

Introduction

Quinsigamond Community College (QCC), in collaboration with education, industry, and community-base organization (CBO) partners, proposes to NSF ATE a three-year initiative aimed at producing more engineering technicians to meet regional Advanced Manufacturing (AM) workforce demands. This will be done by creating an effective system of influence over the career decision-making of adult job seekers and students in grades 7-12, particularly women and underrepresented minorities (URMs). The partnership will enlist and empower key individuals – teachers, parents, and community-based career counselors – who have proven influence with young people and adult job seekers. It will leverage existing influencers’ relationships to promote technician careers in AM, and actively guide students and adults into community college technician education programs by infusing existing college and career planning and recruitment with new AM-related information and delivery methods. The project will advance goals of QCC, the central Massachusetts technology employer base, and NSF ATE.

The proposed project, called the *Massachusetts Technician Education Collaborative* (Mass-TEC), will marshal significant regional resources to bear on the critical problem of a shortage of adequately skilled technicians to support regional employers’ high-end engineering and manufacturing operations. Mass-TEC will address and support several NSF priorities, including 1) research on technician-level education focused on regional challenges and barriers to participation in post-secondary technical education, 2) career guidance-oriented professional development for grades 7-12 teachers, parents, and community-based career counselors who most directly influence prospective students’ career decision-making processes, and 3) development of a permanent seamless technician-level college and career pipeline from the grades 7-12 and adult education feeder systems. QCC will play a leadership role in advancing this aggressive public communications and recruitment agenda with a specific focus on fields of technology that directly support and enhance AM, including electromechanical, electronics, manufacturing, and computer systems engineering technologies.

I. Mass-TEC Motivating Rationale

I. a. Why Advanced Manufacturing?

Preliminary discussion among Mass-TEC partners coupled with a review of relevant research confirms what QCC has struggled against for years: the perception among the general public and potential technical students that manufacturing jobs are not “good” jobs or that there are no jobs to be found in manufacturing at all. Industry personnel and labor economists know otherwise, that the infusion of advanced technology has transformed local manufacturing jobs into high paying, high opportunity, technically sophisticated, clean, and modern careers with a high degree of employee involvement and control. Countering this misperception and impediment to growth will be the primary focus of Mass-TEC.

Despite intense media attention focused on the downsizing of manufacturing across the nation and the outsourcing of jobs to other countries, the manufacturing sector continues to account for 14% of the US gross domestic product and 11% of total employment in the United States.ⁱ The US Department of Labor (USDOL) has identified “advanced manufacturing” as one of fourteen targeted industries in its High Growth Job Training Initiative. Industries that meet the following criteria are included in this Initiative: “(1) they are projected to add substantial numbers of new jobs to the economy or affect the growth of other industries; or (2) they are existing or emerging businesses being transformed by technology and innovation requiring new skill sets for workers.”ⁱⁱⁱ

In the Northeast, despite growing global trade, a high cost of operation, and a severe 2001-03 recession that weakened the technical/manufacturing sector, New England gained 164 manufacturing plants in the 12-month period that closed in early 2006 and 1,700 over the past five years. Massachusetts remains the region’s top industrial state, accounting for 38% of New England manufacturing plants and 45.5% of the area’s industrial employment, with Worcester ranking third largest in concentration with 255 plants in the city proper.ⁱⁱⁱ This region gained plants because its workers rank high in the skills, education, and technology that comprise America’s new advanced manufacturing.^{iv}

Yet, local employers like Metso Automation, a global manufacturer of industrial valves and plant automation equipment, struggle to find enough skilled technician-level employees. As David Bayreuther, Vice President of Engineering for Metso Automation states:

“Technology is our competitive advantage. We reinvest a significant portion of our revenue in research and development to ensure we retain a competitive edge in today’s global manufacturing environment, and to remain the technology leader in the industries we serve. Like many manufacturers, Metso is struggling to obtain the skilled resources that are essential to develop and implement advanced technologies. We are facing the stigma that manufacturing is on the decline in North America and the negative impact this has had on technology education. Metso has a growing need for technicians that are trained in the current state-of-the-art in industrial automation. In addition, we require educational services to advance the skills of our existing employees. “

Labor economists can demonstrate that manufacturing employment prospects are expanding for Massachusetts workers. Massachusetts’ employers posted 74,305 job openings overall during the 4th quarter of 2005, a 3.3% increase from the same quarter a year ago. The proportion of job postings requiring an associate’s degree or higher continued to edge up over the year, rising from 36% in the 4th quarter of 2004 to 38% in the 4th quarter of 2005. With 4,539 open positions, manufacturers posted the fifth largest number of job vacancies among the state’s 20 major industry sectors during the 4th quarter of 2005. Job vacancy rates in Massachusetts’ professional and technical services, another category in which some manufacturing-related professions are categorized, were even more significant, climbing over a longer time-period, from 1.4% in 2002 (4th Quarter) to 4.1% in 2005 (4th Quarter). By the end of 2005, there were 7,873 job vacancies.^v

QCC and the Mass-TEC partnership will work to significantly impact the regional technician shortage by building greater awareness and understanding of AM, and routes for preparing to enter these fields such as QCC degree and certificate offerings and those of its four-year college partners. Major employers utilizing technicians, such as Saint-Gobain, Metso Automation, Intel Corporation, Stonebridge Corporation and employers represented through the Mass. Manufacturing Extension Partnership (MassMEP) will assist in shaping, supporting, and implementing these efforts. (See letters in Appendix)

I.b. *Motivating Rationale: Advanced Manufacturing Employment Demand Data*
Advanced Manufacturing^{vi} Employment Trends in Worcester, MA-CT Area (2000-2005)

Mass-TEC defines and describes AM and the technician-level occupations that comprise it using labor market information and data published by the USDOL. According to USDOL’s O-NET On-Line (<http://online.onetcenter.org/find/indemand?i=ADV&g=Go>), there are multiple in-demand technician level skill sets critical to AM, including computer support specialists, first-line supervisors and managers of production processes, sales representatives, electrical and electronics technicians, engineering technicians, and industrial machinery mechanics.

