to pay salaries of two staff people – the Chelsea Center's Office Manager/CEF Coordinator and the Director of Economic Development Programs – as well as most program funds. Chelsea Center FY99 funding sources were - Clean Environment Fund- Approx 73%, STEP- Approx 25%, EPA Institute. - Approx 2%
The Chelsea Center accomplishes much of its work through alliances with public colleges and universities. For example, in FY'99, approximately 37% of the Chelsea Center's CEF funds went to the University of Massachusetts campuses for research, business assistance, interns, and for overhead to the Donahue Another 8% went to other public schools (universities, high schools, and community colleges). The remainder paid for consultants, private researchers, manufacturers, etc.
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Advanced Technology & Manufacturing Center

http://www.atmc.umassd.edu/

The project to establish the ATMC was born out of a tragedy. On January 12, 1987, a catastrophic fire hit the Kerr Mill complex on Martine Street in Fall River MA, reducing the historic building to rubble. It was an economic disaster for 946 workers employed in various manufacturing and retail

enterprises located on the complex on the north shore of South Watuppa Pond. Almost immediately, city leaders began looking for ways to redevelop the site, and eventually went into an agreement with UMass Dartmouth to build a research and development center there.
After over ten years of planning, the $14 million ATMC was financed and built by the Massachusetts Development agency. The facility, which is operated by University of Massachusetts Dartmouth and a center for research and development on new and emerging technologies.

ATMC was opened on November 14, 2001 as a 60,000 square-foot, state-of-the-art facility that was aimed to create 120 new jobs in the region. The Center includes laboratories, classrooms and an incubator for new companies. The state is considering paying back the initial investment of $14M to MassDevelopment, and a number of bills were proposed for this purpose.

The Massachusetts Marine Fisheries Institute (MFI)

http://www.smast.umassd.edu/mfi/about_goals.html

The Massachusetts Marine Fisheries Institute (MFI) is a cooperative venture between the Massachusetts Executive Office of Energy and Environmental Affairs and the University of Massachusetts to promote sustainable fisheries through education and research.

The Massachusetts Marine Fisheries Institute supports one of the most historic and valuable industries in Massachusetts and New England. The health of New England's commercial fishing industry is vital to the nation's economy, while the Massachusetts marine recreational fishery ranks among the most valuable in the United States. The MFI, as a cooperative partnership, helps protect these vital marine ecosystems through groundbreaking research and innovative cooperative programs.

The conception of the Massachusetts Marine Fisheries Institute (MFI) goes back to 1994, when three large marine protected areas were established to protect groundfish stock, resulting in the closing of historic scallop grounds. Scallop stocks were believed to be very dense in these areas, so closing them to protect the over-fished groundfish stock brought the New England sea scallop fishery to near bankruptcy by 1997.

Bobby Bruno and Malvin Kvilhaug, two scallop fishermen from New Bedford and both leaders of the Fisheries Survival Fund, approached the University of Massachusetts Dartmouth School for Marine Science and Technology Dean, Dr. Brian Rothschild, to request help from the scientists at the University.

Dr. Rothschild, current Co-Director of the MFI, brought together a coalition involving the School for Marine Science and Technology, the Fisheries Survival Fund, the National Marine Fisheries Service and the Virginia Institute of Marine Science and launched a commercial dredge survey of one of the closed fishing areas. The survey resulted in a search for a new, innovative way to assess the scallop populations, and a research program to assist the marine fisheries in Massachusetts.

Massachusetts-NREL Wind Technology Testing Center

http://www.masstech.org/wttc/index.html

The Massachusetts Wind Technology Testing Center is a partnership between the Massachusetts Clean Energy Center and the U.S. Department of Energy's National Renewable Energy Laboratory to develop a world class large wind turbine blade testing center in Boston.

Massachusetts won a competitive grant of $2 million in federal support, plus in-kind technical and operating assistance to help outfit and run a new wind blade testing center. The Massachusetts team included local, state and university leaders who came together to win the federal government's assistance in establishing this center, which could attract new wind technology and other renewable energy technology companies to the region. Specifically, the Commonwealth partnership that applied for the CRADA in November 2006 to DOE/NREL included the Renewable Energy Trust/Massachusetts Technology Collaborative (MTC), the Massachusetts Port Authority, the Renewable Energy Research Laboratory (RERL) at UMass Amherst, and the Executive Offices of Housing and Economic Development (EOHED), and Energy and Environmental Affairs (EOEEA).

The Wind Technology Testing Center (WTTC) offers a full suite of certification tests for turbine blades up to 90m in length. WTTC will also offer the latest wind turbine blade testing and prototype development methodologies in order to help the wind industry deploy the next generation of onshore and offshore wind turbine technologies. NREL is providing the technical expertise and testing hardware for WTTC under its Cooperative Research and Development Agreement with the Massachusetts Technology Collaborative. The Testing Center is primarily in the business of providing certification tests for new blade designs and reliability testing for existing blade designs for wind turbine manufacturers.

