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ABSTRACT

Developed by an advisory board of industry and education representatives to raise issues for the consideration of policy makers, community college administrators, labor leaders, and managers in Michigan, this report discusses the increasing significance of training to industry; the challenge to public education and, in particular, to community colleges posed by these training needs; and the implications for a coordinated training policy at the state level. Following introductory comments, the report examines the increasing importance of a trained workforce, explains general themes appearing in training delivery systems, and discusses the impact of a heightened emphasis on training in manufacturing on the relationship between an individual firm and the public school system. Next, the report offers a rationale for Michigan community colleges playing a major role in training for new technologies, highlighting the reliance of community colleges on local support, the location of the 29 institutions in major industrial areas, and the importance of industrial training in computer-based manufacturing for the economic survival of the manufacturing base of Michigan's economy. The next section looks at issues for the educational community raised by the emphasis on training, considering the impact on mission, different constituencies to be trained, barriers to the development of Michigan community colleges as a major center of training in programmable automation technologies, and the need for an appropriate balance between public and private roles in training. Next, the report looks at training issues for the state, directing a series of recommendations at state authorities. Finally, concluding comments point to the need for improved relations between education and industry and increased business and labor involvement. (EJV)

Final Report

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Preface

The following document discusses the issues of training and public policy. It was developed by an Advisory Board of industry and education representatives. The Board was convened to aid James Jacobs in the completion of a study of The Training Needs of Michigan Small Firms in the New Manufacturing Technologies. This study was funded by a grant to Macomb Community College by the Governor's Office For Job Training. Under the grant Dr. James Jacobs was located at the Industrial Technology Institute where he conducted the study. A supplemental grant was also made available by the Michigan Department of Education The research began in the spring of 1985 was concluded the fall of 1986. An interim report was available to all study participants in the summer of 1986.

The research included:

- visits to twenty-five automotive supplier firms to identify their training needs for the successful implementation of advanced manufacturing technology;
- a survey of over two hundred Michigan automotive supplier firms to identify their present and future training needs;
- on-site interviews with vocational technical administrators from six community colleges in the state; and
- interviews with eight personnel managers concerning the career ladders open to community college students in the area of computer based manufacturing technologies

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Introduction

For the past year, this committee has discussed how advanced manufacturing technology is challenging the training offered at the community colleges of Michigan. What follows is a summary of these discussions, plus a series of suggestions for educational and governmental authorities. This statement reflects some of the research conducted at the Industrial Technology Institute by James Jacobs and the extensive industrial and educational experience of the members of the committee.

The following statement summarizes our concerns. It is directed at educators, governmental authorities, unionists, and manufacturers. In this statement we attempt to outline the increasing significance of training to industry, the challenge to public education and in particular to community colleges, and the implications for a co-ordinated training policy on the state level. The goal of this statement is to raise issues which policy makers, community college administrators, labor leaders, and managers can consider.

Increasing Importance of A Trained Workforce

Within most manufacturing firms, the training of personnel was often an afterthought, something to be determined once plans were made for plant layout and the deployment of machinery. The issues concerning training were simple and straightforward--where to get it and what is the lowest cost. Training for production workers was usually handled through informal on-the-job training. Most companies did little formal training, relying on the school systems and other institutions such as the military, to provide the background that workers needed to perform their tasks. Only when a specific process was initiated or a specific new machine deployed, did the company pay for training directly. Normally, the vendor of the equipment provided the necessary training to a few of the company's engineering staff, who then informally trained the firm's workers on the job.

There was little systematic evaluation of the training and little interest in viewing training as anything more than a narrow assumption of necessary skills to run the specific piece of equipment. Training to meet future needs in terms of company plans, or the capability of the machines, was absent. Furthermore, this traditional view of training did not provide a systemic context which placed the specific skill learned within any general engineering theory, or knowledge of the production process.

