Applying Skills-Based Automation Through Participatory Management: The Center for Applied Technology

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The Center for Applied Technology

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Origins of the Center for Applied Technology

The Center for Applied Technology was first proposed in January 1987. Governor Dukakis wanted a program that would bring state-of-the-art technology to the traditional industries of Massachusetts as a means of preserving employment. He also wanted to show his concern for issues affecting working people. He asked the Secretary of Labor to cooperate with other state agencies to devise a program. The Secretary worked with agencies such as Massachusetts Centers of Excellence Corporation, the Massachusetts Product Development Corporation, and the Industrial Services Program—all quasi-public corporations, most under the budgetary authority of the Department of Economic Affairs (Commerce). During the spring of 1987, the Centers looked at other state industry-university partnership programs, especially those in Pennsylvania and Michigan. These programs focused on building industry-university partnerships to foster innovation in manufacturing.

The Center for Applied Technology (CAT) was constituted along the lines followed in other states—with one important exception as discussed below. The CAT board reflected the industry-university connection and the technocratic bent of the administration. Thus the members of the board included representatives from three of the most prominent engineering schools in the Commonwealth, business representatives from two high-technology firms, and state agencies dealing with economic development issues. The Center for Applied Technology formally began operations on November 1, 1987.
CAT searched for ways to encourage worker participation in the technology design and implementation process. It was this dedication to the notion of worker participation in the design process that distinguished CAT from other agencies in the state or elsewhere who were attempting to assist manufacturers modernize their productive facilities. CAT's work in this area was supported and encouraged by the CAT board.

**CAT and Worker Participation**

Generally speaking, the labor movement has little influence on the industry-university model of innovation and economic development. CAT wished to alter this traditional model. The objective of worker participation was met through both administrative and program initiatives.

As an example of an administrative action, the Secretary of Labor chaired CAT's advisory board. It was felt that by placing the Center under the titular direction of the Department of Labor, a signal would be sent to the labor movement that CAT was open to labor participation in economic development issues. In addition, meaningful participation of working people in the economic development process also required defining programs in such a way as to encourage participation from all groups using manufacturing technologies.

CAT approached this problem by requiring worker participation in order for university-industry research partnerships to get financial support. CAT did not specify the form that worker participation should take in the research projects, however, it was one of several funding criteria. Financial support by CAT for firm-specific technical assistance also required that a union, if any, or representatives from the workforce be included in any committee that helped define the problems to be solved. In addition, all CAT conferences (there were four) were organized to include both management and labor participation.

While these organizational changes were important in themselves, the actual impact of labor/worker participation on the shape and content of the projects needs to be assessed case by case.
In CAT’s view, this formal representation is not enough. CAT was searching for ways that rank-and-file workers could speak in their own right regarding questions of technology design and implementation. CAT was aware of the action research models employed in Scandinavia which might serve as models. However, there are stronger institutions, especially unions, that serve as support for these projects. This country does not have that trade union institutional structure that can lend support to research projects.

Each project was to try to find a way to involve the user-workers in its research. Eventually each research project developed a means of involving the end user. For example, the University of Lowell shop-floor programming project actually hired machinists to evaluate software under review. That phase of their project devised criteria for judging how the software under discussion was designed, referencing the procedures that skilled machinists employed in making a specific part.

Program Development

At the outset of the Center for Applied Technology formation process, the Massachusetts Centers of Excellence (MCEC) had a view of applying state-of-the-art technology to traditional industry via industry-university partnerships. However, it was not clear to CAT that this could be done. While manufacturing in Massachusetts has pockets of modernity, a good deal of manufacturing is also not up to current technical standards. If computers are in use, they are generally in the office and not integrated with the shop-floor manufacturing process.

In September 1987, the author made a presentation to the CAT hiring committee proposing a different model of technology implementation and transfer as an alternative to the state-of-the-art university-industry partnership model. Rather than try to apply state-of-the-art technology, the author suggested that CAT use the resource that is most abundant in the metalworking sector of manufacturing in the Commonwealth—skilled workers. Based on the availability of one resource (skill) and the lack of another (capital), CAT argued that a skill-based strategy which emphasized better use of existing technologies was both immediately applicable and would have the most immediate and
lasting impact on industry. Eventually a successful skill-based approach would also put the metalworking industry in a position to use more advanced technologies if they made sense. Thus CAT’s idea was to apply appropriate technology, defined as worker-centered and skill-based.