The Testing Center is in a large industrial building at 100 Terminal Street, Charlestown, Boston in which wind turbine blades will be tested for structural integrity and durability. This is critical to ensure the competitiveness of U.S. wind turbine and blade manufacturers. It will also be a critical element in helping to develop the off-shore wind turbine technology required to tap Massachusetts' substantial off-shore wind resources. WTTC is uniquely positioned at an existing deep water port (all large blades can be shipped via water to this site) and near interstate highways.

Massachusetts Medical Device Development Center

http://www.uml.edu/m2d2/default.html

Through initial funding from the John Adams Innovation Institute/Mass Technology Collaborative and other private sources, the Massachusetts Medical Device Development Center (M2D2) provides a unique service to the state's smaller medical device companies: offering inventors and executives easy, affordable, and coordinated access to researchers and resources at the Lowell and Worcester campuses of the University of Massachusetts.

M2D2 is looking to help smaller firms convince venture capitalists that they too have marketable ideas and products. The Center offers resources to develop viable products every step of the way, from proof-of-concept to commercialization. Tapping broad-based expertise in engineering and the conduct of clinical trials at the University, M2D2 assists companies in meeting FDA standards for medical device design and controls, materials selection, material procurement and control, prototype development, process development and validation, cGMP Phase I manufacturing, sterile package design, process and testing, and all stages of medical device clinical trials.

The Massachusetts Cranberry Experiment Station

Located in East Wareham, the Cranberry Experiment Station, a part of the UMASS Amherst Campus, is an outreach and research center charged with the mission of maintaining and enhancing the economic viability of the Massachusetts Cranberry Industry through research and outreach and serving the public welfare by supporting economic development and the protection of the environment.

The Cranberry Station programs are focused on the cranberry production system in the areas of systems ecology (including crop protection and sustainability) and the interaction of cranberry growing and the environment. Current projects include the use of alternative cultural practices, especially flooding, to control insect, weed, and disease pests in cranberry, a study of the impact of phosphorus use in cranberry production on surface water quality, and physiological factors that may be limiting production.

The origin of the Cranberry Station may be traced back to the 1905 summer meeting of the Cape Cod Cranberry Growers Association (CCCGA). Professor H. T. Fernald of the Massachusetts Agricultural College in Amherst, now the University of Massachusetts at Amherst, was asked to speak to that group. He talked about certain insects, including cranberry fruitworm and black-headed fireworm, which were said to have very seriously reduced the crop every year in the early history of the Massachusetts cranberry industry. As a result, growers urged further study on this subject and Henry Franklin was chosen for the job. Years later he recalled. "As a result of all this, arrangements were made with the Agricultural Experiment Station at UMass Amherst to send a man into the cranberry section to make a survey of the cranberry insect problems during the growing season of 1906. Consequently, CCCGA petitioned the Legislature to fund a permanent facility for cranberry research. The CCCGA solicited a 1 cent per barrel pledge from growers on their 1908 crop to fund a researcher. In 1910 the legislature made $12,600 available for the purchase of land, including a cranberry bog, and the construction of a building which was completed in 1911. And thus, the Cranberry Experiment Station of the Massachusetts Agricultural Experiment Station began its existence.

In its 100 year history, the Cranberry Station and its scientific staff have seen many changes in cranberry growing as a result of its research efforts. Some of the major milestones include the development of the frost forecasting system and determination of cranberry hardiness levels, insect monitoring and modern IPM programs, introduction of modern cultivars, the use of biological control agents for cranberry pests, modern fertility management programs, effective weed management combining cultural control with post-emergence herbicide use, and effective disease prediction and management programs.

In 1994, legislation was enacted to form within the University of Massachusetts, a Cranberry Station Board of Oversight. The Board's role is to advise and assist the President of UMass in the management of the Station. The Board is charged with maintaining the scientific credibility of the Station and keeping the focus of the Station on its mission to assure the economic viability of the Massachusetts Cranberry Industry. The Board oversees Station budgets and acts as an advocate for the Station and its programs. Board meetings are held four times each year at the Cranberry Station.

The Board membership consists of representatives of UMass Amherst, UMass Dartmouth, the Massachusetts Legislature, the Governor, and the Cape Cod Cranberry Growers Association.

Summary

Implementation Factors:

(1) Association with or engagement with academic institutions
(2) Third party initial funding (grant, loan, federal earmark, etc.)