Regionally, there are at least 34 occupations (accounted for within the categories termed Professional & Technical Services or Production Occupations) that align with AM and for which job vacancy and employment trends are measured quarterly. In the period 2000-2005, several of these occupations exhibited promising trends in employment growth. Over 1/3rd (38%) have shown significant employment growth, including such positions as industrial engineers, environmental scientists and specialists, and sales representatives for wholesale and manufacturing, technical and scientific products. This is reflective of the overall high-demand and high-growth AM occupations within the Worcester area, and a commensurate need for supporting technicians.

Manufacturing sub-sectors in central Massachusetts whose competitiveness is threatened by a lack of skilled technicians include aerospace products and parts, computers and electronic products, and machinery manufacturing, including precision metal-working. As referenced earlier, given the complex and sophisticated nature of AM, the technical skills, knowledge, and abilities in demand are multi-

disciplinary, including computer support specialists, first-line supervisors and managers of production processes, sales representatives, electrical and electronics technicians, engineering technicians, and industrial machinery mechanics.^{vii} Mass-TEC activities will be directed toward connecting new candidates to these skills and careers.

I.c. *Motivating Rationale: The Challenge*

As a result of an extensive review of the literature, discussion with key partners and with other NSF-funded ATE project directors and staff, Mass-TEC partners contend that there is interplay of several key variables contributing to the serious and in some cases persistent skills shortage in AM. These include: 1) an overall deficiency in technological literacy among the general population; 2) a negative public image of manufacturing as a career pathway; and 3) lack of support and encouragement for young people and adult job seekers to pursue rigorous STEM content, especially women and URMs.

Challenge #1: An Overall Deficiency in Technological Literacy among the General Population

As the rate of technology innovation intensifies, and consumers' implementation and adaptation continues apace, there is a growing disconnect between end-users' understanding of the technology, engineering, and science principles powering the tools; their ability to make informed decisions regarding technology and their own opportunities within in it, and their understanding of its potential relevance to the economic health of the region, state, and country. In a seminal document^{viii} Technically Speaking: Why All Americans Need to Know More about Technology, the National Academy of Engineering and the National Research Council define technological literacy as "one's ability to use, manage, evaluate, and understand technology." Among many claims made as to the need for advancing technological literacy, they purport that the improvement of

"...technological literacy would also help to prepare individuals for jobs in our technology-driven economy, thus strengthening the economy. Technologically literate workers are more likely than those lacking such literacy to have a broad range of knowledge and abilities. Arguments that have been made about the importance of literacy in mathematics and science to the economic future of the country are at least as salient in the context of technological literacy."

By integrating key questions about technological literacy, such as those used by the ITEA/Gallup poll, in our surveys, Mass-TEC will explore the relevance of technological literacy to the role that teachers, parents, and career counselors play in either recommending, or not recommending, lucrative careers in the technical fields that support AM.

Challenge 2: A Negative Public Image of Manufacturing as a Career Pathway

There is a well-documented public perception that manufacturing jobs consist of dirty, repetitive, and low-skilled tasks. This 19th Century Dickensian image of jobs in manufacturing is one factor that is often attributed to the serious and critical shortage of highly-skilled, technically-trained people coming into the profession. Per The Manufacturing Institute, "...research has shown a direct relationship between manufacturing's negative image, which is tied to old stereotypes of the assembly-line, and the decreasing number of young people pursuing careers in the industry."^{ix} In addition, ongoing media focus on downsizing, outsourcing, and cost-cutting in manufacturing and virtually all technology-based enterprises has led to an assumption that the industry offers few career opportunities and even less long-term stability. The dot.com bust of 2002 further fueled this perception of instability and led to a decline in the number of people pursuing advanced study in computer or engineering-related disciplines (see Figure 1 below). At the regional level, it is further evidenced by the enrollment drop in QCC's technical programs since 2002 (see Figure 2 below).

Figure 1

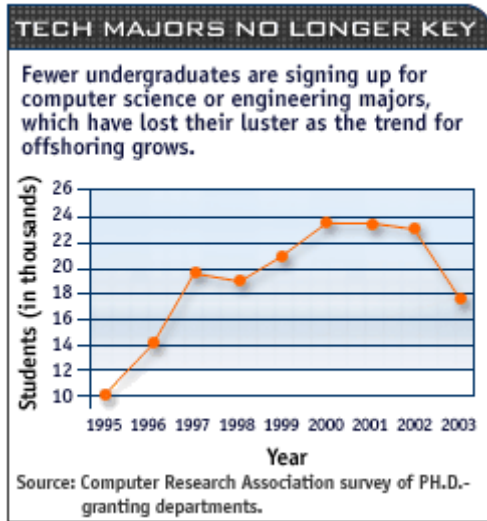
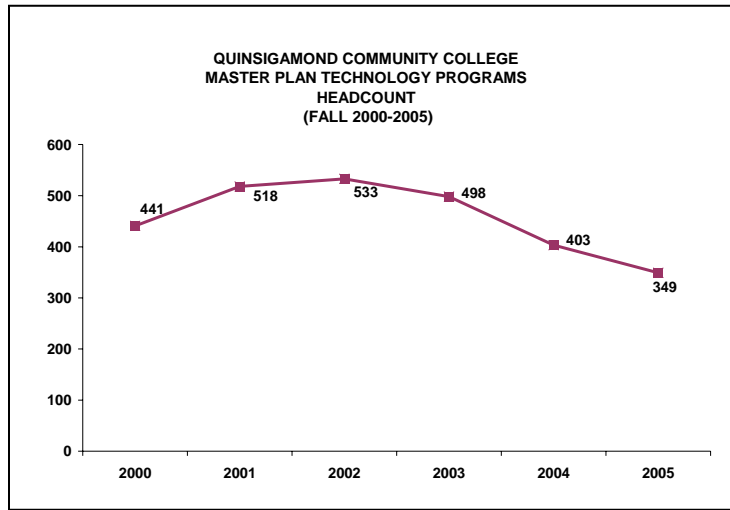


