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The MechTech Program

An Education and Training Model for the Next Century

Robert Forrant, Ph.D.

The small-firm metalworking industry is routinely characterized by cutthroat competition and fierce privacy. Yet, since the late 1980s, the members of the western Massachusetts chapter of the National Tooling and Machining Association have participated in an education, training, and technology diffusion network characterized by a high degree of interfirm cooperation. Hundreds of workers and managers have take part in group training sessions and seminars. The reconstruction of the skill base is central to the MechTech apprenticeship program through which apprentices spend four years in participating firms, exiting the program as licensed machinists, tool and die makers, or moldmakers. In an important break with the typical short-term and firm-specific training approaches of American industry, apprentices rotate among several firms engaged in various aspects of metalworking to receive a comprehensive education. They also join a two-year college program and receive a degree in manufacturing technologies. The costs of the plan, including the college degree, are borne almost entirely by the participating firms. This article describes briefly the evolution of the entire western Massachusetts metalworking training program and in some detail how MechTech functions, concluding with a discussion of the program's implications for policymakers.

Background

Since the late 1980s, member firms of the western Massachusetts chapter of the National Tooling and Machining Association (NTMA) have participated in an education, training, and technology diffusion network characterized by a high degree of interfirm cooperation. Several association members are also involved in the MechTech apprenticeship program, an important model for policymakers intent on building a skilled workforce in a variety of occupations. MechTech, a nonprofit corporation, operates a high-quality apprenticeship program to prepare what it terms master craftworkers for the machining industry of the future. In addition, high school pre-apprentices spend well-supervised time in participating machine shops during their second and third years in school to gain valuable hands-on instruction that provides clear links to their classroom education. Full-time apprentices spend four years in participating firms and exit the program as machinists, tool and die makers, or moldmakers.

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In a conspicuous departure from the short-term, narrow-focus, firm-specific training approaches in much of American industry, MechTech substituted a single-company approach for a program that involves a quarterly work rotation for apprentices among participating firms over a four-year period. High school pre-apprentices and full-time apprentices participate in a rigorous academic schedule that leads to their graduation from the program with an associate's degree in manufacturing technologies. The dynamic cross-firm collaboration has made it possible for small and medium-size shops to construct an apprenticeship program that approximates what was once the dominant and effective machinists' training model among large U.S. metal-working firms, for example, Pratt and Whitney, Brown and Sharpe, General Electric. It is a model cast off by large corporations in the 1960s and 1970s in the rush to jettison what they believed were non-production-related expenses.

The Economic Development Link

For several years, numerous government and business policymakers and social scientists have promoted "high performance" or "flexible" work systems as the key to restoring U.S. manufacturing competitiveness. Lagging productivity in the 1980s stimulated increased state and federal interest in and support for organizations that assist firms in productivity-related areas such as technology acquisition, new product development, marketing, defense production conversion, and education and training. For these policymakers, success in the international marketplace is predicated on production characterized by the agile and efficient use of technology coupled with organizational strategies to reduce hierarchy and encourage the involvement of front-line personnel in production-related decision making. From such a vantage point, global competitive advantage is dependent on three interrelated factors: how inputs, such as raw materials, are utilized; how quickly new products are designed and brought to the marketplace; and how well employee skills are enhanced and deployed. Therefore, substantial investments in human capital formation are a critical component for economic success.

Along with the heightened public attention currently being paid to education and training, there is a growing consensus in economic development literature that the clustering of firms may carry with it the potential to accelerate education, training, and learning in firms and across regions. For Stephen Appold, agglomerations offer "shared inputs, eased surveillance, and knowledge spillovers. Consequently, presence in an agglomeration is held to facilitate interfirm collaboration, thereby enhancing improved performance." A. J. Scott contends that "regional development is — and to an ever increasing degree — based on competitive advantages that are socially and politically created." For Eileen Applebaum and Rosemary Batt, what emerges from a theory of industrial districts is the notion that the potential exists for firms in a region to work together to foster comprehensive training systems "that have a strong local institutional base and that can evolve and respond flexibly to new demands on labor from changing technologies or products." This argument is borne out by recent events in western Massachusetts.

MechTech illustrates how interfirm collaborations, when supported by a public-sector training apparatus keen to listen to what industry wants, can resolve what appear to be intractable labor-market problems. How is it possible that the private

sector stepped up to play a leadership role in the delivery of high-quality training? Why is it that firms realized the competitive advantages that could accrue to a consistent investment in education and training? How does the metalworking training program coordinated by the NTMA chapter benefit the regional training infrastructure? Are the lessons of this model of industry-mediated training applicable to workforce development in other industries? These questions are answered through a detailed discussion of the MechTech program. The article concludes with an analysis of the lessons learned and a consideration of policy implications for education and training programs.