(3) Strong local industry or public advocacy
(4) Political championship
(5) Special circumstantial conditions (major dislocation, natural disaster, tec.)
(6) Strong economic development rationale
(7) Research breakthrough/special emerging technologies

MA Technology Centers	Implementation Factor						
	1	2	3	4	5	6	7
Chelsea Center for Recycling & Economic Development							
Advanced Tec & Manufacturing Center							
The Massachusetts Marine Fisheries Institute							
Massachusetts-NREL Wind Technology Testing Center							
Massachusetts Medical Device Development Center							
The Massachusetts Cranberry Experiment Station							

Yes- very important influence

Moderate influence

No or very little influence

Not known

ATTACHMENT – H

MCAPMT PROFORMA BUDGET

Center Components Implementation Configuration- 7 Years Budget (Option 1)

	FY1 Budget	FY2 Budget	FY3 Budget	FY4 Budget	FY5 Budget	FY6 Budget	FY7 Budget	Total
Beginning Center Fund Balance		$50,000	$134,900	$52,547	$150,923	$199,851	$194,447	$182,880
Revenue								
State and Federal Appropriation	$500,000	$500,000	$1,200,000	$1,000,000	$1,000,000	$150,000	$150,000	$4,500,000
Federal Contracts			$100,000	$100,000	$200,000	$500,000	$600,000	$1,500,000
Center Sponsorship	$20,000	$25,000	$50,000	$50,000	$50,000	$50,000	$50,000	$295,000
Event Fees & sponsorships	$2,000	$2,000	$4,000	$4,000	$4,000	$4,000	$4,000	$24,000
Foundations Funding	$0	$50,000	$50,000	$50,000	$100,000	$100,000	$100,000	$450,000
Grants (STTR, SBIR, etc.)	$0	$40,000	$40,000	$50,000	$100,000	$200,000	$200,000	$630,000
Facilities & Equipment Use Fees	$0	$0	$0	$10,000	$30,000	$40,000	$50,000	$130,000
Interest	$0	$1,500	$4,047	$1,576	$4,528	$5,996	$5,833	$23,480
New Revenue Sources- IP, Licensing					$50,000	$50,000	$100,000	$200,000
Realized/Unrealized Gain/Loss								
	$522,000	$618,500	$1,448,047	$1,265,576	$1,538,528	$1,099,996	$1,259,833	$7,752,480
Total Revenue	**$522,000**	**$618,500**	**$1,448,047**	**$1,265,576**	**$1,538,528**	**$1,099,996**	**$1,259,833**	**$7,752,480**
Center Activities								
3.2 Technical Services and Shared Resources								
Manufacturing/Application Engr.	$80,000	$150,000	$150,000	$150,000	$200,000	$200,000	$200,000	$1,130,000
Business Development Specialists	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$140,000
Manufacturing Technology Specialists	$80,000	$80,000	$150,000	$80,000	$80,000	$80,000	$80,000	$630,000
								$0
3.3 Technology Development								$0
In-house Technology Dev. Projects			$80,000	$80,000	$80,000	$150,000	$150,000	$540,000
University Research Partners	$15,000	$15,000	$20,000	$20,000	$20,000	$20,000	$20,000	$130,000
Development tools/ equipment			$500,000	$200,000	$50,000	$0	$50,000	$800,000
								$0
3.4 Workforce Development/ Education								
Incumbent Employees Training	$25,000	$25,000	$5,000	$5,000	$5,000	$5,000	$5,000	$75,000
New Skills Training	$5,000	$25,000	$5,000	$5,000	$5,000	$5,000	$5,000	$55,000
Gr.8-12 STEM Partnership	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$17,500
Industry-Education Partnership	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$17,500
3.5 Early Stage Tech Dev / Prototype/Pre-Product Pilot								
Engineering & Tech Personnel			$50,000	$60,000	$80,000	$150,000	$200,000	$540,000
Fabrication and Test Facility			$100,000	$150,000	$10,000	$10,000	$10,000	$280,000
Special Test Equipment/Tooling			$100,000	$100,000	$20,000	$20,000	$20,000	$260,000
3.6 Industry Consortium								
Industry Members								
Policies								
Industry liaison/ management	$20,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$80,000
3.7 Facility and Capital Equip.								
Offices & collaboration facilities	$70,000	$30,000	$100,000	$60,000	$60,000	$40,000	$40,000	$400,000
Major fabrication, demo & test equipment					$400,000	$50,000	$50,000	$500,000
Shared Fabrication & and Test Equipment					$200,000	$10,000	$10,000	$220,000
Subcontract for services						$50,000	$100,000	$150,000
Center Development- Planning & Sys. Dev.	$30,000	$30,000						
Management & Program Services								
Personnel- Management (10%)	$25,000	$33,000	$49,500	$43,500	$50,500	$64,500	$69,500	$335,500
Personnel- Technical (Services, non-program	$25,000	$33,000	$49,500	$43,500	$50,500	$64,500	$69,500	$335,500
Personnel- General & Administrative (10%)	$37,000	$42,600	$61,400	$50,200	$58,600	$66,400	$72,400	$388,600
Personnel- Business Development (.5 FTE)	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$280,000
Professional Fees								
Communications								
Information Technology & Services	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$105,000
Facility Support	$10,000	$10,000	$20,000	$30,000	$30,000	$30,000	$30,000	$160,000
Depreciation Expense								
Total Management & Program Services	$152,000	$173,600	$235,400	$222,200	$244,600	$280,400	$296,400	$1,604,600
Total Programmatic Activities	$320,000	$360,000	$1,295,000	$945,000	$1,245,000	$825,000	$975,000	$5,965,000