From a design point of view, CAT took traditional engineering criteria for machine or process design—such as speed, repeatability, and accuracy—and added the enhancement of skill as criteria for designing or applying new production methods to a particular shop. In addition CAT was sensitive to ergonomic considerations including noise. After all if workers can’t hear because there’s too much noise, they probably can’t think either.

An industrial system that focuses on skill requires greater emphasis on process and on the worker so, automatically, the worker becomes more central to the picture than the machine. The CAT technical assistance project at the Pneumatic Scale Company in Quincy, Massachusetts met these criteria. Pneumatic was actually two projects—a retraining of the assembly workers, who were among the most skilled craftspeople in the plant and organization of a manufacturing cell to produce spare parts. Deputy CAT director Dr. John Hoops assisted the firm and the union in organizing a training program for the assemblers with Wentworth Institute that allowed the mechanical and electrical assemblers to combine their knowledge with increased familiarity with electronics and hydraulics. Thus the assemblers’ skills could keep pace with the changing machinery they produced. The skilled work was kept in the bargaining unit. The jobs of assemblers were kept unified by adding an enhanced technical component.

The work cell was an answer to the chronic problems with spare parts availability and delivery. Placement of the machines was the least difficult task. The organization of production, the role and skill levels of the workers, and the proper provision of work and orders to the work cell became the focus of the union-management discussions, assisted by CAT.

In both examples at Pneumatic, the people were upgraded—not the equipment. Organizational solutions which focused on enhancing skill were the chosen path. Implementation was aided, and indeed made possible, by the active participation in planning and development by the unionized workforce.
From Theory to Practice

CAT's challenge was to take a concept of applied technology based on skill, that is, the worker, and turn it into a legitimate, accepted economic program. The CAT concept had two parts: an engineering notion called skills-based automation, and an implementation pathway based on user (worker) participation. In order to make the concepts real, CAT decided to fund three distinct types of services. First, they funded the Massachusetts Manufacturing Resource Center, a source for information about skills-based automation. Second, CAT funded applied research in the area of manufacturing. Third, CAT staff organized and CAT funded a technical assistance service.

With the organization of three distinct program areas, CAT transformed itself from the conception that the governor had of high-tech and state-of-the-art applications. CAT became an organization that provided down-to-earth advice and assistance to small manufacturers. The name didn’t change, but the content did. The nature of the project changed from a grant-giving institution for research with industry, with no labor participation, to a subsidized technology transfer and consultation business with strong labor participation and a supporter of research with a strong bias to labor.

The Massachusetts Manufacturing Resource Center

In June 1988 CAT established the Massachusetts Manufacturing Resource Center (MMRC). CAT's initial vision for the center was drawn from organizations such as the Science Center in Berlin, the Norwegian Computing Center and the Worklife Center. CAT hoped the MMRC would be a place where unions and manufacturers could come together to learn about skill-based manufacturing methods. CAT wanted the Center to publicize the concept and explain the benefits. CAT also wanted the Center to establish a current, and preferably online, collection of articles and materials to provide examples of attempts to employ a skill-based method. The MCEC and CAT boards saw the MMRC as a major component of the CAT program and devoted one-third of the program budget to the MMRC.

The project was located at Tufts University and at the University of Lowell. The University of Lowell is one of the Commonwealth’s best
engineering schools and has a close relationship with industry. It also houses an environmental and health and safety program which enjoys widespread industry and labor support. Tufts has a focus on engineering and technical policy issues. CAT felt that the MMRC could draw on the expertise of both institutions to establish itself as a source of both engineering and policy information.

Program work was divided between the two institutions. The Lowell branch established the MMRC library. It collected articles, case studies, pamphlets, and materials from unions, universities, and companies regarding work organization, skills-based automation, and attempts to implement skills-based systems. The Lowell team also emphasized its contacts with labor, doing some outreach to labor unions and the Massachusetts State AFL-CIO.

The Tufts end of the program began to specialize in the development of a network, as one aspect of making the information available to potential users. Tufts also worked with some manufacturers to assess their views on a skills-based approach with a view to recruiting them to the Board of Directors of the MMRC.