Figure 2



As further evidence of the perception challenge, there are several high profile image building campaigns currently underway across the country. The *Dream It! Do It!* campaign, sponsored by the National Association of Manufacturers, is one widely known example. *Manufacturing is Cool!*, sponsored by the Society of Manufacturing Engineers, is developing and disseminating K-12 curriculum materials and other teaching tools. The National Science Foundation itself funds seven ATE centers focused on manufacturing. In each center, there is at least one disciplinary focus on the promotion of manufacturing careers, student recruitment, or other image-building or pipeline development activities. Mass-TEC has initiated discussions with the NSF Regional Center for Next Generation Manufacturing and will seek their technical assistance to guide the development, implementation, and evaluation of project efforts.

Challenge #3: Lack of Support and Encouragement for Young People to Pursue Rigorous STEM Content, Especially Women and Underrepresented Minorities

There is a substantial body of literature that examines perceived barriers or other deterrents to the pursuit of engineering/technical careers, including research on the low participation rates of academically prepared girls in engineering degree programs or why URMs are not better represented in rigorous STEM courses. *Extraordinary Women Engineers*, a project of the American Society of Civil Engineers, identified several perceived barriers. Among them, young women state that the image of the profession is both challenging and math & science intensive, and further, that engineering and technical professions are perceived to be “male” jobs. In addition, project findings stress that key career influencers have little familiarity with guiding students to engineering.^x

A *Black Issues in Higher Education*^{xi} article summarized findings of an NSF-funded project titled “Women, Minorities and Persons with Disabilities in Science and Engineering” as such: Barriers to entry to STEM careers for African Americans and other underrepresented groups included a lack of role models and networking opportunities; an information gap along the digital divide that includes not only a lack of access to technology, but also lack of exposure to and understanding of the economic gains associated with technology-related careers; and a perception that computer-related careers are for white males.

Clearly, these and other challenges facing AM are likely impediments to grades 7-12 students and adult job seekers choosing to pursue technical careers, despite their continued availability and competitive wage structures. Mass-TEC in Years 1-3 will identify these impediments through research and inquiry in the project’s first year. Mass-TEC will develop and implement a regional Public Communications Campaign to address misperceptions among a key group of career influencers, and to engage them in activities designed to build their understanding of the AM workplace and its benefits.

After the research phase is completed, Mass-TEC partners will involve Career Influencers in a range of activities including exposure to a tailored Public Communications Campaign and other activities that are designed to increase their awareness, knowledge, and perceptions of opportunities in AM and technology careers, thus increasing their ability and motivation to appropriately guide young people toward careers in AM. All efforts will be geared toward serving the project's primary purpose: To increase interest in and pursuit of employment in technical fields among potential technical workers – adult job seekers and students grades 7-12 – by increasing the frequency and effectiveness of advocacy for technical employment and education as conveyed by parents, teachers, and community-based career counselors. All project activities are designed for replicability with an eye toward similar-sized regions seeking to employ a low-cost, grass-roots outreach and recruitment strategy.

Intellectual Merit & Broader Impact

The motivating rationale has important implications for key intellectual merit and broader impact consideration: advancing the knowledge and understanding of issues inhibiting or preventing pursuit of technical education and designing effective replicable strategies to improve recruitment. Mass-TEC's anticipated social science research and project evaluation partner, Education Development Center, Inc. (EDC), will bring extensive expertise to the process of more fully understanding this phenomenon. Results of baseline research will guide the grass-roots outreach phases of the project.

Based upon an extensive literature review and project research, it is evident that many similar efforts, including several ATE projects & centers, are experimenting with image building and pipeline development activities for AM by targeting the prospective student populations directly. Mass-TEC will target those groups that influence the career-decision making processes of students & adult job seekers, with the intention of realizing a more systemic impact than with direct solicitation of prospective students alone. In addition, the comprehensive regional collaboration representing industry, education, and community based organizations not only underscores regional commitment, but the grass roots nature of the strategy itself. At the project's conclusion, Mass-TEC will share lessons learned with NSF, peer community colleges, school systems, and all others with similar regional concerns and limited resources who are interested in replicating successful approaches.

II. Mass-TEC Goals, Objectives, Activities & Outcomes

The Mass-TEC partnership will be the foundation upon which all project goals and objectives will rest, and from which all activities and outcomes will be derived. Mass-TEC's primary purpose is to increase interest in and pursuit of employment in technical fields among potential technical workers – adult job seekers and students – by increasing the frequency and effectiveness of advocacy for technical employment and education as conveyed by parents, teachers, and community-based career counselors. Please refer to the Appendix for a full listing of Mass-TEC Advisory Committee members.

Goal 1: Identify the impediments that limit or prevent career influencers from guiding adult job seekers and students toward the pursuit of technician education programs and AM careers that are available in the central Massachusetts region.