An important exception to this dominant trend in Michigan industry was the

development of the Ford Trades School by Henry Ford. This school took high school graduates and gave them a thorough grounding in the technical education of the day, which was primarily mechanical engineering. While the original mission of the school was to develop trades-people for the Ford Motor Company, many individuals who went through the program continued their education, earning engineering degrees. Even though Ford Motor Company disbanded the school in the early 1950's (the grounds became the site for Henry Ford Community College in Dearborn), the concept of offering a general grounding in technical education before specific training continues to have many supporters in Michigan industry.[1]

The introduction of advanced manufacturing technology has considerably altered this picture of training. The knowledge and skills demanded by the deployment of this new equipment has necessitated large-scale formal training programs which have been costly. Accurate figures for company training costs are very difficult to obtain. According to the American Society for Training and Development (ASTD), U.S. corporations are spending over $10 billion annually for formal training of workers outside of their normal work place. Indications are that this figure will rise in the future.[2]

Training for advanced manufacturing technology does not stop with the production worker. Companies that have successfully implemented this technology have also directed major efforts at training their managerial and engineering staff. Indeed, what distinguishes the present training in advance manufacturing technology from past efforts is the extent to which the training is directed at management and engineering ranks as well as hourly workers. The new technology requires not only the skills to run the new equipment, it requires abilities to apply the "soft" process technology such as Just In Time (JIT), Statistical Process Control (SPC) and Materials Requirements Planning (MRP) as well. This soft process technology requires that specific training be directed at management and engineers.

Much of the programmable manufacturing technologies are in such flux, that almost continual training is mandatory. Some companies have calculated that the occupational "half-life" (the length of time when one half of the knowledge and skills needed by

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[1]Another school was established by Cross & Company. Students were paid by the company a wage while they attended a six-month program in all aspects of the machine tool business--from manufacturing to sales.

[2]For the best summary of training costs see: Office of Technology Assessment, Technology and Structural Unemployment: Reemploying Displaced Adults, Washington, 1986, pp. 281-292.

workers to perform their jobs are obsolete) has declined from 7-14 years to 3-5 years. As a result, companies are rapidly establishing new internal training departments and developing the capacity to continually train their workforce.[3] The nature of training has also been influenced by the new technology. Instead of learning a single skill or how to run one machine, workers must develop overall skills to integrate data, troubleshoot problems, and understand the relationships among increasingly integrated equipment; in brief, to learn to think about the overall process of production and their role within it. The new training requirements are skill oriented based around principles of design and mechanical or electrical engineering theories. However, one of the new required skills is the ability to think about the entire manufacturing process. These new technologies have also brought a new concern with interpersonal and "team" skills. This concern has transformed training programs into more general courses in production strategies and troubleshooting, and has raised a concern for management about issues such as the ability of workers to read, write and communicate.

Training Delivery Systems

The clear consensus on the need for more training in basic skill areas does not extend to the type of delivery system for training. Indeed, the growing concern with training has produced a blizzard of delivery options. Some companies depend on equipment vendors to perform their training, while others rely on community college programs, in-house training centers, or use a combination of delivery systems supported through a government job training program. Most of the larger companies use a variety of basic delivery systems. The actual choice appears to be a product of the specific context faced by the local plant. Two factors that appear relevant are the responsiveness of the existing training delivery systems to the needs of the firm, and the experience of the firm's training co-ordinators in the design of their activity. However, whatever training system is used, the following general themes appear evident:

- Training programs should be customized. Good programs are designed for

[3]This increase in training makes it a greater economic cost element in the production process. The new training must be absorbed within the cost of the products. For example an employer will purchase three servo-controlled robotics at $65,000 each, only to spend another $30,000 in training engineers, skilled trades, and maintenance workers to operate the equipment. There are indications that training now accounts for 20-30% of the cost of the implementation of computer based manufacturing equipment. A specific determination of actual training costs for the introduction of new computer based technology is still difficult to obtain. It is of vital importance to the justification process, and as training needs for new equipment increase, more companies will begin to specify training for new equipment as a separate cost item.

the specific needs of the company. The design of a training program must consider not only where the company is now, but where it wants to go with the technology.

- Training programs should be continually assessed. It is clear that many firms launch training programs with specific goals in mind. Unfortunately, they often lack the proper "follow-through" to assess the success of their efforts. This evaluation is especially important for computer based technologies where the purpose of training is to motivate individuals to think as workers within a system, not simply as operators of a particular piece of equipment.