CAT made two assumptions in the original thinking regarding the MMRC. First, they assumed that as the ideas of alternative manufacturing strategies were publicized by the MMRC, business would be willing to use the resources of the Center. Second, they felt that as unions understood the value of a skills-based approach, they would also begin using the Center and vigorously support it. CAT hoped that unions wanting to pursue a skills-based approach would have a resource to draw on for information that would also be "legitimate" in the eyes of management. Therefore the concepts of skills-based manufacturing would get wider exposure, and the requisite political support from management and labor would develop so as to secure continued funding for the MMRC.

For a variety of reasons, the MMRC did not succeed in all of its missions. From the start there were organizational difficulties engendered by the dual location of the MMRC. Problems of coordination and focus were magnified by the location of distinct functions at different institutions. Second, the MMRC did not stabilize as an organization in the first year. A strong board, representing business, labor, and the universities, and which could and would support the MMRC, never really got off the ground. This contributed to the growing lack of financial
support. In its original plans, CAT intended to support the MMCR at a high level for three years, by which time it was felt that the organization would have had time to prove its worth. However, under the pressure of continuing and severe state budget cuts, CAT was unable to maintain that high level of support. Although a significant level of support remained, the MMRC had to find other sources of support after only 18 months. Therefore, on one level, the inability of the Commonwealth to make a long-term investment in an alternative manufacturing pathway eventually fatally wounded the MMRC.

The combination of different missions on different campuses combined with limited funding possibilities intensified MMRC's drift away from its original purpose. As mentioned, one part of the Center (Tufts) began to concentrate on electronic networking. In part the theory was to help bring about the type of close cooperation between small metalworking plants that tends to distinguish northern Italy. The system serves to link small concerns for the purpose of marketing and information sharing. Eventually it is intended to be a means with which the smaller firms can get information on-line from the National Institute of Standards and Technology (NIST) regional technology centers, especially the one located at Rensselaer Polytechnic Institute (RPI). However, while the project has done some extremely interesting work, it has also moved away from the skill-based technology aspects. Lack of state funding means that now the network receives most of its funding from the NIST and increasingly is integrated with the NIST center at RPI. As an economic development initiative, especially in regards to technology innovation, the network idea has great potential. It is unclear if, or how, the network will function on behalf of worker participation in the application of technology or proselytizing for skills-based automation.

The University of Lowell branch of the MMRC acquired documentation and information regarding skills-based concepts. From the first it focused more on building relations with the labor movement, which has fewer financial resources to commit to any activity and has rarely committed resources to engineering research/documentation. NIST and other federal agencies are interested primarily in technology transfer or relatively technocratic models of technological innovation. Thus public, i.e., state support, for the Lowell activities is crucial. The Lowell branch was unable to do enough outreach fast enough to establish
an independent financial base before the fiscal crunch hit. CAT will be able to support the library and acquisition functions of the Lowell branch, but CAT will not be able to support the other functions at as high a level as wished due to changes in funding.

In short, for an MMRC to succeed, a higher level of institutional, political, and hence funding commitment will be needed. It may be that such an institution is beyond the capacity of one state. It is also clear that an MMRC-type institution needs a champion outside of state government—either in industry or labor—in order to serve as a pole of attraction for political support.

**Applied Research**

CAT funded six applied research projects. An example of the applied research is the Shop-Floor Programming project that CAT sponsors at the University of Lowell. If the worker is central to the process and not an afterthought, the design of the man-machine interface becomes important. For instance CAD/CAM systems are designed with the engineer in mind. Essentially engineers are writing the programs based on the steps they take when they use computer-aided design. The "thought process" in the CAM software mirrors the CAD thought process.

Do machinists visualize a problem of machining differently from engineers? The Lowell project demonstrated that indeed the answer is yes. Thus, if machinists are to have software that allows them to do parts programming, the internal architecture of the software must be redesigned to match the thought processes of the machinist. In this example, the idea of "user-friendly" takes on a different dimension. It is not a question of making a keyboard "easy" to use, or of providing a menu-driven system with limited selections, but rather a question of redesigning the system itself to more closely approximate the way a skilled machinist envisions a metalworking problem.

The project at Worcester Polytechnic Institute (WPI) approached the problem of worker participation differently. Their objective was to develop a more user-friendly and flexible CAD/CAM system for the production of sheet metal parts. WPI organized a project with a specific metalworking shop and gradually over a period of months worked out a close relationship with the sheet metal workers in the shop. WPI
designed a custom training program such that programmers were able to upgrade to more design, and machinists were able to do on-line shop-floor programming of their machines in response to customer demands. Simultaneously, the software was also configured to meet the needs of the machinist users. The CAD/CAM system and course is now available for distribution. A good deal of time was spent by the machinists off the floor at WPI learning the system and providing feedback to the researchers as to how it could be modified.