Objective 1.1: Assess career influencers' current and ongoing awareness of AM careers, their knowledge about education programs, and their attitudes toward STEM preparation, technician education and AM careers

Activity 1.1: Conduct focus groups and surveys with a representative sample of each of three target audiences: 1) parents, 2) teachers, and 3) community-based career counselors

Short/Intermediate Term Outcome 1.1:

1) To inform the development and implementation of the public communication campaign, its messaging and the selection of outreach strategies; 2) To inform evaluation efforts; 3) To inform similar efforts in other regions in the country

Project partners acknowledge that the AM industry suffers from a negative public image and that few people, especially women and URMs, are willing to pursue academic programs or careers in which

strong mathematics or scientific reasoning skills are essential. Mass-TEC planners contend that it is necessary to complement national research and findings regarding these challenges with regionally specific data to both broaden understanding of the perception challenge and better inform our regional strategy for the public communications and grass roots outreach campaign.

Specific activities toward objectives in Goal 1 will include conducting baseline research with a sample of each of three target audiences on potential impediments to individuals' pursuit of technical education. This will be accomplished by conducting focus groups or surveys aimed at documenting and describing the target audiences' current perceptions, skills, and knowledge relative to college-level technical education programs of study and the pursuit of technical careers. Through this process, Mass-TEC intends to investigate, analyze and report on local factors that may be inhibiting career influencers from promoting and encouraging young people and adult job seekers to pursue these options.

Baseline research will be conducted in the project's first six to nine months, so that findings can be used immediately as a means of tailoring the Public Communications Campaign and grass-roots outreach strategies. This data will also serve to inform project evaluation efforts. Mass-TEC will report its findings at the end of Year 1 and each subsequent year thereafter, and will disseminate them via the project web site and other appropriate mechanisms.

Goal 2: Increase the frequency and effectiveness of Career Influencers' efforts to guide adult job seekers and students toward the pursuit of technician education programs and AM careers that are specific to the central Massachusetts region.

Objective 2.1: Increase awareness of and knowledge about the AM industry, skilled technical careers, and college-level technician education programs, with a particular emphasis on access and outreach to women and URMs

Activity 2.1: Conduct a multi-faceted Public Communications Campaign, to include following proposed strategies: 1) radio/television spots 2) print materials; 3) billboards/transit posters; 4) website that will emphasize: 1) successful women, 2) URMs in images, messages, and information

Short/Intermediate Term Outcomes 2.1:

1) To increase target audiences' awareness of the nature and extent of AM in the region, its importance to the local economy, and the availability of skilled technician level jobs; 2) To increase target audiences' knowledge of the availability of skilled technician careers in the region, the varied industries and companies where employment exists, the type of work and pay involved, the skills required, and how to prepare for those careers; 3) To increase target audiences' understanding of the issues that are particularly important to women and URMs in the pursuit of college-level technical education programs of study and the pursuit of technical careers

Objective 2.2: Increase motivation to guide adult job seekers and students toward college-level technician education programs and AM careers.

Activity 2.2: Conduct 1 outreach event per quarter, per target audience (3 events/quarter; 12 events/year), via existing channels that are familiar, well-respected, and culturally and contextually appropriate. Proposed outreach events include: technician education and career planning meetings for parents and families; integration of technician education and career information into teacher professional development programs; seminars/workshops for career counselors; AM industry tours for all target audiences

Short/Intermediate Term Outcomes 2.2: 1) To change the perceptions and attitudes of target audiences regarding the AM industry, skilled technical careers, and college-level technician education programs; 2) To increase motivation among target audiences in guiding women and URMs to college-level technician education careers, 3) To provide career influencers with support from their peers that will reinforce their interest in guiding students and adult job seekers toward to college-level technical education programs of study and the pursuit of technical careers within AM

Specific activities directed toward the accomplishment of Goal 2 will constitute some of the project's most ardent pursuits and the focus of project evaluation efforts throughout its three-year duration. These include:

- Defining AM and the technical careers that support it
- Understanding the role an individuals' level of technological literacy may play in forming perceptions of technical education and careers
- Understanding the positive impact and contribution of AM industries and technical careers on regional economic and workforce development and growth
- Understanding how one prepares for college-level technical education programs of study and the pursuit of technical careers within AM

Mass-TEC will design and launch a "Public Communications Campaign" to include one or more of the following strategies:

- Strategic billboard/transit poster campaign, with a well-researched plan for where/how to place images for best reach to target audiences (i.e., along key transportation routes, near central meeting places, or other identified "common" areas)
- Well-planned and executed series of radio/television interviews or public service announcements scheduled on a regular basis throughout the week, month, and year to air on such media outlets as NECN (New England Cable News), WTAG-580 (a popular news and talk radio station), WORC-1310 (a popular Latino news and talk radio station) and others as identified during the research phase of this project to best meet target audiences
- Regular newspaper coverage in such media outlets as the *El Vocero*, *Worcester Magazine*, *Worcester Telegram & Gazette*, *Worcester Business Journal*, and other respected and well-utilized print media outlets as identified during the research phase
- Print materials designed to convey the message in simple, straightforward, compelling manners
- A web presence designed specifically for the target audiences

With this said, Mass-TEC is quite realistic about the complexity and sheer cost of this type of Public Communications Campaign. Project partners will prioritize above strategies based upon projected return on investment and available resources. In addition, partners are committed to leveraging private resources in the form of pro bono services from industry partners, from local advertising/marketing firms or media outlets, or in generating cash matches and other resources to underwrite the design and fullest launch of this phase of the campaign.

Beyond the Public Communications Campaign, Goal 2 involves increasing the aptitude, ability, and motivation of those who influence the career decision making process – classroom teachers, parents, and CBO career counselors – in conveying the benefits of pursuing college-level technical education programs and technical careers. This will include the development of industry and career awareness materials that describe and define AM, the technical occupations that comprise it, and how to prepare for them. These materials will be developed jointly by Commonwealth Corporation, Worcester Polytechnic Institute, and the Mass. Manufacturing Extension Partnership.