- Most of the new training for advanced manufacturing technology includes an element of cross-training or multi-skilling. Since most computer based technologies combine some of the traditional engineering disciplines (i. e. robotic technicians should know both mechanical and electrical engineering concepts), a good deal of the training addresses the variety of skills necessary to run such systems. How many skilled workers should be trained to perform, however, is an open question.

- Good technical training is essential, and effective companies are willing to pay for it. The successful companies find there are no short-cuts to a trained workforce, and for specific key technologies, large amounts of money are spent training relatively few workers. As one executive put it, "to spend $5,000 on an inferior training program that will lower productivity and create down time on a $7 million machine is incorrect thinking."

Training and the School System

The increasing emphasis upon training in manufacturing has profound influence upon the relationship between an individual firm and the public school system. In the past, the school system "trained" individuals only in the broadest sense for occupations. Indeed, the traditional separation was between the general knowledge of an area or discipline, and the more specific skills necessary to work at a specific job. The purpose of the educational system was to impart knowledge; skills would be received at the firm. With this division came the belief that the development of educated workers was the responsibility of the school system, while the responsibility for training workers in specific skills was the responsibility of business. Good schools were considered a "spill over benefit" to the community because they provided a well prepared work force (knowledgeable) that could be trained (given skills) by business.

The training required for new technology shatters this convenient distinction. First, with some computer based technologies the relationship between knowledge and skill is

very difficult to separate. An individual can learn how to operate a computer aided design terminal, but in order to achieve full productive use of the equipment, there must be an understanding of both design and mechanical engineering that will permit the use of the terminals for computer assisted engineering. Indeed, to refer to a job as a "CAD operator" restricts the potential tasks that could be performed by that operator. If to operate as a flexible machining cell team, all workers must be able to communicate in writing, does this mean that taking a communication course only improves the "skills" of writing?

Second, if a work force with a particular background is critical to the maintenance of a specific industry that is the major employer in an area, the school system has an obligation to respond to these specific training needs both to guarantee future employment for students, and to retain a tax base for the community. In a real sense, the willingness to undertake specific work force preparation becomes an investment in the future economic activity of the area.

Finally, a good deal of the new training required by firms involves retraining of their present work force. These are not workers who follow the traditional path from school to work, but rather might return to classes from work on a regular basis. The emphasis upon life-long learning or adult learning serves to re-orient the direction of public education. Both knowledge and skills courses might be needed by this group to prepare for new computer based technologies.

These training issues have raised some serious questions about the role of delivery systems. How much of the training should be done by the company--either in-house or through some other form of delivery system? How much of the training can be accomplished through the public educational system, before individuals enter the work force? What amount of educational resources should be invested in retraining the present work force, and what should be devoted to meeting the future training needs of the local economy? The demands for more sophisticated and broader training pose significant policy issues for training at the company and plant level, as well as for the programs of educational and governmental authorities at the national, state and local level.

Finally, these policy issues are made even more difficult to resolve by the tendency in some governmental circles to substitute a training policy for an employment policy. The ability of a government to enhance training capabilities is certainly a desirable objective, both for firms and citizens. It cannot, however, replace a commitment to

achieving full employment. This is particularly true in the area of computer based manufacturing technologies where most of the new occupations will at best have limited growth.

In most other western capitalist nations, educational institutions are integrated within the macro economic policy. In Canada, most of the federal and provincial job training programs utilize the state-supported schools systems as the deliverers of training. Agents for the province work directly with employment authorities and employers to design programs for industry.[4]

Why Community Colleges

The community colleges of Michigan can become an important institution in the training for new manufacturing technologies. First, these institutions have been developed for the past twenty years by Michigan citizens into a multi-billion dollar investment. Since almost all of the them are partially funded through local property tax initiatives (on the average, 30% of their institutional budgets come from that revenue source), they must return to the voters for approval on a regular basis. More than any other institutions of higher education, they must reflect the real interests and needs of their areas.