At the University of Massachusetts, Amherst, the problem was more difficult. Labor relations at the industry partner were poor. The project in its initial phases was also pretty abstract in that it was to define mathematically the tool path for a grinding wheel doing a complex part (a cutting tool). After many discussions with the researcher involved, the company, and the unionized grinders, the grinders were able to participate more fully in the project. The grinders were able to evaluate at the worksite the software produced and visit the University of Massachusetts during working hours to get a better understanding of the entire process.

There are very difficult problems to overcome if we are to involve working people in a meaningful way in a research project. Institutional questions such as paid time off from work are one problem. But cultural problems are another. The university is not the environment that most blue-collar workers are used to. Likewise, most professors are not used to taking the opinions of shop-floor workers seriously. There are also language problems. People speak differently and use different words. There may be a period of education needed, so that all participants in the project can comprehend the significance of the changes in software or tool design that they are advocating. This education period is not simply aimed at blue-collar workers, but also at researchers since they too must learn the significance of proposed design changes on the skills and environment of the worker.

Nonetheless, CAT feels it has taken important first steps in this area and crossed one crucial barrier. The individual professors involved became advocates of the idea. Perhaps, if funding allows, support for work in these areas can be deepened and broadened.

The research projects have led to some industrywide changes, and they do aid some specific firms. However, for a project such as the Lowell project to succeed, significant funding and additional time are
needed. As of this writing, the funding outlook is not promising. However, a software development pathway emphasizing worker (blue-collar) skills has significance and can offer a means to bring complicated programming functions into the shop in an economic and practical fashion.

In CAT's view, the research sponsored should be guided by the actual conditions in the field. CAT had to show the industry, by example, that a skills-based, participatory model of technical innovation would work. CAT also realized that demonstration projects that actually performed a service to an industry would help make the program understandable to the legislature, other business, and local unions. Therefore CAT decided to organize "pilot technical assistance projects." In effect, CAT became a small industrial extension service, using a skills-based model of technical innovation. Some of the projects are discussed below.

Technical Assistance Projects

Direct services to the workforce and the manufacturer help validate CAT's other work and also provide models for a worker participation method of technology innovation. So far, CAT has worked in about 15 different factories of varying sizes. Approximately 1,000 people were employed in the various firms. Projects have ranged from laying out a small factory, to designing and implementing a machining cell as part of a larger effort to restructure jobs, skills and the work flow in a sizable factory. As mentioned earlier, the Pneumatic Scale Company project involved not only the design of a cell, but also a general upgrading of skills throughout the affected areas. This, in turn, required a sizable training program. The objective of the project was to ensure the survival of the plant by reducing the time it took to get needed spare parts to the customer. In fact, the time was reduced, mostly due to paperwork types of reorganization, and the company is now prospering. A detailed description of this project would require a chapter in itself.

CAT chose to focus on small and medium-sized firms in the metalworking industry. The choice of firm size was driven by several factors. First, Massachusetts industry is characterized by the smaller firm, so to serve the Commonwealth the smaller firm should be the recipient
of aid. Second, most small firms do not have the financial or engineering resources to adequately access the information they need to apply new means of manufacturing to their operations. Third, the number of people employed in smaller firms is a significant sector of the workforce.

CAT chose metalworking for more parochial reasons. Metalworking was and is an important producer of wealth in Massachusetts. Metalworking supports more than its share of service jobs—one service job for each job in metalworking. Metalworkers—especially unionized metalworkers—are also the highest-paid manufacturing workers, so saving jobs in that sector is a priority. But for CAT, one other important reason for choosing metalworking was that the author had worked in the industry for 15 years and thus understood a good deal about manufacturing conditions and skill levels.

The important aspect of all of these technical assistance projects is the participation of the workforce in the projects. By participation, CAT means decisionmaking. In each project, CAT organizes a team of workers to be part of a committee comprised of management and their technical staff (if any), CAT consultant or CAT staff, and the workforce. This committee figures out what needs to be done and how the project should proceed. CAT facilitates that process by providing relevant technical expertise or organizational assistance. The point is to bring the workers' knowledge and expertise into the discussion in a proactive, meaningful way. This does not mean "cooperation" with a preset agenda, but a jointly developed plan for upgrading a particular plant or operation. Generally speaking, the union emerges from this process strengthened organizationally. If nothing else, the union or workers have a much deeper knowledge of the factory and how it works than they did previously. Since one of CAT's design criteria is to enhance skill, most projects also result in an increase in the number of skilled workers and thus usually an increase in wages as well.