It is Mass-TEC's vision that this information will be integrated into programs or materials pertinent to each target audience, (i.e. proven STEM professional development programs for teachers; outreach materials for parents or career counselors in CBOs; or otherwise utilized to enhance Career Influencers' curriculum, professional or personal knowledge and skills). Mass-TEC estimates that its activities will directly benefit 165 Career Influencers, and indirectly, 1900 students and adult job seekers.

Goal 3: Determine strategy for institutionalizing most effective Public Communications Campaign and outreach strategies in Year 4 and beyond.

Objective3.1: Determine overall effectiveness of all facets of public communications and grass roots outreach strategy

Activity 3.1: Conduct periodic reviews of process and product evaluation data with members of the Mass-TEC coalition

Short/Intermediate Term Outcome 3.1: Determine which activities should (and should not) be continued, expanded, or otherwise enhanced

Objective 3.2: Develop mechanism for long-term sustainability

Activity 3.2: Conduct periodic reviews of process and product evaluation data with members of the Mass-TEC coalition

Short/Intermediate Term Outcome 3.2: Identify mechanism(s) for sustaining the Mass-TEC coalition beyond project funding

Activities around Goal 3 will entail both the assessment of campaign and outreach effectiveness and the development of a long-term mechanism to sustain the most effective components for promoting interest among potential technical workers in employment in the technical fields. The Public Communications Campaign will leverage partner strengths and capabilities, including regional media, to change public perception of AM and technical employment in order to reflect its reality of quality jobs with autonomy, career opportunity, good pay, and important added value. This will include public education through major media outlets, and targeted information and outreach in schools and colleges, local employment centers, and in adult-serving community agencies.

Effective processes solidified through this three-year grant will be institutionalized. Project partners understand that commitment of time, resources, and quality thinking given to goals attainment will be worthwhile and necessary to effectively achieving long term outcomes.

In addition, QCC will specifically develop its organizational capacity for targeted technical outreach and recruitment and is committed to long term institutionalization of a staffed function after the grant period.

Goal 4: To provide a model for conducting grassroots Public Communications Campaigns that may be used to increase interest in AM careers and technician education programs in similar communities across the country.

Objective 4.1: Document the activities undertaken and the materials produced in the course of this project

Activity 4.1: Maintain ongoing records of project activities, process, products, and outcomes

Short/Intermediate Term Outcome 4.1: Create a package of materials that represents the efforts of this project in a manner that can be utilized by other potential coalitions

According to information gleaned from the US Department of Labor's website on advanced manufacturing, (<http://www.doleta.gov/BRG/Indprof/Manufacturing.cfm>), the

"... US DOL has sought to understand and implement industry-identified strategies to confront critical workforce challenges. It has listened to employers, representatives from industry associations and labor-management organizations, and others associated with the AM industry regarding their efforts to identify challenges and implement effective workforce strategies. However, the challenges they face are far too complex for one institution or industry sector to solve alone. USDoL's Employment and Training Administration is supporting comprehensive partnerships that include employers, the public workforce system, and other entities that have developed innovative approaches that address the workforce needs of business while also effectively helping workers find good jobs with good wages and promising career pathways in the AM industry."

Both pipeline development and image building are included among multiple recommendations made by USDoL in response to priorities identified by the AM industry itself. Mass-TEC, as a comprehensive partnership involving employers and workforce development partners, will be built around the principles of effectiveness and replicability, with collaboration and low cost as key

underpinnings. Mass-TEC will document activities undertaken during this three-year period with the intention of creating and disseminating a guide for project replication in other similarly sized regions.

III. Mass-TEC Deliverables

Ultimately, Mass-TEC will be successful if it is able to demonstrate progress toward ATE’s primary goal of “producing more science & engineering technicians to meet workforce demands.” Understanding that image building and pipeline development activities are long-term investments & the project period is relatively short, Mass-TEC is proposing both qualitative indicators of increasing interest in AM employment as well as modest demonstrated increases in enrollments in college-level technician programs within the funded period.

Deliverables

1. Research-based understanding of local impediments that limit or prevent Career Influencers from guiding adult job seekers and students toward the pursuit of technician education programs and AM careers, with emphasis on women & URMs
2. Materials development for technical career awareness building for Career Influencers
3. Professional development curricula for Career Influencers using above materials & concepts
4. Multiple mechanisms for engagement with Career Influencers for awareness building
5. Evaluation of Mass-TEC specific activities and goals toward refinement & replication
6. Project documentation guiding other regions interested in replicating Mass-TEC efforts
7. Measured increase in “increasing interest” in technical programs as measured by number of hits on project website, number of requests for program information, and/or applications to related technical programs (F07-F08; F08-F09; F09-F10)
8. 10% increase in enrollment in related technician education programs at post secondary degree level over the project’s three year period, to be maintained or increased further in subsequent years
9. Increase in number of women & URMs enrolling in those programs
10. Permanent mechanisms in place to maintain ongoing technical outreach & recruitment efforts

IV. Mass-TEC Project Timetable

		Year 1 (Qs)				Year 2 (Qs)				Year 3 (Qs)			
		1	2	3	4	1	2	3	4	1	2	3	4
Goal 1	Research impediments to career influencers guiding potential students												
	Use baseline data to shape strategy for public communication campaign												
	Develop technical occupational & college preparatory info modules												
	Revise technical occupational & college preparatory info modules												
Goal 2	Develop multi-faceted public communication campaign strategy												
	Conduct multi-faceted public communication campaign												
	Develop grassroots outreach strategy												
	Conduct 1 outreach event/quarter targeting parents and families												
	Conduct 1 outreach event/quarter targeting career counselors												
	Conduct 1 outreach event/quarter targeting grades 7-12 teachers												

Career Influencers. Project evaluation will monitor and measure Career Influencers' changes in attitude toward AM careers, and changes in behavior in recommending AM resulting from changed attitudes.