Second, the 29 community colleges are located in all the major industrial areas of the state. They are expressly designed to serve the interests of local business and industry, and so can specialize in specific curricula beneficial to the dominant local industries. In the major economic area of Southeast Michigan, there are ten community colleges that are in close geographic proximity to specialize in training for particular technologies which can save needless duplication of facilities for relatively low enrollment programs.

Third, if industrial training in computer based manufacturing is considered significant for the economic survival manufacturing base in the state of Michigan, then involvement in this activity by public education is legitimate. The community college

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[4]An example from Ontario is the Training In Business and Industry (TIBI) Program. Private firms approach the provincial government with the specific training program they wish to perform. This program includes the design of the course, the equipment to be used and even the instructor. If funded by the provincial government (the firm also pays part of the training), the implementation of the training is undertaken by the local community college. The college runs the program even if they must hire specific people outside of the school to perform the training. On the federal level, the Canadian Employment Commission "buys" seats in community college classes for employers to train individuals in certain nationally designated "critical skills."

system represents a group of institutions that can accommodate the specific training needs and interests of the state of Michigan. It is possible to use the community college system as an agent for economic development interests. Two examples from a variety of options might be possible. In turn for the use of training resources at Michigan community colleges by firms (which externalizes some of their training costs), these firms can agree to hire students "certified" by community colleges at a particular technical level.[5] Another possible "accord" would be for firms to receive state monies for specific vendor training. They can use part of that money to pay for vendor instruction of community college faculty who would then train the in-plant work force in that technology. In this way not only will the firm get state support for training workers, but the community college can upgrade some of its staff.

Fourth, the implementation of programmable automated equipment displaced workers and, at the same time, raised the skill requirements of those remaining. Indeed, it appears that one of the fastest growing jobs in Michigan's otherwise shrinking industrial occupational base, is that of technician. It is precisely the community college which can prepare students for these skill requirements.

Issues For Michigan Community Colleges

The emphasis on training raises some important issues for the educational community. First, what is the proper mesh between public educational institutions and the private demands for company training? Many public institutions are involved in the development of customized training programs for companies. However, how much of these developments move institutions away from their more global mission of obtaining work for young students entering the work force? In another area, what is the responsibility of the community college to develop the more general basic skills (i.e. reading, writing, mathematics, social science, and general computer awareness) of all students to make them productive citizens? Firms certainly would profit from an adequately educated work force.

Part of this question is further complicated by looking at the different constituencies that need to be trained. They are: post-secondary students who have yet to enter the labor market; younger workers returning to school to develop greater skills by which to advance on the job; and, older workers sent to school for retraining. Each of these

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[5]This concept of a "training accord" has been suggested by the Auto In Michigan Project in their 1985 report. See: AIM '85: The Auto-In Michigan Project 1985 Report, October 1985, pp. 33-34.

constituencies demands a different treatment by the community college and a different mixture of public and private responsibility.

Before suggesting what some of these relationships might be, the committee has examined some of the programs taught at community colleges in detail. There have been many positive steps taken by Michigan community colleges. In general, training in new technologies is available and there is a commitment to view this area as a priority for future vocational-technical programs. We believe community colleges have developed excellent programs for entry level students. However, resources and efforts need to be assembled to deal with the other two groups. There are many barriers to the development of Michigan community colleges as a major center of training in programmable automation technologies. We have found:

- A tendency to think in terms of a comprehensive "CIM" curriculum, which may aid a student in knowing about the overall areas of advanced manufacturing technology, may not provide him/her with a firm basis in a particular skill;

- Sometimes converting broad programs into very specific technology where the demand by industry may be intense, but only for a few individuals;

- Growing courses and programs in computer based technology that are geared for entry level students, when much of the present need is the retraining of the current local workforce;

- The need to place more emphasis on the development of basic skills that will permit students to learn and develop within a company;

- A willingness to customize educational programs to fit the needs of local employers, but the difficulty to overcome present barriers of inflexible facilities, faculty, or staff for design;

- Purchasing new equipment, but encountering difficulty in the preparation of the faculty to teach about the new technology;

- Too little resources elevated to the writing and mathematics abilities of occupational students;

- Too little attention devoted to developing a "mesh" between the programs of the community college and the training performed by local vendors;

- Too much separation between complementary courses in business areas and

those in the vocational-technical areas;

- A need to focus vocational training for entry level workers not only on present skills, but in anticipation of learning future skills.