However, CAT programs also distinguish themselves in one key area from typical labor-management cooperation programs. CAT tried to organize its technical assistance work so that workers could have a meaningful voice in what technologies would be introduced and how they would be used. In other words, they sought ways to allow working people and management collectively to make the strategic decisions, as opposed to simply asking workers to help implement or make minor
modifications. To CAT, the question of design was the starting point, not the problem of implementation.

CAT technical assistance projects also reemphasized a point made in 1950 when firms began experimenting with various productivity and quality programs such as the Scanlon Plan. Then Fortune magazine advised employers that the presence of a union was necessary for these plans to reach their full value. CAT technical assistance projects also showed it to be easier to work in factories where the union was well organized.

In unionized shops, there is an organization of people elected and trusted by workers with whom CAT could speak. They were not afraid to raise questions and could help define the problems with an independence from management not demonstrated in nonunion shops. People could speak with less fear and more openly as they had a contract to protect them. In nonunionized shops, often the people management made available to CAT were those trusted by management. They were not necessarily the most skilled or competent (although they could be), but they owed their position on the committee to management, not to their fellow workers. Thus there tended to be considerable self-censorship and/or willingness to allow traditional authority to define the issues. This process makes it more difficult to isolate and solve problems of production and design. Also, without a contract and grievance procedure, workers, in reality, do not have the ability to speak their mind.

Of course there may be reasons why the existence of a union could present additional difficulties. For example, there may be contractual regulations regarding job placement, training, removal, and pay levels. In addition, the union may decide to choose its representatives on a technology design/change committee. In the unionized plants at which CAT worked—Pneumatic Scale and Mitchell Machine—these so-called problems were not major issues. Regulations regarding job placement allowed CAT to work within a defined and accepted framework. The existence of a union at Pneumatic allowed for an organized approach to training and pay problems. And just as management chose its representatives to the committee on technology/organizational issues based on a combination of knowledge of the area and ability to make decisions, so did the union.
Of course in a union environment the union can always withdraw from a team and thus kill it. However, it is also true that in serious questions of design in a joint worker-management setting, management can withdraw. It has been CAT’s experience that management is more likely to resist sharing authority as compared to the union’s resistance to gaining it. In other words, management resistance to empowering workers to discuss design issues was the problem. Neither union withdrew or threatened to, even though in varying degrees the firms showed considerable concern with their participation at various points.

CAT has found that technical assistance projects are extremely difficult to organize and manage. Technical innovation is the least of the problems. Getting management to the table and willing to alter their plans at the request of the workers is often the greatest difficulty. Naturally we are dealing with issues of control of the workplace, along with traditional styles of top down authority.

CAT also tries to make sure that the discussions take place in an atmosphere of equality when it comes to making technical decisions about fixtures, machines, etc. This often means that the firm must invest in an education program, or at least encourage team members to work with resources knowledgeable of the area under discussion. Two types of education usually need to occur. There has to be technical education. Workers and management need to be familiar with the technical choices at their disposal. There also has to be education that enables the parties to do joint problem solving and strategic thinking. In addition, the firm needs to allow time for the education process to take place. Naturally this should occur during the working day, not as an extracurricular activity.

The role of the consultant in these projects is particularly important. The consultant is often fulfilling two functions at once. On the one hand he/she offers technical expertise. On the other hand he/she tries to facilitate meaningful worker participation in decisionmaking. In general, experience has encouraged CAT to provide a different consultant for each role. In some cases, CAT staff does the facilitating, but in larger projects CAT employs people who have expertise in teaching empowerment strategies, organization tactics, how to hold meetings, and so forth. When CAT hires consultants for their technical skills, they also strive to acquaint them with the larger CAT agenda as well.
Over time, CAT has identified a number of people who are now more sensitive to the needs of all of their users.

**CAT and Economic Diversification**

Part of CAT's job is to service the needs of the small and medium-sized manufacturer. The objective is to maintain the manufacturing base. Massachusetts, however, has an extremely high defense dependency. A good proportion of the work of many of the smaller firms is defense-related—mostly supplying parts to prime contractors. In many cases these firms need to find new customers very soon or they will be out of business.