Mass-TEC draws on national reports identifying specific recommendations such as image-building and pipeline development for AM. What sets Mass-TEC apart is its grassroots approach using local resources to create new solutions to these problems. It has the right players, will thoroughly engage them, and will use Worcester's challenges as impetus for creating project solutions.

Commonwealth Corporation (CommCorp), Mass. Manufacturing Extension Partnership (MassMEP), and Worcester Polytechnic Institute (WPI) will play key roles in all components of Mass-TEC implementation – most importantly developing real-time curriculum and training modules regarding technical career opportunities for use by the Career Influencers, and offering professional development for Career Influencers involved in Mass-TEC.

MassMEP will also provide Mass-TEC with a vital connection to small, central New England AM firms, for input to project leadership about firms' rapidly evolving needs regarding employee skill and credentialing requirements, and benefits for job seekers in AM. MassMEP CEO Jack Healy will serve a primary role in the development of the Public Communication Campaign, connecting PCC media developers to pertinent manufactures for materials creation, and guidance toward high relevance of all created AM promotion materials. MassMEP Operations Manager, Kathie Mahoney will serve as one of the project's Senior Personnel members.

Latino Education Institute (LEI) and Worcester Family Education Coalition (WFEC) , representing Latino, Southeast Asian, African-American and other parents within the Worcester Public Schools, will play lead roles in connecting the Mass-TEC project through grassroots and community-based organizations to parents, grandparents, extended families, and other mentors.

QCC Admissions Office will play a vital link in connecting Mass-TEC with CBOs that serve adult job seekers. QCC, as part of its strategic enrollment plan, is focusing on more targeted program enrollment strategies and individual groups of constituents in order to better enroll targeted programs as well as to better equip prospective students with the information they need to navigate the college enrollment process. Targeted technical outreach and recruitment activities conducted via Mass-TEC are aligned with the College's strategic vision and will serve to build the institution's capacity. QCC has committed to institutionalizing a staffed role focused on technical outreach and recruitment in year 4 and beyond. Steve Sullivan, VP of Enrollment & Student Services, will serve the Mass-TEC Advisory Board.

Worcester Public Schools science and technology teachers, an important underprepared and underutilized group of Career Influencers, are a project targeted group. A small group of Mass-TEC teacher liaisons will be linked closely to project activities and will work within their respective schools to promulgate the information, content and strategies developed. In addition, they will encourage peer teachers to avail themselves of opportunities offered by WPI, QCC or other Mass-TEC partners to advance their knowledge and understanding and promotion of technical careers and AM. Mass-TEC teachers liaisons will contribute classroom experience to the development of the professional development materials and pilot implement use and evaluation of the materials; assist in the rollout of use of the materials by peer teachers and counselors initially in their own schools, and long-term in other schools. Joe Buckley, WPS Science/Technology Curriculum Liaison, will serve as a Mass-TEC Co-PI.

EDC will provide critical social science research in Mass-TEC's first year, supporting the project's intellectual merit consideration and informing development of other key project elements, including Career Influencers' materials development and the Public Communication Campaign. As detailed in the evaluation plan, EDC will conduct research on key project intellectual merit questions.

VI. Mass-TEC PI, Co-PI, & Senior Personnel, Roles & Responsibilities

Mass-TEC management team members have distinguished themselves in their respective fields & will bring that knowledge & experience to bear in all facets of the project. Kathy Rentsch, QCC Dean of Business & Technology, will serve as Principal Investigator. She will be supported by Co-PIs Joseph W. Buckley Jr., Science & Technology/Engineering Curriculum Liaison, Worcester Public Schools; Martha Nevin Cyr, Director of K-12 Outreach, WPI; Robert Richardson, East Coast Education Manager, Intel Corp.; & Elsa Rivera, College Access Coordinator, Latino Education Institute at Worcester State College.

Senior Personnel will guide Mass-TEC, & contribute to implementation. Kathie Mahoney, Operations Manager, MassMEP; & Abigail Jurist Levy, Senior Research Scientist, Center for Science Education at EDC. Mass-TEC will also hire a key operative position: Mass-TEC Project Director (PD).

Mass-TEC PI: Kathy Rentsch, QCC Dean of Business & Technology

Preparedness: Ms. Rentsch is an accomplished administrator in both public higher education & non-profit organizations. She is a skilled facilitator who works well with faculty, community & business leaders to direct collaborative initiatives aimed at educational improvement & expansion – her abilities are demonstrated by the management of the processes that have brought to fruition this Mass-TEC partnership, & its engagement over nine months to produce this project concept & funding proposal.

Roles & Responsibilities: Oversee all aspects of project implementation & evaluation; provide direction & support to the Project Director; engage project partners in all aspects of the project; work closely with NSF, providing programmatic & fiscal reports in compliance with all requirements.

Mass-TEC Co-PI: Joseph W. Buckley Jr., WPS Science & Technology/Engineering Curriculum Liaison

Preparedness: For over 40 years, Mr. Buckley has been an urban educator working with low-income students of diverse ethnic backgrounds & world-wide origins. He possesses an in-depth knowledge of student learning & values community career opportunity education. As WPS Science & Technology/Engineering Curriculum Liaison, he has participated in developing PreK-12 curriculum, the Mass. engineering/technology frameworks & many K-12 professional development programs.

Roles & Responsibilities: Assist in development & implementation of outreach strategies; assist in delivering technical career outreach programs; identify candidates for WPI teacher professional development programs; serve as guest speaker for selected outreach programs; assist in refining marketing message; oversee & support all aspects of implementation & evaluation efforts.