The Western Massachusetts Metalworking Industry Redefines Itself

Background

For most of the nineteenth century and much of the twentieth century, western Massachusetts, with Springfield, its largest city, was a hub in a prosperous metalworking manufacturing region stretching up and down the Connecticut River Valley between Hartford, Connecticut, and White River Junction, Vermont. Firms along the river designed and built machine tools and components for virtually every other manufacturing sector in the nation. Machine tool firms built equipment for use in the manufacture of durable and nondurable goods, including automobiles, paper, textiles, and processed foods. Precision machine shops turned out the tooling, fixtures, and gages needed by machine tool builders to complete this equipment and to produce these components for industry. Taken together they comprise the metalworking industry.

In the 1970s and 1980s, a dramatic wave of layoffs and plant closings among western Massachusetts's largest metalworking manufacturers led to rapid industrial decline and massive dislocation for several thousand of the region's workers. Between 1969 and 1976 an average of 12 percent of the Massachusetts job base was lost annually owing to plant closings, with an additional 8 percent lost because of permanent layoffs. Overall, manufacturing employment in Massachusetts plummeted to slightly more than 600,000 in 1977 from 714,000 in 1967. As the rate of plant closings accelerated in the early 1980s, organized labor demanded action on the issue from then governor Michael Dukakis, whom it had supported and helped return to the State House in the November 1981 election. In response, Dukakis appointed a thirty-eight-member Commission on the Future of Mature Industries in the fall of 1982. The aim of the commission, composed of leaders from business, labor, government, and academia, was "to develop strategies for strengthening older industries and preserving jobs" and to "develop an industrial policy to move the state toward a truly balanced economy . . . in terms of its industrial mix and in its distribution of benefits to the Commonwealth's regions and citizens."

Ultimately, the commission endorsed voluntary standards of corporate behavior regarding notification that encouraged employers to give workers ninety days' notice of shutdowns. In addition, new programs established an institutional framework for industrial policy across the state. These included the Industrial Services Program (ISP), whose mandate was to work with firms to help them avoid closings, provide retraining if a closing occurred, and help communities affected by large numbers of plant closures; and a Reemployment Assistance Program to provide counseling,

training, job placement services, and an extra thirteen weeks of unemployment compensation to displaced workers. The program, with a \$14 million annual budget, was passed into law in July 1984.

One feature of this legislation was the establishment of what were termed the Cooperative Regional Industrial Laboratories under the direction of the Industrial Services Program. As part of this experimental economic development effort, the ISP allocated \$100,000 a year for three years to what became the western Massachusetts Machine Action Project (MAP). MAP's original intent was to assist in the orderly transition of the regional economy from metalworking toward service industries. However, research revealed that a large and complex network of small metalworking firms existed. Rather than shift displaced workers out of the industry, MAP determined that the program's goal should be to nurture the remaining small-firm economy composed of hundreds of small job shops that supplied tooling and parts to the machine tool, aerospace, defense, and electronics industries. Over the next six years, MAP acted as a catalyst between the region's metalworking firms, their industry association, local education and training providers, and state and federal agencies to provide industry-focused training and technical assistance to hundreds of managers and workers employed in the region's metalworking industry.

Conventional Wisdom Takes a Back Seat

In the aftermath of the shutdowns, a consensus that the western Massachusetts metalworking sector was decimated took shape among state and local public policymakers and economic developers. Yet today the region is home to a thriving and competitive collection of more than 350 small metalworking firms. These firms are mainly contract machine shops selling time on their machines to produce precision fixtures, tools, gages, subassemblies, and prototype components to aircraft, automotive, computer, and electronics manufacturers. Twenty percent of these firms are dues-paying members of the local chapter of the National Tooling and Machining Association (NTMA). Most NTMA shops employ fewer than a hundred people. For an industrial sector known for cutthroat competition, cost-driven business strategies, and fierce privacy, a nucleus of approximately seventy-five firms, most NTMA members, stand apart for their openness.

Shops routinely provide training to employees from other companies in shop-floor problem-solving techniques. A product development network of firms engaged in rapid prototyping is currently exploring commercial business applications with companies such as Pratt Whitney, General Electric, and Ford Motor Company. Hundreds of workers and managers have participated in group training and seminars over the last several years in topics including blueprint reading, computer numerical control machine tool programming and repair, work-flow management, and quality control.

Finally, a four-year program in which apprentices rotate among participating firms is in place to cultivate the next generation of skilled workers and managers. How did a region that only a decade ago symbolized the demise of traditional U.S. manufacturing give rise to such a dynamic industrial district?

Part of the explanation lies in a series of well-constructed social and political interventions that altered the downward industrial trajectory that many policymakers and development experts assumed was inevitable. These activities, first embodied in the state-supported Machine Action Project and today carried out

under the private-sector auspices of the local chapter of the National Tooling and Machining Association, were built upon existing social relations among firms that were able to stimulate and maintain a rich and continuous interfirm learning process. This, in turn, led to an enduring partnership among public officials and private actors who enabled industry leaders to directly shape economic development programs and services to satisfy their needs. New institutions, services, and forms of collaboration between and among firms and service providers emerged from this continuous process of engagement and adjustment between the public and private players.¹¹