For years, the discussion of economic diversification has turned on the question of product diversification. It is true there is a need for product diversification, and also for community- and worker-based, multiple-use committees to encourage that diversification. But that is not the whole story.

From CAT's perspective as an organization that works with the manufacturing process, many companies make useful products. But they are making them according to military standards and procedures and are, therefore, not competitive in the commercial market. Thus there is a role for a process-driven strategy of economic diversification. In other words, if CAT can fix up the manufacturing process so that the company can produce for the commercial market, then they have a chance to survive.

To this end, CAT has actively sought to have the various federal defense adjustment bills changed so that there is federal aid to the smaller firms via agencies like CAT to enable them to make the transition from one style of manufacture to another. Naturally, CAT would help firms make this transition using their normal criteria—worker participation and a skills-based production design. So far, the process-driven approach has succeeded in reducing the defense dependency from 60 percent to about 20 percent in a plant that was producing for both commercial and defense markets. In this case, changes in manufacturing technique allowed the firm to lower unit costs and increase quality, thus allowing it to win a substantial commercial contract.
Since its defense business is expected to decline, the ability to manufacture for the commercial sphere will save the firm and the jobs. Obviously a process-driven approach is not the only approach that can be of use, but for firms whose products are similar for the defense industry and for the commercial market, it does offer some assistance. In addition, a process-driven approach to diversification places real value on worker participation, since the changes CAT supports are dependent on the worker. In other words, the workforce is not a spectator to the diversification process but a participant.

**CAT as a Political Organization**

In certain ways, the CAT project director has a political rather than technical job. In order to move the CAT agenda forward industry, academics, and the labor movement must all support it. Just getting the notion across that technical innovation occurs least expensively and more efficiently when it is based on worker participation and skill is a big agenda item. Obviously, if firms refuse to even try the model, there will be no projects. If CAT cannot convince engineers and others to work with them and for them, they will not get the technical expertise needed. Likewise, AFL-CIO support has been critical for CAT in identifying plants that are in need of assistance and in working with local unions to encourage participation.

Worker participation is also a profoundly political idea. It is derived not only from common sense and experience in industry, but also from a view of how a state-supported agency should function. Most of the people in the state are working people. They pay the taxes. They are the "users." Therefore it seems only fair that economic development must explicitly serve the needs of all the users, not just the managers and technicians. After all, no industry favors the trickle down theory when it comes to their needs; public agencies should not favor trickle down ideas when it comes to the needs of working people either.

CAT has set out consciously to build a constituency of people who recognize the importance of the industrial base in Massachusetts. This is not a glamorous task. Given the extreme budget problems in the
state, it takes a high degree of cooperation from the constituent base to maintain the program. So far, CAT has been successful.

Support for manufacturing can take many forms. CAT's contribution to the discussion is trying to get across the notion that a state extension service for manufacturing is not a finance problem; in fact, most of it is manufacturing process. Looked at from a process point of view, workers and their organizations are put in the middle of the innovation process, as opposed to participating later. A process-oriented program would favor in-plant education and apprenticeships. A process-oriented program also focuses assistance on the recipients—the small manufacturer and the workforce—not intermediaries. Process-driven programs do not spend most of their resources at the university or insuring bank loans.

Overall, however, the weight of those who favor support for manufacturing is relatively weak. Even in good times, the Massachusetts programs did not match the scope and intensity of the industrial assistance programs in most other industrialized states, or in many southern states. There is not yet a large enough consensus in the Commonwealth to support a manufacturing extension service in light of the fiscal problems facing the state.

What makes the CAT program unique is its commitment to a worker-centered, skill-based approach. As such, it has more worker involvement than most. It has also been successful in saving or enhancing manufacturing activity in a number of plants. Therefore, even though CAT is not expected to grow substantially over the next few years, it should be able to continue to function.

NOTE

This essay was written for a lecture presented in May 1990. It was edited in August 1991. By that time the Commonwealth of Massachusetts had disbanded the Centers of Excellence, CAT's parent organization. CAT was able to move to another agency, but with no new funds appropriated in the 1991 or 1992 budget.

Frank Emspak was Project Director of the Center for Applied Technology from November 1, 1987 until April 1, 1991.