MECOMTRONICS ENGINEERING TECHNOLOGY - EDUCATING TECHNICIANS FOR THE 21st CENTURY

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The New Jersey Center for Engineering Technology Education, NJCATE, is restructuring engineering technology education in order to produce engineering technicians who are equipped with the capabilities needed to meet the demands of industry in the 21st Century. Central to this effort is the creation of a Mecomtronics Technology Program which addresses industry needs for a multifunctional technician, skilled in the areas of mechanics, computers, telecommunications and electronics. The Mecomtronics program, by achieving a synergistic relationship between industry and education will emerge as a major alternative foundation for lifelong careers in a wide range of rapidly evolving technology areas. Mecomtronics will not only provide students with the breadth and depth of education essential to the changing demands of career opportunity and growth, but will demonstrate to industry the effectiveness of the Associate Degree as the base requirement for entry level technical positions. The Center is supported by funds from the National Science Foundation Advanced Technological Education Program.

Introduction

An intense process of self-examination and restructuring that is a direct result of global economic competition, is revolutionizing American business and industry. Companies are seeking to increase profitability through organizational change that is leaving them leaner and operating more efficiently. This process requires an organizational change that relies on a greater use of technology and a radical difference in the use of human resources.

To fit into the new organizational structure, technical employees must be more quality-minded and customer oriented and must accomplish multiple tasks of great diversity. Where once an employee was expected to do a job without reference to what others were doing, now "teamwork, communication skills, breadth of knowledge, initiative, versatility, and leadership skills" are basic requirements for employees at all levels.'

Education is currently mounting efforts to reformulate itself to produce graduates with the knowledge, skills, and attributes that employers seek. Technical mastery is no longer enough; the technician of the future must posses the knowledge and skills and the ability to function with decreased supervision in an environment that demands greater creativity, autonomy, and accountability. It has become clear that a piecemeal approach to educational reform has not worked and that comprehensive re-examination of the assumptions on which education is built must be engaged in.

The radical changes in knowledge and practices required of technicians are nowhere more evident than in the engineering technology area. Industry's move to a quality focus and the widespread adoption of concurrent engineering, requires a technician with a broad-based knowledge of multiple technical disciplines along with an awareness of the economic and environmental factors that impact on society.

Technicians are described by Louis S. Richman in a Fortune magazine article of 1994, as "the core employees of the information age"[2] and as the employees who "understand how the process operates in its entirety and are ready to intervene if trouble arises".[3] He further explains that the education of technicians is a critical component in the revitalization of American business and industry.

Just as the engineer of today must be knowledgeable in more than one area and must be able to learn other fields quickly,[4] an environment characterized by rapid telecommunications, sophisticated information systems, and use of advanced technological mechanisms requires a new technician who has a thorough understanding of the mechanics, electronics, and computer hardware and software that drive this technological society.

Mecomtronics Technician

The New Jersey Center for Advanced Technological Education, NJCATE, through a grant from the National Science Foundation Advanced Technological Education (ATE) program, is working towards restructuring engineering technician education, through the creation of a Mecomtronics Engineering Technology program. Mecomtronics, which responds to the specialized demands for the multifunctional engineering technician, is defined by NJCATE as the engineering technology discipline that combines the areas of mechanical and electronics technology, and computer hardware and software systems linked through telecommunications. Mecomtronics technicians are multifunctional technicians with the knowledge and skills to work in a technologically diversified business environment, and who are able to participate on a team to specify, trouble-shoot, develop, design, and prepare for production of cost-efficient, state-of-the-art products which can compete for value in a global economy.

The multifunctional Mecomtronics technician will be educated to perform a variety of technical tasks as part of a team, in a multitude of industries, with a strong grounding in mathematics, the sciences, and communications, as well as an understanding of the economic, environmental, ethical, and other social factors that drive business and industrial enterprises.

New Jersey Center for Advanced Technological Education

The New Jersey Center for Advanced Technological Education is a partnership of five two-year institutions, two four-year institutions, a secondary school district, industry and professional associations focused on the continuous improvement of engineering technology education to meet the challenges of an intensely competitive global environment. The seven post secondary institutions (Essex County College, Mercer County Community College, Middlesex County College, County College of Morris, Raritan Valley Community College, the New Jersey Institute of Technology, and Trenton State College), bring to the partnership recognized leadership in engineering technology, engineering and technology education. Current and recent initiatives include strong Tech Prep curriculum projects with public and private secondary school.

NJCATE activities include: curriculum development, instructional materials development; student outreach and recruitment, retention and success of under represented populations; articulation - high school, associate degree, baccalaureate collaboration; industry; academic; professional society relations; clearinghouse, electronic networking and dissemination; and faculty/teacher/industry personnel development. Each of the components is coordinated by a partner institution with cross-fertilization within each component achieved by participation of individuals from partner institutions. Teams of interdisciplinary and inter-institutional composition work together to promote wide dissemination of activities, as well as greater ownership by all partners.