Skills Shortage Hampers Growth

It is ironic that after the steep business decline in the late 1970s and through much of the 1980s the most persistent inhibitor of metalworking expansion in Massachusetts today is the dearth of skilled machinists.¹² In the late 1980s, Machine Action Project staff were incredulous when they heard from small-firm owners that there was such a shortage. A survey and skills audit of firms revealed that the workers losing their jobs in the region were, at best, machine operators who lacked the blueprint reading and math skills required by the precision shops. In fact, workers in small firms were three times more likely to have machinery setup skills and could operate several different kinds of equipment. In other words, typical small-firm workers had more intellectual and hands-on depth and breadth of skill than their large-firm counterparts who were being laid off.¹³

With the average age of machinists across New England approaching sixty, this knowledge sparked genuine concern among many firm owners, who soon realized that without investments in long-term education and training the historically rich worker skill base, and with it the innovative capabilities of firms, would disappear. Therefore, NTMA shop owners willingly participated in the education and training projects started by MAP in the late 1980s. At the time the chapter ran a training school to turn out introductory-level machine operators and was searching for a way to provide additional services to its members. Soon technical high school machining programs in Chicopee and Westfield began to provide evening upgrading training for workers already employed in local machine shops. MAP obtained a grant to offer a course in the repair of Computer Numerical Control machine tools at Springfield Technical Community College. Industry representatives were instrumental in developing a suitable course of study. A monthly newsletter kept firms informed of upcoming courses and events. In 1991 a subset of firms established MechTech, modeling it after a program started in 1986 in Cranston, Rhode Island.¹⁴

The machinist shortage did not develop overnight, nor is there a shortcut to its amelioration. Yet the United States continues to spend very little of its federal \$6 billion education and training budget on rigorous, long-term training programs and less than one percent of U.S. workers participate in apprenticeship programs. Beyond manual skills, a machinist must possess a working knowledge of computers, geometry, algebra, trigonometry, blueprint reading, and manufacturing theory. It takes at least four years to educate and train a top-flight machinist capable of setting up and operating equipment, and it takes several years to gain great proficiency in the setup and operation of the myriad types of equipment utilized in the industry.

According to Raymond Gosselin, president of the Boston Tooling and Machining Association "We're faced with an aging workforce. We see the need to develop

training for new people.” John Moda of Adom Engineering in Haverhill has placed numerous help wanted advertisements in local papers to no avail. As a result, his small company started an in-house training program even though it was expensive and time-consuming. “Desperately Seeking Machinists” read the headline of a March 1997 article in the business section of the Springfield Sunday newspaper. “Machine shops are bidding against each other for what has become a rare commodity: skilled machinists.” The president of one local company told a reporter that his firm ran an advertisement for machinists for several weeks and received just two applications for the positions. John Hoops, director of the western Massachusetts NTMA chapter, observes that member firms are having trouble filling openings. For example, in late 1977, the nine firms on the chapter’s governing board together had more than sixty job openings that remained unfilled. This shortage exists elsewhere in the country as well. In Portland, Oregon, for example, firms that depend on skilled machinists are concerned that as “an aging experienced workforce heads toward retirement” there will be “an economic void in the metals industry.” A Portland-area vice president for human resources at a large manufacturer noted that over the next five to ten years companies there would be retiring approximately 50 percent of their skilled workers and that there is no one to take their place.¹⁵

MechTech: Building a Skill Base for the Coming Century

From Public to Private Leadership

When in late 1992 Machine Action Project staff learned that their state funding was to end, they worked with the National Tooling and Machine Association, the Bay State Skills Corporation, area technical high schools, and Springfield Technical Community College to keep the education and training initiatives going. Several academic studies noted the unique economic development approaches that MAP employed. MAP was highlighted by a number of influential academic researchers as a “best-practice” model of regional industrial and training policy. In MAP, analysts observed two particularly innovative features related to the localized nature of its strategy and activities. First, MAP’s strategy evolved from detailed analysis of the local industrial base and through local actors’ discussions of their own problems and needs. As noted above, the conventional wisdom was that the machining industry in western Massachusetts was decimated and that displaced workers had to be trained for new industries. By conducting industry-based research and tapping local knowledge, however, an alternate course of action emerged, a course that central state planners could not have designed on their own. Action-oriented research, as Joan Fitzgerald and Allan McGregor point out, became a key feature of MAP, identifying “several niches of employment growth within declining sectors” and revealing numerous employment possibilities in the region’s small firms.

Second, by acting as a broker between firms, educational institutions, and state agencies, MAP translated the requirement for higher skilled workers into specific training courses. Observers of the program noted that this strategy represented a vast improvement over centralized job training programs as it compelled the local education and training infrastructure to be responsive to the genuine needs of industry. The MAP model, suggest Rosemary Batt and Paul Osterman, went well beyond “the simple provision of training funds or technical assistance to that of creating new forms of organization and cooperation within the private sector and

between public and private sector organizations.” By working in this fashion, MAP served as a focal point for regional economic development activities related to metalworking and helped to focus the attention of existing development agencies on the needs of local firms.¹⁶

In the spring of 1993 the group submitted a proposal to the MassJobs Council, then the state’s clearinghouse for the expenditure of workforce development funds. The proposal stated that “within the universe of employed workers the need exists for continuous and coordinated upgrading of skills to allow employees to utilize existing technology to remain competitive. New technologies have created the need for new skills not only for machinists, but for owners, middle managers, and supervisors as well.” It noted that existing education and training programs were not coordinated and thus created problems of continuity and accessibility for employers and workers. The proposal offered a way for the state to support an industry-led consortium intent on helping firms to develop proficient managers and front line workers.