Mass-TEC Co-PI: Martha Nevin Cyr, Director of K-12 Outreach, Worcester Polytechnic Institute

Preparedness: Dr. Cyr is Director of K-12 Outreach & an adjunct assistant professor with WPI's Mechanical Engineering Department. She serves on the Mass. Science & Mathematics Advisory Council, played an active role in the newly accepted engineering curriculum frameworks & has extensive NSF experience. As Director, she develops programs that emphasize engineering principles to excite & motivate K-16 students & teachers in learning mathematics & science.

Roles & Responsibilities: Work with CommCorp and MassMEP to develop technical career modules; integrate materials into WPI & others' existing programs & processes; assist in design of seminars for target audiences; serve as guest speaker for selected outreach programs; assist in refining marketing message; oversee & support implementation & evaluation efforts.

Mass-TEC Co-PI: Robert W. Richardson, East Coast Education Manager, Intel Corporation

Preparedness: Mr. Richardson's career has been a balance of experience in corporate & public environments – the vast majority of it related to the merging of education & technology, & building the STEM pipeline. A central theme of his work has been to break down the isolation between key stakeholders, creating effective programs that reach students & build 21st Century skills. He currently represents the Intel Foundation, managing the transfer of Intel resources to schools & colleges (including QCC) to build sustainable STEM programs for students, especially URMs & women.

Roles & Responsibilities: Assist in explaining where the high skill/high wage jobs are, types of workers needed & the level of post-secondary education required; development & implementation of outreach strategies; provide access to Intel facilities & technical employees; and refining marketing message.

Mass-TEC Co-PI: Elsa Rivera, College Access Coordinator, Latino Education Institute

Preparedness: As College Access Coordinator via LEI for Worcester State College, Ms. Rivera develops programs & initiatives for Latino students & their families that facilitate access to higher education, including early college awareness & college preparation activities. She organizes & implements the Latino Family College Fair, & also, the LEI's Annual Latino Education Family Day.

Roles & Responsibilities: Provide a vital link to Worcester's Latino students and families; work with Mass-TEC to design & implement technical outreach activities; assist in refining marketing message; oversee & support all aspects of implementation & evaluation efforts.

Mass-TEC Senior Personnel: Kathie Mahoney, Operations Manager, Mass. MEP

Preparedness: Kathie Mahoney has worked closely with area manufacturing companies to promote the industry for nearly a decade. Activities include working with area youth through a WIA grant to promote career opportunities within manufacturing, writing & editing the MAC Action Newsline, & managing public events including the annual *Manufacturing Our Future* summit.

Roles & Responsibilities: Work with CommCorp and WPI to develop technical career modules; assist in explaining where high skill/high wage jobs are, what types of workers are needed and the level of post-secondary education required; provide expertise & broker access to area manufacturing employers; work with Mass-TEC to refine marketing message; oversee & support all aspects of implementation efforts.

Senior Research & Evaluation Partner: Center for Science Education, Education Development Center

Preparedness: Abigail Jurist Levy, Ph.D., Senior Research Scientist at EDC in Newton, Massachusetts. As research team leader, she is involved in projects focusing on the teaching workforce & workplace issues, the sustainability of reform, & the impact of inquiry-based science teaching on student outcomes. Dr. Levy possesses extensive experience with the evaluation of NSF projects & activities.

Roles & Responsibilities: Oversee all aspects of Mass-TEC social science research & project evaluation.

Mass-TEC Senior Personnel: Mass-TEC Project Director (PD)

Preparedness: The PD will possess strong industry experience, a demonstrated ability to lead collaborative efforts as well as strong leadership, management, interpersonal & communication skills. Prior experience in education will be desired, but not required.

Roles & Responsibilities: Realize vision, goals & outcomes; guide development & implementation of Public Communications Campaign; establish regular schedule of outreach activities; leverage private resources to expand activities & impact; Work directly with EDC & partners in research & evaluation. While the PD has not been identified yet, partners have already been enlisted to identify potential candidates. QCC intends to launch a search, pending notification of funding, in early 2007.

VII. Mass-TEC Sustainability Plan – Year 4 & Beyond

Sustainability, the long-term continuation of effective Mass-TEC products & practices, has been a major focus of the partnership & development team since the project's inception. Partners entered into the project with the understanding that the purposes of the partnership will persist beyond the grant period, & that long-term commitment of persons & resources would be necessary to make the undertaking worthwhile. As such, Mass-TEC is proposed to NSF with important sustainability elements built in:

- A partnership of organizations with established multiple, significant existing relationships – indicating a high likelihood of ongoing relationships toward Mass-TEC purposes
- A project design that uses partners' existing expertise, processes, & program offerings to deliver Mass-TEC content, rather than creating new ones requiring unsecured funding
- A project budget that invests early in the grant timeline in deliverables with long-term uses
- A primary grant cost, the Project Director position, will be 33% funded by QCC in Year 2, & 67% funded in Year 3 – major QCC commitment to sustainability
- The Project Director will be 100% funded by QCC in Year 4 & beyond, institutionalizing technology-focused targeted outreach through Career Influencer & other mechanisms
- Pursuit of partner-funded &/or pro bono continuation of Public Communication Campaign

VIII. Mass-TEC Research and Evaluation plan

EDC will conduct Mass-TEC research and evaluation. EDC will work with Mass-TEC on both the initial research phase of the public awareness campaign, and on evaluation of the campaign itself. EDC will contribute to Mass-TEC's goal of developing a model for conducting grass roots Public Communications Campaigns by collaborating with the project's leadership team and incorporating materials developed in the course of the evaluation into Mass-TEC's project documentation. Research and evaluation components of the design are informed by the work of Coffman (2003)^{xiii}, Dorfman, Ervice, & Woodruff (2002)^{xiii}; and Rice & Paisley (1981)^{xiv}. The outcome questions that guide this evaluation are:

- 1) Whether and to what degree did target audience groups' awareness, knowledge, and perception of technical manufacturing careers change;
- 2) Whether and to what degree have target audiences increased the frequency with which they provide information to students and adult career changers regarding technical manufacturing education and careers, particularly to women, and URM's;
- 3) Whether and to what degree did the accuracy of target audiences' representations of technical manufacturing education and careers improve; and
- 4) What aspects of the public awareness campaign, if any, were associated with these reported changes?

