
An Innovative Curriculum Approach for Expanding Engineering Technology Education

by

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Abstract: *Expanding engineering technology education under the constraints of resources and budgets is a challenge for both faculty members and administration. This paper summarizes our experience of developing a BS degree program through innovative curriculum approach. In 1997, Missouri Western (Missouri Western State University - MWSU) inaugurated an associate degree program in manufacturing engineering technology to meet the needs of the manufacturing companies in the surrounding regions. To meet the growing need from graduates, employers, and current students for a four-year program, we proposed an innovative B. S. degree program in manufacturing engineering technology. The new program was designed on the foundations of the existing two-year program in manufacturing and other four-year programs in engineering technology currently existing in the department. The new curriculum model not only fully utilizes the existing resources but also extends the concept of manufacturing engineering technology to an interdisciplinary approach. The new model also enhances the technical content of the manufacturing engineering technology degree. Except for the traditional requirements of the manufacturing field, the new curriculum model includes some state-of-the-art aspects of the modern manufacturing industries. The graduates from our new program will be more flexible and will demonstrate competencies that are more relevant to industry in the face of changing technologies. This model should be a good reference for relatively small programs or departments.*

I. Introduction

With a long history of career-oriented education as a primary part of its mission and function, Missouri Western State University has a solid undergraduate program in engineering technology accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). It valuably serves both its students and the employers of the City of St. Joseph, the northern fringes of the Kansas City metropolitan area, and its five-county regional service area by providing highly skilled engineering technologists and technicians to help the region grow and prosper. It wishes to continue to serve the people of Missouri in this way.

As a public, state supported institution, Missouri Western State University is providing a blend of traditional liberal arts and sciences and career-oriented degree programs [1]. Professional education

programs such as teacher education, nursing, engineering technology, and business have played an important role at Missouri Western for many years and have come to be seen as an area of strength for Missouri Western throughout the northwest Missouri region.

Missouri Western State University (Missouri Western) started an associate degree program in manufacturing engineering technology in 1997, based on the regional surveys conducted in the mid 1990s [2], to meet the needs of the manufacturing companies in the surrounding regions. Within a few years of the start-up of the two-year program, the demand from graduates, employers, and current students for a four-year program in manufacturing has steadily grown.

Manufacturing Engineering Technology (MET) is the profession in which the understanding of a broad range of technologies is necessary to apply and control manufacturing processes. It includes methods of production of industrial commodities and consumer products. The manufacturing professional must be able to plan, design and implement the facilities, tools, machines, and the sequence of operations for producing high quality products at competitive prices.

Manufacturing Engineering Technology is a highly interdisciplinary field, requiring elements from other areas of engineering technology, along with an in-depth knowledge of materials and manufacturing processes. The manufacturing professional must possess excellent technical and communication skills, knowledge of computer technology, electronics, engineering materials, and information technology.

Graduates with an associate degree in manufacturing engineering technology are able to fill a wide variety of positions in industry. However, graduates with baccalaureate degrees are capable of performing much more complex and diversified roles. Specifically, career opportunities exist in engineering of facilities, machinery and tool design, process and quality engineering, computer-aided design and computer-aided manufacturing (CAD/CAM), robotics and industrial automation, computer integrated manufacturing (CIM), technical sales, plant engineering, production and supervision of management processes, and productivity improvement. Baccalaureate degree graduates, with a strong foundation in engineering sciences, physical sciences, and mathematics, have a strong and broad base that enables them to perform well in any field which requires the application of manufacturing principles. The graduates will grow as new technologies develop and at the same time will be sensitive to the impact of technology on society. Manufacturing engineers get involved in the production of a variety of industrial and consumer goods and develop the expertise to see them through the completion [3].

II. Needs for Expanding

A recent survey of two-year manufacturing students indicated that 100% of them would like to pursue a four-year degree in manufacturing if Missouri Western were to offer a four-year degree in manufacturing engineering technology. The Industrial Advisory Board members of Missouri Western's two-year manufacturing program strongly supported a four-year program in manufacturing engineering technology. Local manufacturing companies, such as Altec, Wire Rope, Snorkel, etc. showed a strong interest in Missouri Western's engineering technology programs. The four-year program in manufacturing at Missouri Western is a logical extension of the currently existing two-year program,

and the two-year program serves as an excellent feeder program to the four-year program [4]. The demand for manufacturing is becoming stronger in the St. Joseph – Kansas City metro areas. The Kansas City region is the first in the country to collaborate with the National Association of Manufacturers (NAM) in a program that will dramatically change the image and reality of manufacturing in our country. The Alliance for Innovation in Manufacturing – Kansas City (AIM-KC) is collaborating with NAM to improve Missouri and Kansas manufacturing business climate through legislative and policy changes and bring new vitality to our manufacturing community. AIM-KC supports educational programs that support manufacturing. Introducing a four-year program in manufacturing engineering technology at Missouri Western is a step in the right direction to meet the growing shortage of manufacturing personnel.

According to Alliance for Innovation in Manufacturing – Kansas City (AIM-KC), there is a projected shortage of 13 to 15 million skilled workers by 2020 [5]. It is their goal to create 1,000,000 sq. feet of newly constructed manufacturing and/or distribution space. Because of global economy and domestic and international pressures, US manufacturing companies will be forced to upgrade their facilities and improve their manufacturing processes including hiring of work force equipped with high-tech skills in manufacturing. Hence, there is a need for two-year and four-year graduates in manufacturing. AIM-KC has already collected data on educational programs that have capability, or will have capability to deliver manufacturing engineering/technology education. The State of Missouri has also identified a shortage of trained personnel in manufacturing. This data is available through the Missouri Economic Research and Information Center (MERIC). Labor demand data shows a projected growth of 3.1% to 17.2% for trained personnel in the technology areas. In the overall category of professional/technical area, over 22,000 job openings will exist by 2008 according to Missouri Occupational Employment Projections. The proposed manufacturing program will contribute toward filling some of those jobs.