State agencies grasped the efficacy of the argument and provided the group with \$300,000 for a two-year program. The Bay State Skills Corporation (BSSC) played an important role in coordinating the group’s activities. Firms defrayed 50 percent of the cost for hands-on training for their employees. The Industrial Services Program provided support for several cycles of a twenty-three-week, full-time training program, mainly for dislocated workers. BSSC procured a \$200,000 U.S. Department of Labor grant to help staff the program and support in-plant industrial modernization activities. The January 1995 newsletter announced an equally ambitious calendar of courses and seminars. The list includes Computer Numerical Control (CNC) Milling, Turning, Interpreting Engineering Drawings, Basic and Advanced CAD/CAM (computer-aided design/computer-aided manufacturing) using AutoCad and SmartCam, Basic and Advanced CNC Programming, Technical Math Levels I and II, Machine Shop Job Costing, Inventory Management, and ISO 9001/2. Finally, the project provided planning and oversight assistance to MechTech. The state and federal funds were used successfully to institutionalize the capacity of the NTMA to provide a broad range of education, training, technology diffusion, and marketing services to firms. The chapter’s school has upgraded its equipment, new classrooms have been built, a computer-aided design laboratory was opened, and enrollments are the highest they have been since the school opened in the early 1970s.

An important hypothesis underlying the NTMA program is that public training dollars are more effective if the content and delivery of the training are designed in collaboration with industry. A central goal of the program is to use the infusion of public funds to develop the industry association’s capacity to design and deliver services and stimulate demand for these services among firms throughout the region. Drawing on their own membership, the NTMA determines what types of training and technical assistance firms throughout the region require. It then works with educational institutions and consultants to develop appropriate services. Building from the MAP model, the NTMA now serves as the broker between firms, government agencies, educational institutions, and service providers.

The MechTech Program Takes Shape

MechTech began operating in Cranston, Rhode Island, and the southeastern region of Massachusetts in 1986. A nonprofit MechTech corporation was started in 1991 in western Massachusetts by six National Tooling and Machining Association shop

owners. It was envisioned as the main feeder providing firms with an ongoing source of seasoned, technologically updated personnel capable of assuming managerial and ownership positions in the industry. MechTech's machinist (8,000 hours) and tool and die maker and moldmaker (10,000 hours) programs meet state and federal apprenticeship guidelines, and MechTech became an approved sponsor of apprentices by the Division of Apprenticeship Training of the Massachusetts Department of Labor and Industries in 1995. While the commonwealth presently allocates very little of its education and training budget to apprenticeships — approximately \$300,000 of a \$105 million Labor and Workforce Development budget — industry leaders hope that the success of MechTech will change this. MechTech received a significant boost with the establishment of the metalworking consortium in 1993. For one year Jim Kubinski, the current director of MechTech, received some financial support from the state grants to the NTMA to expand MechTech. Today MechTech is supported entirely by industry.

The MechTech corporation is the employer of record for all apprentices. The total amount to be paid by firms to MechTech is calculated at an hourly rate. Firms pay approximately \$5.00 per hour more above the wages they pay their pre-apprentices and apprentices. This money is used to staff the program, test and select trainees, monitor trainee progress, purchase medical and dental insurance for participants, and reimburse college tuition. MechTech pays participants their wages and benefits, including medical and dental insurance, ten paid holidays, and one week of paid vacation. Periodic raises are built into the salary structure and over the four-year training cycle, average annual earnings reach approximately \$27,000. These full-time participants in the program start at \$8.00 an hour and after completion of each one thousand hours on the job, they receive an increment toward their apprenticeship and academic work of \$0.50 to \$0.60 an hour increase. There is also an articulated wage structure for high school pre-apprentices. Juniors receive \$7.25 an hour for full-time work during the summer between their senior year and \$7.75 as seniors on their cooperative education placement in a MechTech shop.

In 1996 the program expanded from western Massachusetts to include shops in the central and eastern parts of the state, where the demand for machinists is quite high. Recruitment has also occurred in Connecticut, where 14 apprentices and 7 firms are part of the program. With the expansion the number of participating firms reached 60 in 1999, up from 9 in 1991, and there are 50 registered full-time apprentices and 20 high school pre-apprentices. Active high schools in the pre-apprentice machining and pre-engineering programs include Blackstone Regional Vocational Technical, Chicopee Comprehensive, Somerville, Ludlow, Pathfinder Vocational-Technical, and Westfield Vocational-Technical. There are currently 60 registered full-time apprentices and 25 high school pre-apprentices.