Phase 1 – Research: The purpose of the research phase of Mass-TEC is two-fold. First, to gather information from each of the three target audiences of the public awareness campaign—parents, science teachers, and career counselors—regarding the impediments that limit or prevent them from appropriately guiding students and adult job seekers toward the pursuit of technician education programs and AM careers. This information will be used to shape the features of the Public Communications Campaign such as format, design, placement, and messages. Second, the research phase will provide baseline data that will enable the evaluation to answer the project's evaluation questions.

Data collection and analysis: Data for Phase 1 will be collected through two focus groups with each target audience: science teachers (n=20); parents (n=20); and career counselors (n=20), totaling approximately 60 informants. EDC will ensure that appropriate steps are taken to protect human subjects and will consult with the Human Subject Protection Program administrators in both EDC and QCC in order to do so. Focus group members will be recruited in collaboration with QCC's Admissions Office and Mass-TEC partners Worcester Public Schools, Latino Education Institute, and the Worcester Family Engagement Coalition. If it would be helpful, a translator will join the parent focus groups to ensure that parents and evaluators can communicate with each other fully and comfortably. All focus group discussions will be audio-taped and transcribed for analysis. Participants will be informed that their contributions are voluntary and anonymity will be protected.

Mass-TEC project leaders have identified awareness, knowledge, and motivation as the major impediments that this project will address. Therefore, this phase of research will employ an instrument designed to assess target audiences' current status with regard to these variables. If possible, an instrument that has already been designed for this purpose will be identified; *The Handbook of Mental Measures* and the National Center for Women in Information Technology are two potential sources that will be consulted. In addition, the evaluators will work with the project leaders to identify features of the public awareness campaign that should also be explored in these focus groups in order to determine for example, what neighborhoods should be identified for billboards, bus signs, or other printed media; which radio stations and programs are most appropriate for spots; or what types of messages and/or images are most meaningful for each target audience. Data will be analyzed using Atlas.ti software; we will employ qualitative analysis techniques, such as open, axial, and selective coding (Strauss and Corbin, 1990)^{xv} to analyze and synthesize the data. The findings from this phase of the project will be applied to the design and implementation of the public awareness campaign.

Phase 2 – Evaluation: In keeping with the small scale and grass-roots approach of Mass-TEC, this evaluation will focus only on the impact of the grass roots outreach campaign on the target audiences:

parents, teachers, and career counselors. Evaluation activities will begin in the second half of year one, and continue in years two and three.

Data collection and analysis: Baseline and follow-up data collection will use instruments designed to assess current awareness, knowledge, and attitudes regarding technical manufacturing education pathways and programs; the frequency and accuracy with which target groups provide guidance regarding these career and education options; technological literacy; as well as the degree to which their participation in project activities and/or their exposure to public awareness campaign efforts played a role in changing their behavior. At the end of year one, follow-up data will be collected from parents through two focus groups (n=20); from teachers (n=60-80) and career counselors (n=25-30) through the implementation of online surveys. In addition, a smaller focus group with the five teacher liaisons will be conducted in order to gain their perspective on Mass-TEC's implementation and impact in each of their schools. In years two and three, prior to their participation in project activities, evaluators will collect pre-participation, baseline data from parents through one focus group (n=10); and from online teacher (n=60-80) and career counselor (n=25-30) surveys. The impact of participation in project activities on the outcomes of interest will be assessed through a focus group with the same parents and through online, follow-up surveys of teachers and career counselors. Survey data will be analyzed using SPSS software. Associations between individuals' technological literacy and their exposure to public awareness campaign messages, and changes in their awareness, knowledge, attitudes toward technical manufacturing education pathways and programs and the frequency and accuracy with which they provide guidance regarding these career and education options will be sought

Evaluation Products: Evaluators will produce one report each year of the project that summarizes findings from the research phase, the baseline or follow-up evaluation data as well as the implications of these findings for Mass-TEC design and project activities. In the final year of the project, the evaluators will work with Mass-TEC leaders to ensure that these products are revised appropriately for inclusion in the project's handbook.

Meetings with Program Leaders: Evaluators will meet with program leaders several times during each year. Meetings will focus on sharing findings from the evaluation so that they continue to inform project activities, and contribute to the institutionalization of the most effective public communications and outreach strategies in year four and beyond. The evaluators will also seek guidance where appropriate from the Connecticut-based NSF Regional Center for Next Generation Manufacturing.

IX. Mass-TEC Dissemination Plan

The Mass-TEC replicability & dissemination plan includes the following;

Replicability:

- Goal 4 makes project replicability a top priority
- Proposed research methods on technician education would apply in similar regions
- Heavy use of existing community organizations & existing communication channels to deliver new technician-career awareness, advising, & enrollment services
- Minimizing necessary new financial expenditure – multiple activities with little new funding

Dissemination:

- Creation of project web site for use by project staff, Advisory Board, project partners, Career Influencers, general public, other NSF projects, colleges interested in becoming an ATE or other NSF grant project site
- Advising other colleges on Mass-TEC topics & sharing of approaches & information
- External evaluator-produced summative evaluations made available to NSF & others interested
- Presentation of findings at NSF & other technology conferences during & after project completion
- Sharing Mass-TEC deliverables with others interested, with NSF cited as project's primary funder.
- Working with Mass. Community Colleges Executive Office (MCCEO) in latter stages of project to share project findings and models among the 15 Mass. community colleges