The data from Bureau of Labor Statistics, U.S. Department of Labor, shows that overall engineering-related employment is expected to increase through 2010. The estimated growth is from 4.5% to 17.1%. This projection reflects the need for 6,100 to 160,000 new engineering-related personnel by 2010. There are currently 35 total TAC/ABET-accredited AS and BS degree programs in the country, 27 out of which are BS-level, and eight (8) are AS-level. There is an excellent opportunity for a four-year program in manufacturing engineering technology at Missouri Western to support the employment needs of the manufacturing industry in the region. The innovative B. S. degree program in manufacturing engineering technology that was proposed and which has been approved was designed on the foundations of the existing two-year program in manufacturing and the other four-year programs in engineering technology that were already existing in the department.

III. Innovative Approach, A Case Study

The new B.S. degree program in manufacturing engineering technology requires total credits of 124 – 127 for graduation with a residency requirement, which complies with the requirement of MWSU, that is, 30 of the last 45 credits to be taken at MWSU in residence course work. A total credits of 42-46 of general education courses, and a total credits of 77-80 of major requirements including pre-major requirements, plus 9-16 free elective credits comprise the new BS degree program in manufacturing engineering technology. A special requirement is internship and design project/internship. Two courses,

namely MET 390 Design Project/Industrial Internship (2-4 Credits), and EGT 490 Engineering Technology Internship (3-4 Credits) are designed to emphasize Applied Learning. In addition to teaching traditional requirements of the manufacturing field, an existing course EGT 370 Financial Aspects of Engineering Projects was added as a requirement to allow the students to have the knowledge of project management principles. In addition, more focus was put on integrating modern technologies, highly computer-automated manufacturing technologies, into the new program. Because of domestic and international pressures in the industrial sector, U.S. manufacturing companies are under stiff competition to improve their manufacturing facilities, manufacturing equipment, and manufacturing processes including hiring of manufacturing work force that is educated and has the educational background to deliver quality products at the minimum cost. This requires producing high-caliber graduates; hence, the integration of manufacturing automation is essential in the new program. In order to incorporate manufacturing automation in the program and to take into account the limitations of the available resources, such as laboratory space, instructional facilities, and faculty, an interdisciplinary collaboration is emphasized. Several new courses such as, "Automation and Process Control Technology" and "Programmable Logic Controllers", which are usually required or available only for students in electronic/electrical engineering technology program, are proposed and dual-listed with other programs such as, electronics and computer engineering technology, as well as core courses in engineering sciences strengthen the foundations of the program [6].

The existing two-year degree curriculum in manufacturing engineering technology and other existing programs in the Department of Engineering Technology provide the necessary foundations for the BS degree program. The new program is designed to minimize the burden of generating new courses. All the new and dual-listed courses are developed from the existing courses in different disciplines. The new program will utilize faculty from various areas in the department. The utilization of the physical facilities and equipment increases the efficiency of the resources in the department. The facilities used solely for electronics, computer, manufacturing, and construction programs are now tailored for all programs, and allow for enhancement of collaborations between programs and among faculty. The department benefits from this interdisciplinary collaboration in cutting down on duplication of the courses, increasing the course enrollment, and boosting the student population and diversity, thus further lowers the operation cost. The students benefit the most because of their exposure to faculty from various disciplines and because of their involvement in a variety of interdisciplinary laboratories.

The Department of Engineering Technology has currently seven full-time and additional part-time faculty to deliver programs in manufacturing, electronics, construction, and electronics and computer engineering technologies. Efforts are made to adhere to TAC/ABET criteria on faculty credentials, and a relevant mix of faculty education and experience are relied on to deliver the best possible education to engineering technology students. The new program is designed to meet the TAC/ABET criteria with emphasis on the mixture of traditional and modern manufacturing technologies. The program complies with the TAC/ABET criteria which states, "Graduates must demonstrate the ability to apply the technologies of materials, manufacturing processes, tooling, automation, production operations, maintenance, quality, industrial organization and management, and statistics to the solution of manufacturing problems." The goal of the proposed four-year program in manufacturing engineering technology is to secure TAC/ABET-accreditation at the appropriate time in the future. The graduates of this four-year B.S. degree program in manufacturing engineering technology will be prepared for career opportunities in industry as engineering technologists in a variety

of industries that engage in industrial automation and robotics, machine and tool design, computer-integrated manufacturing, process and productivity improvement, etc. The graduates will demonstrate flexibility and will be highly sought after in the high-tech and modern manufacturing job market.

The new four-year manufacturing program has been approved by the University Curriculum Committee and the Missouri Coordinating Board for Higher Education. The program went into effect in fall 2006.

IV. Conclusion

The Missouri Western's manufacturing engineering technology curriculum model not only fully utilizes the existing resources but also extends the concept of manufacturing engineering technology to an interdisciplinary approach. The model also enhances the technical content of the manufacturing engineering technology degree. In addition to traditional requirements of the manufacturing field, the new curriculum model includes state-of-the-art aspects of the modern manufacturing industries. The graduates from Missouri Western's four-year program in manufacturing engineering technology will be more flexible and will demonstrate competencies that are more relevant to manufacturing industry in the face of changing technologies. Missouri Western's innovative curriculum model will serve as a good reference for other educational institutions in which engineering technology programs are small to medium-sized.

References

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