A unique feature of the program, one that demonstrates the willingness of firms to work together, is the rotation process for hands-on training. Trainees proceed through several shops over the four-year period to gain broad knowledge on all aspects of the tooling and machining industry. Apprentices experience machine shops, tool and die firms, production companies working in large volumes, mold manufacturers, pattern makers, and firms with the latest in computer numerically controlled machine tools and computer-aided drafting technologies. Firms complete weekly written reviews of their apprentices including a day-by-day description of the types of work performed and an overall weekly grade for the student. The re-

views are shared with each apprentice before every rotation to a new company. The MechTech staff also maintains an apprentice competency profile in which all college grades are recorded. The profile includes an extensive competency checklist for the skills to be learned by apprentices that is shared with every employer. In turn, and in the spirit of continuous improvement, trainees evaluate the firm at the conclusion of each rotation. Firms are rated on the variety of learning that took place, the opportunity for individual performance, the general housekeeping and organization of the shop, and the quality of instruction they were provided.¹⁷

A mandatory college-level academic curriculum includes college English, technical report writing, mathematics, machine design, fluid mechanics, four levels of computer-aided design, two levels of computer-aided manufacturing, and physics. Apprentices earn either a terminal associate of Applied Science degree or they may transfer their credits into an accredited engineering program at a participating four-year college or university. MechTech reimburses students' college tuition and closely monitors their academic progress. Students who do not do well in school must leave the program. An industry-funded college scholarship program for the pre-engineering students is in place — the first \$1,000 scholarship was awarded in 1997 for a Holyoke High School student to attend the mechanical engineering program at the University of Massachusetts Amherst.

School-to-Work Links

In 1996, for the first time, high school students were recruited by MechTech to become registered pre-apprentices. They are provided with a well-supervised co-op placement in a machine shop, after-school employment, summer work, and if they remain in good academic standing they can enroll in college courses during their high school senior year with the costs reimbursed by MechTech. The high school program stands in bold relief to the often criticized schooling typically offered to students not bound for a baccalaureate degree. To be eligible for the program students must maintain a minimum grade point average of 2.5 and have at least 95 percent attendance at school. If they remain in good academic standing and master the technical requirements of the program, they are enrolled full time in MechTech upon high school graduation. They then are guaranteed a job, credited with 1,000 hours earned toward their formal apprenticeship, and will have the remainder of their college education paid for. Several high schools are working with MechTech to adopt an industry-developed set of curriculum standards that will become the baseline for evaluating the soundness of instruction in machining and pre-engineering at the schools.

Industry representatives sit on technical high school machining program advisory boards, donate their time to recruit students to the high school program, assume all the wage obligations for participants, and take great care to assure that students are placed in jobs that have a rich learning component. In its third year, high school recruitment cannot keep pace with the demand for students from participating firms. According to Dan Dyer of Truex, Inc., in Pawtucket, Rhode Island, the students are "ambitious, anxious to learn and work out well. The MechTech program is really good for students, good for us, good for the state." Tom Monaghan of Osley & Whitney in Westfield, Massachusetts, notes that "any person who goes through [MechTech] will probably never be without a job. . . . Because of the quality training they will find work in any part of the country." Susan Fath of Morgan Construction

Company in Worcester, Massachusetts, adds that “MechTech apprentices are the cream of the crop. They are goal oriented, motivated, and academically superior. Our whole company feels as if we have adopted them.”

MechTech and the Benefits of Collaboration

Working Together

Interviews with greater Springfield employers and workers suggest that local, industry-driven training programs like MechTech provide at least five distinct advantages over more traditional education and training initiatives.

Screening of Trainees, Apprentices, and Training Providers. An important aspect of participants’ satisfaction with the program relates to the screening function performed by the firms in charge of MechTech recruitment. Employers and workers respect the National Tooling and Machining Association and MechTech and are confident of their ability to design or identify relevant courses and seminars and select high-quality instructors, consultants, trainees, and apprentices.

Development of Programs Desired by Industry. State funding for the general metalworking training program and for MechTech was earmarked for programs demand driven through industry requests. Because knowledgeable industry leaders were involved with training providers in the design of courses taught at technical high schools and public and private training providers, the overall content of the training improved. In addition, the collaborative approach simplified decision making for state and federal funders. The NTMA chapter was recognized as the clearinghouse for metalworking education and training programs. With confidence in the initiative, firms agreed to provide a good deal of its overall financing, thus successfully leveraging public and private funds.

Improvement of Technical and Vocational High Schools. Industry leaders viewed MechTech as a vital resource for the education and training of all-around machinists at a time when a shortage of such workers posed a serious impediment to firm growth. There has been a substantial improvement of technical high school machining programs. For example, one school, having acquired the latest in computer-aided design technology and two machining centers, is offering evening upgrading courses to area firms. With the revenues derived from this training it continues to purchase new equipment. A second school started a program for students interested in engineering that allows them to work in a computer-aided design lab and spend time in the machine shop making what they design. The industry-school link has helped schools to increase enrollments in their machining programs. Chapter members serve on the Regional Employment Board, the chapter is involved in several school-to-work activities, and members are on the advisory boards of several area high school machine shop programs.