In general, the committee would like to see more attention paid to the appropriate balance between public and private roles in the area of training. Public institutions such as community colleges should provide the training in basic skills for entry level workers (i.e. reading, writing, computation, communication skills, and general machinery skills.). Once inside the firm, these workers can be trained by the company in a specific sophisticated technology. Some of this training will no doubt be performed at the community colleges through customized company paid education. Some of it will be done through equipment vendors. Where public resources are utilized, the key task is to provide entry-level workers with basic skills training so that they will be prepared to obtain additional training in the future.

Attaining the appropriate mesh of basic and specific skills provides a real challenge to community college authorities. Instead of developing many specific technical programs directed at younger students under the assumption that such training will get them a better job, community colleges might be better off promoting the concept that possessing basic skills will make an individual within a particular company "ready to learn." Education in basic skills better guarantees further specific training in a company than narrow vocational training can guarantee. Moreover, using community colleges for the latter places specific costs on the State, that individual firms should bear.

In contrast, specific technical programs should be designed to serve older workers already on the job. Part of this training should be customized basic skills courses to develop communications, reading, and mathematics skills. Institutions should focus on the adult learner and the development of programs that bring these older workers "up to speed" in their basic skills. Since these workers are being offered the same services that community colleges offer younger students, it is legitimate for the costs to be borne by the state.

This perspective also best serves the general economic interests of the community in the development of an overall trained workforce, and protects the existing workers within their firm. On the other hand, the emphasis upon specific skills is correctly assumed by the firms themselves.

Training Issues For the State

Changes in community college occupational programs are influenced by the role of the federal and state governmental authorities who establish overall educational policy. At this point, the federal role in occupational education is decreasing and it is difficult to suggest a short term strategy, other than the need to develop one. Our efforts are directed at state authorities. While the committee has not explored these suggestions in depth, a few appear evident:

- State authorities in education must be far more receptive to economic development projects at the state level, and develop strategic planning objectives to target key occupational programs, or specific institutions, with financial aid;

- The needless duplications of courses and programs, and the "competitive" atmosphere that often exists between community colleges, need to be replaced with planning and cooperation in program development. In this regard, some of the program work done by the Michigan Occupational Deans Administrative Council is a model to be emulated at the state level;

- More strategic coordination of programs initiated at the state level. The implementation of the Transformation In American Industry Program through the participating community colleges is one good example of how a particular significant technology (Statistical Process Control) was taught in a coordinated fashion in a majority of Michigan community colleges. Another good example of coordination is the development of community college training associates by the Michigan Technology Deployment Service;

- More resources need to be devoted to the re-training of existing faculty in some of the new technologies and new processes. For example, as the automobile industry moves into greater use of plastics, there needs to be more effective programs at the community colleges in this area. This might mean the development of a state program to retrain present community college staff;

- In cooperation with business and labor representatives, a reassessment of the apprentice program training in the state of Michigan. The apprentice programs need to be re-developed with specific statewide criteria that get implemented systematically. The present system is a patchwork of local arrangements that serves neither the worker or the company

- Better coordination of data on occupational changes and new industrial processes. The state of Michigan now has a number of good "border scout" institutions (such as the Industrial Technology Institute) and research

projects (Auto-In-Michigan). Educational authorities need to avail themselves of the data gathered by these projects in a systematic way.

In these suggestions to state authorities, we are mindful that the process of change is exceedingly difficult and will take coordinated actions. We also recognize that many of these concerns are not new. We believe the specific demands of advanced manufacturing technology motivate an urgency in the implementation of these efforts.

Conclusion and Further Direction

These suggestions are only initial steps. No doubt many of them have been recognized before, and no doubt there are many individuals and groups involved actively in their implementation. In addition, inside the educational community there are a number of local initiatives which deserve the support of local industry. Too often local firms do not participate and help shape these efforts. Furthermore, representatives from labor unions have been absent from debates around these concerns. The issues involved with training for new technology in Michigan are far too significant for this to continue. The involvement of business and labor is essential for future efforts.