Technical Education

Comparison of the characteristics of the traditional engineering technician of the past with the requirements for the engineering technician of the future illustrate the differences in the technician's role in business and industry now and in the past.

The Traditional Engineering Technician	The New Engineering Technician
Narrow focus on single discipline	Flexible and adaptable
Job-ready (Good technical skills for structured work tasks)	Career-ready (integrated core and technical skills)
Able to solve familiar problems	Creative problem-solver
Low emphasis on communication skills, interpersonal skills; multi-cultural awareness are included	Good communication & interpersonal skills with sensitivity and multicultural awareness
Prepared for a structured work environment with clear direction	Comfortable with uncertainty, ambiguity, open-ended thought, and change
Not trained to work in teams, prepared for individual accountability for specific tasks	Able to participate on a team to specify, trouble-shoot, develop, design, and prepare for production of cost-efficient, state-of-the-art products which will complete for value in a global economy
Views technical work as limited to a single discipline	Able to learn and expand fields of interest and knowledge
Narrow focus on specific industries	Prepared to use technical skills in non-traditional careers
Usually limited to engineering technology only	Prepared to move to bachelor's level programs

The engineering technology programs of the past were designed and succeeded in preparing technicians for the demands of the workplace of the past, but they are not succeeding in preparing the technician of the future. The table which follows illustrates the changes that need to be made if engineering technicians are to become, as "core employees of the information age" that Richman

believes they can be. .

Traditional Engineering Technology Programs	Proposed Program to Educate the Engineering Technician for the 21st Century
Sequential instruction; theory before application	Cross-discipline team approach
Generally, elective cooperative education	Strong Work Experience Component
Industry limited to "advisory" role	Strong and meaningful industry involvement (true partnership in education)
Learning as individual effort	Learning as collaboration
Faculty as provider of information judge of accomplishment	Faculty as coach
All learning from "expert" faculty	Student responsibility for own learning
Curriculum focus on technical knowledge	Total Curriculum focus on desirable technician characteristics
Primary dependence on lecture - laboratory format	Use of the most advanced instructional technology
Laboratory technology often lags behind industrial practice	Education in industry-standard technology
Internal faculty development with little or no industry or other institution involvement	Strong faculty development component with industry involvement
Theory followed by laboratory experiments	Project-and-problem-centered curriculum
Need for collaboration with high schools only recently perceived	Strong relationships with high schools for curriculum development, joint faculty development, information exchange, joint projects
Minimal interaction with government agencies	Strong government agency involvement
Curriculum developed with out reference to external standards	Curriculum that meets professional association standards
Stand-alone programs	Strong affiliation with professional associations
Limited transferability to other programs	Transferability of credit to other curricula - designed to lead to further education

Curriculum development is conducted by interdisciplinary teams drawn from consortium institutions and working closely with business and industry representatives. As Joseph Bordogna stated, education in the future will "shift from a linear (math→physics→ applications) to an integrated continuum (just in time)"[5] in which necessary elements of physics and math are

introduced as needed for applications. This integration of discipline areas to produce concurrent instruction in mathematics, science, engineering, humanities and social science requires new mechanisms for the division of instructional time and the award of discipline credit. Integration of ethical and social values into curriculum will be an additional important sub-focus of curriculum development.

The educational program that prepares the technician will be an interdisciplinary one, taught by program faculty, rather than the current structure of faculty separated by departmental lines. The faculty, with industry cooperation, will work as a team to deliver the educational components using a "just-in-time" approach to learning based on a quality model of "concurrent manufacturing" and "continuous quality improvement". "Just-in-time" refers to context in which core discipline subjects will be delivered. Rather than presentation of theoretical concepts followed by application, often in separate courses, "just-in-time" dictates concurrent instruction in theory and application, within the context of realistic projects or problems. The comprehensive curriculum design process is addressing the integration of core disciplines with the delivery of instruction in a project centered context.

Instruction will be based on projects provided by industry partners or designed by faculty in collaboration with industry personnel, with students assuming greater responsibility for their own learning. Work experiences for students will play an important role, and a wide range of instructional methods and tools will be employed, making use of advanced instructional technologies to develop critical thinking skills, work ethics, and team participation.

Conclusion

In conclusion, the New Jersey Center for Advanced Technological Education, through the creation of a Mecomtronics program, is developing a new paradigm for engineering technology education that will produce engineering technicians to meet the demands of industry. The Mecomtronics program, by achieving a synergistic relationship between industry and education will emerge as a major alternative foundation for lifelong learning in meaningful professional careers in a wide range of rapidly evolving technology areas.

References

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