New Forms of Collaboration Beyond Training. Among the partners, MechTech has provided greater access to well-trained workers, and across the entire industry the total metalworking initiative has demonstrated how a focus on skill development

can enhance firm competitiveness. As an offshoot of the MechTech and other NTMA-related activities, various production consortia, including a product development group, have formed. Firm owners and employees are exposed to technical and organizational innovations in other companies. In cases where firms are not familiar with one another, common interest in issues such as quality documentation or rapid prototyping help owners transcend the fear of exchanging information. The apprenticeship approach, with its four-year time line, has also forced firms to realize that skill-related issues will not be resolved in the near term.

Perpetuating the Skill Base. MechTech provides firms with a viable way to enhance the skills of their present workforce and give something back to the trade. It offers a way to give students a meaningful, well-supervised work experience with a minimum of bureaucratic red tape and expense. Further, it prepares students for a well-paying trade and a post-secondary education. The combined college grade point average of MechTech apprentices at the start of 1998 was slightly over 3.0, demonstrating the valuable educational opportunities that MechTech provides to individuals generally discouraged from seeking to continue their education. One participant in the group of fourth-year apprentices has expressed an interest in working for a few years and then becoming a technical high school machine shop instructor. A second apprentice is already training other workers in computer programming, and a third has begun to offer basic instruction to a high school pre-apprentice.

A. J. Scott argues that regional development activity, and by extension a regional economy, can be improved by employing three strategies: timely provision of such services as technology, marketing, and training information to groups of firms; development of production consortia to boost aggregate regional productivity; and establishment of forums to encourage industries to think long term. The MechTech program is involved in each of these arenas, and with the larger metalworking training collaborative, fosters a forward-looking alternative to "smoke-stack chasing" development strategies.¹⁸ The approach allowed the local education and training providers, especially the community colleges and technical high schools, to learn a good deal about the education and training needs of the industry. Armed with this knowledge, the institutions were able to convince school boards and institutional budgeteers to appropriate the funds necessary to acquiring the technology needed to provide appropriate technical instruction.

The Policy Picture

Over the past few years, several states and regions of the United States have adopted industry sector or cluster approaches to development. MechTech is, therefore, an important model for teaching firms to become engaged in shaping a training agenda and contributing to the economic development of a region. In Massachusetts, for example, cluster strategies are being developed or are under review for the plastics, biotechnology, software, and fiber optics industries. Recent case studies of the Delaware Valley Industrial Resource Center in Philadelphia and the Labor Management Council for Renewal in Michigan demonstrate that public-sector organizations can indeed facilitate positive organizational change by working with groups of small and medium-size firms, thus assisting in the long-term revitalization of once declining manufacturing regions. Such organizations have five defining characteristics.

First, the organizations have to be credible with employers if they are going to avail themselves of offered services and participate in various programs. Second, the organizations have to be connected, namely, to be linked to the range of training institutions, business and trade associations, and technical colleges and universities that exist in a particular locale. Third, the organizations have to be catalytic to making things happen. Fourth, the organizations have to employ collective strategies to bring groups of firms together to reach some scale of program delivery. One-on-one assistance, while certainly effective, cannot generate the program scale required to boost the performance of a critical mass of firms. Finally, the organizations need to be continuous. For firm owners to have confidence that help is there, they must believe that the helping organization has staying power. MechTech does indeed have these characteristics.¹⁹

What can be generalized from the western Massachusetts experience? It is evident that to sustain a vibrant economic development and training collaboration, representatives from the industry or industries to be affected, and the workers in those industries, must be located at center stage and assume real leadership, defining the types of services needed and the range of collaborative activities in which they are willing to engage. The existence of a highly skilled workforce, accompanied by a continuously evolving education and training infrastructure to make certain that the workforce remains skilled, is a critical component for sustainable economic development. To reemphasize, it is the groups with the most to gain, especially firms and interested education and training providers, that have the clearest sense of the kinds of services required to bolster industry, as opposed to distant and therefore disconnected state and federal policymakers. By sitting at the table as programs are developed, the stakeholders with the most to gain, and conversely the most to lose, have a fighting chance to design a worthwhile training system. However, as I have argued elsewhere, this approach is at variance with the more traditional U.S. manufacturing modernization model in which direct subsidies and individualized technical assistance are provided to firms. If firms are not active participants at the outset of public program formulations, these programs are unlikely to deliver intelligently the kinds of real services firms require or complete a transition to private-sector leadership.²⁰

In a review of federal and state economic development strategies, Zenia Kotval discusses the key elements of various manufacturing network programs. These include the application of public resources to demand-driven strategies; the increased ability to leverage public and private resources; and the establishment of evaluation measures to determine whether a program is effective. J. Held points out in his study of cluster strategies in New York that the development of support within the private sector is critical to success in whatever programs are instituted. Firms in the Hudson Valley participated in several focus groups organized by economic development officials to establish a research agenda and subsequently shape follow-up programs.²¹ In Toledo, Ohio, development officials acted like social mobilizers among small and medium-size firms. In the Delaware Valley of Pennsylvania, public agencies were able to dramatically improve the delivery of programs to firms by forming active partnerships with them.²² Clearly, there have to be strong ties between the community, the training providers, the funders, and the industry or industries to be served.²³

Final Thoughts

For policymakers and economic development officials, the weight of the evidence supports the importance of organizations like MechTech, but developing such vibrant organizations takes time. Therefore, it is incumbent on state funders to look well beyond the typical one-year fiscal cycle, as the various Massachusetts agencies did here. Mutual learning reinforced a strong sense of partnership and provided incentives for private and public actors to accommodate one another to meet common goals. Flexible public funding first enabled the Machine Action Project and then the NTMA to experiment with program development and delivery. MechTech grew out of this approach to economic development, an approach that takes time. Twelve years have passed since MAP called its very first meeting with industry leaders and public agencies to assess the health of the metalworking sector. The commitment to continuous improvement, at both the firm and the program administration level, has enabled participants to learn from their experiences and to move forward.

MechTech demonstrates that firms can interact with flexible public agencies to build a comprehensive training system. This holds out the opportunity for reaching economies of scale in the delivery of education and training services to firms in other industries. However, this approach remains at some variance with more traditional delivery models, and precious few school-to-work programs in the high schools of the state have taken the lessons of MechTech to heart by attempting to work with groups of firms to establish sector-wide programs. In general, training providers, with little firsthand knowledge of the regional economy in which they operate or the particular needs of the industries they ostensibly serve, continue to offer courses in these programs. As the disappearance of skilled machinists in a labor market desperately seeking them demonstrates, traditional approaches to skill formation are incapable of resolving the difficult education and training issues that face the nation. MechTech, scaled up by several degrees of magnitude and fostered in other occupational fields, can move us along the way to reproducing the nation's skill base.

MechTech's continued growth, and the sustainability of the more general training network, are a consequence of the fact that these activities were embedded in an iterative process among firms, funders, and education and training organizations. At no point did a state or federal funder attempt to dictate what ought to be done. As the firms started to define their goals and objectives, great care was taken by state and local development organizations to allow that process to unfold, albeit in its own halting way. From the outset, the Bay State Skills Corporation, the Industrial Services Program, and the Regional Employment Board determined that no one institution would dominate the delivery of education and training. Potential partners were asked to do what they could do best. Everyone was involved in the planning process when grants and other funds were sought. The dollars were spread among a host of competent providers. The imposition from afar of a predetermined timetable, structure, or set of goals would surely have disrupted the trusting relationships essential to the success of the entire effort.

There is still much to be learned about how to build effective public-private

collaborations. Understanding the MechTech case is indeed an important place to start. Policymakers, training providers, and program funders should carefully review the work of collaborations like MechTech and the larger regional training network of which it is part. MechTech supports an argument put forward by Kotval that "locally authored industrial policy is better able than national policy to speak to the more defined political and economic interests of a particular region or locale."²² Further empirical research to determine whether and how other regions characterized by innovative firm behavior exhibit the kinds of collaborative practices exhibited by MechTech is needed. This will add to the growing stock of knowledge about how declining regions can revitalize themselves and inform policymakers and economic development practitioners intent on the promotion of community-based and firm-based economic development. ❀

Notes

1. Robert Forrant and Erin Flynn, "Seizing Agglomeration's Potential: The Greater Springfield Massachusetts Metalworking Sector in Transition," *Regional Studies* 32 (1998): 209-222. A great deal of information for this article was gathered through a series of interviews with firm owners involved with the National Tooling and Machining Association (NTMA). I interviewed James Kubinski, the director of MechTech, and John Hoopes, the director of the western Massachusetts chapter of the NTMA, in late 1997 and early 1998.
2. Eileen Applebaum and Rosemary Batt, *The New American Workplace: Transforming Work Systems in the United States* (Ithaca: ILR Press, 1994); Rob Atkinson, *The New Wave in Economic Development: Industrial Services in the 1990s* (Washington, D.C.: U.S. Office of Technology Assessment, 1993); Michael Best, *The New Competition: Institutions of Industrial Restructuring* (Cambridge: Harvard University Press, 1990); Erin Flynn and Robert Forrant, "The Manufacturing Modernization Process: Mediating Institutions and the Facilitation of Firm-Level Change," *Economic Development Quarterly* 11 (1997): 146-165; and Paul Osterman and Rosemary Batt, "Employer-centered Training for International Competitiveness: Lessons from State Programs," *Journal of Policy Analysis and Management* 12 (1993): 456-477.
3. Richard Florida, "Regional Creative Destruction: Production, Organization, Globalization, and the Economic Transformation of the Midwest," *Economic Geography* 72 (1996): 315-335; Michael Indergaard, "Making Networks, Remaking the City," *Economic Development Quarterly* 10 (1996): 172-187; Greg Lichtenstein, *A Catalogue of U.S. Manufacturing Networks* (Gaithersburg, Md.: National Institute of Standards and Technology, 1992); Ann Markusen, "Sticky Places in Slippery Space: A Typology of Industrial Districts," *Economic Geography* 72 (1996): 293-313; and Philip Shapira, "Modernizing Small and Mid-sized Manufacturing Enterprises: U.S. and Japanese Approaches," in *Technological Infrastructure Policy: An International Perspective*, edited by M. Taubal, D. Foray, M. Justman, and E. Zuscovitch (Amsterdam: Kluwer Academic Press, 1996).
4. Stephen Appold, "Agglomeration, Interorganizational Networks, and Competitive Performance in the U.S. Metalworking Sector," *Economic Geography* 71 (1995): 27-54.
5. A. J. Scott, "The Geographic Foundations of Industrial Performance," *Competition and Change* 1 (1995): 51-66.
6. Applebaum and Batt, *The New American Workplace*, 162.
7. Forrant and Flynn, "Seizing Agglomeration's Potential."
8. Judith Leff, "The Plant Closing Debate in Massachusetts," Harvard Business School Case Study 9-386-173. Three issues dominated debate within the commission: whether to have any required notification of layoffs or closing; what types of assistance should go to workers in closings; and what role, if any, government ought to play in economic development, particularly in distressed regions of the state. By the spring of 1983, the commission had not reached agreement on plant closing notification, and the Massachusetts legislature was polarized on the issue. Labor advocates pushed for harsh penalties for any firm exiting the state, while pro-business forces argued that legislation would hamper any attempts the

state might make to rebuild its sagging industrial base.

9. Ibid.
10. The Massachusetts Machine Action Project (MAP) was one of five Industry Action Projects (IAPs) established across the state through the Regional Labs program. Each project was designed to involve displaced workers in industry-specific economic development plans to revive their communities. IAPs were established in Greenfield, North Adams, Fall River–New Bedford, Springfield, and Worcester. In each case the IAPs were independent, non-profit, public/private partnerships that empowered local boards to design and implement strategies to strengthen local industry. A defining IAP characteristic was the recognition that labor had a large role to play in this process. The IAPs that achieved the greatest success were the MAP and the Needle Trades Action Project in the Fall River–New Bedford area. The entire program awaits a systematic evaluation.
11. Michael Best and Robert Forrant, "Community-based Careers and Economic Virtue: Arming, Disarming, and Rearming the Springfield, Western Massachusetts Metalworking Region," in *The Borderless Career*, edited by Michael B. Arthur and Denise Rousseau (London: Oxford University Press, 1996), and Charles Sabel, "Studied Trust: Building New Forms of Cooperation in a Volatile Economy," in *Industrial Districts and Local Economic Regeneration*, edited by Frank Pyke and Werner Sengenberger (Geneva: International Institute for Labour Studies, 1992).
12. Andrew McCloy, "Firms Report Shortage of Skilled Labor," *Boston Business Journal*, January 27, 1997.
13. Forrant and Flynn, "Seizing Agglomeration's Potential."
14. Ibid.
15. David Berry, "The Jobs and Workforce Initiative: Northeast Ohio Employers Plan for Workforce Development," *Economic Development Quarterly* 12 (1998): 41–53, and Kathy Brock, "Pedal to the Metal," *Business Journal—Portland*, June 6, 1997.
16. Rosemary Batt and Paul Osterman, *A National Policy for Workplace Training: Lessons from State and Local Experiments* (Washington, D.C.: Economic Policy Institute, 1993), and Joan Fitzgerald and Allan McGregor, "Labor-Community Initiatives in Worker Training in the United States and the United Kingdom," *Economic Development Quarterly* 7 (1993): 172–182.
17. This is broken down into categories including safety, conventional lathe work, grinding, and tool and die work. Each of these categories contains several additional, more specific categories of work to be mastered. For example, the general tool and die classification includes such subjects as design problem solving, first piece inspection, die tryout, and gage making.
18. Forrant and Flynn, "Seizing Agglomeration's Potential," and James Jacobs, "Training the Workforce of the Future," *Technology Review* 92 (1989): 66–73, and Scott, "The Geographic Foundations of Industrial Performance."
19. Flynn and Forrant, "The Manufacturing Modernization Process."
20. Ibid.; Sebastiano Brusco, "Small Firms and the Provision of Real Services," in *Industrial Districts and Local Economic Regeneration*, edited by Frank Pyke and Werner Sengenberger (Geneva: International Institute for Labour Studies, 1992); and Mark Granovetter, "Economic Action and Social Structure: The Problem of Embeddedness," *American Journal of Sociology* 91 (1985): 481–510.
21. J. Held, "Clusters as an Economic Development Tool: Beyond the Pitfalls," *Economic Development Quarterly* 10 (1996): 249–261, and Zenia Kotval, "Industrial Policy: Federal, State, and Local Response," *New England Journal of Public Policy* 13 (1998): 7–18.
22. Flynn and Forrant, "The Manufacturing Modernization Process," and Indergaard, "Making Networks, Remaking the City."
23. Edwin Meléndez and Bennett Harrison, "Matching the Disadvantaged to Job Opportunities: Structural Explanations for the Past Successes of the Center for Employment Training," *Economic Development Quarterly* 12 (1998): 3–11.
24. Kotval, "Industrial Policy," and Charles Sabel, "Bootstrapping Reform: Rebuilding Firms, the Welfare State, and Unions," *Politics and Society* 23 (1995): 5–48.