Master of Science Degree in Industrial management Designed for Technical College Instructors in Engineering and Technology

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Introduction

The manufacturing industry is undergoing a dramatic transformation in terms of the technology being used, market dynamics, workforce demographics, and skills needed to work in an advanced manufacturing environment\(^1\). The rate of technology adoption and the ability to use technology to remain competitive and add value defines the degree of advanced technology adaptation by industry. The transformation of technology has major implementations for the current workforce and for the new workers the industry requires. In order to operate a modern production facility, companies require workers with advanced skills. Rather than hiring a worker to perform a specific task, employers increasingly need workers who are continually focused on innovation of both products and processes. High tech workers require advanced academic and technical skills for their employers to stay competitive. All high tech workers need adequate foundational competencies in math, science, reading comprehension, and technical writing\(^2\). In order to be successful in their careers, technical workers need strong work related competencies including computer literacy, teamwork, and critical thinking skills as well as strong technical competencies in quality and process control, production philosophies including lean, Just-In-Time, and integrated production systems. These skills need to be taught at the technical colleges by college faculty who are educated and trained in advanced academic and technical skills with high level of expertise and proficiency.

The roles of technical colleges are becoming more active in the technology based economic development era of the present time. Technical colleges are becoming the key institutions to train highly skilled and technically capable workers\(^3\). At the same time, the need to identify appropriate instruction and technologies to train skill workers to perform well in industry is becoming more important. The technical colleges bridge the gap between education and training and act as a technology intermediary\(^4\). Many technical colleges wish to meet the educational and training needs of their community but are unable to sustain high level of curriculum and program update on their own\(^5\). Appropriate research and advanced education are required to obtain the needed expertise by technical faculty members to meet their students need. These requirements can be met by providing a Master’s degree in Engineering and Technology designed specifically for technical college instructors\(^6\).

To train qualified technicians to perform well in high tech technical areas, advanced technology concepts should be implemented in technical colleges\(^7\). The best way to achieve this goal is by offering a part-time Master’s program for technical faculty in engineering and technology; one that is designed to their specific needs, and one that provides mentoring and guidance to enhance
their curriculum and teaching skills through conducting research and writing a thesis related to their field of teaching.

**Project Objectives and Plans**

A Master’s degree in industrial management specifically designed for technical college instructors is an academic degree granted to individuals with at least three years of technical college instruction. This requirement guarantees that instructors have developed instructional curriculum and established teaching skills in a specific field within a technical area.

Programs offering MS in industrial management concentrate on management or engineering degree. Few programs are designed for career development in technical areas. A degree in industrial management specifically designed for technical college instructors is an innovative program to help train skilled workforce for industry.

Graduates are required to possess high order skills in analysis, critical evaluation, professional application, and ability to solve complex problems independently. A successful implementation of this program would contribute to increase the quantity, quality, and diversity of the advanced technology and STEM workforce. Specific program objectives are to:

**Implementation of Advanced Technology and STEM**

The purpose of this program is to provide advanced technical training and STEM for technical colleges and train qualified instructors. This will result in training technical college graduates that perform better in high-tech manufacturing environments. Manufacturing industries require a work force that is skilled, creative, and adaptable to new technologies.

*Strategy 1.1 Provide advanced manufacturing training for technical college instructors so they can train graduates that perform better in high-tech manufacturing positions:* Advanced manufacturing technologies are the key to competitive production in manufacturing. They provide efficiency, productivity, and better product quality to the production process. The curriculum to be developed by technical college instructors will be in the form of lesson plans, student projects, online resources, or instructional materials.

*Strategy 1.2 Train skilled technicians to increase the productivity, efficiency, and quality of manufacturing:* Advanced manufacturing incorporates many high-tech computer controlled production tools that are developed for and used in the manufacturing field, including high tech products and processes to produce parts, and flexible manufacturing methods to perform the production process. 3D modeling and computer aided manufacturing are the advanced technologies that are widely used to design and manufacture an array of products. These advanced technologies are the key to competitive production in manufacturing because they provide efficiency, productivity, and better product quality to the production process.
Strategy 1.3 present technical college instructors with the Science, Technology, Engineering, and Mathematics (STEM) education. Emphasizing Science, Technology, Engineering, and Mathematics (STEM) education is critical to improving the success of the students. The technology component of STEM allows for a deeper understanding of the three other parts of STEM education. It allows students to apply what they learned, utilizing computers with specialized and professional applications like CAD/CAM, robotics, and computer simulation to learn automation and other related technologies. Most STEM programs just emphasize the Science, Engineering and Mathematics portions, but Technology is the implementation of all other areas and is most likely to be understood by students.

Strategy 1.4 Encourage technical college instructors to present technical demonstration of advanced manufacturing processes related to Science, Technology, Engineering, and Mathematics (STEM) education to their student: Appropriate presentations, demonstrations and workshops will be developed by instructors. Technical college student will learn about and have hands-on activities using advanced technologies. Technical college instructors will also provide their seniors with related information about existing advanced manufacturing careers in local industries.

To provide technical college instructors with manufacturing philosophies and operational methods that make the production processes more efficient.

The main idea of lean manufacturing is to reduce waste and increase the productivity. Just-In-Time (JIT) is a philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. Set-up is the time required to prepare a machine or a device to perform a useful task. With reduced set-up time, the time required for a change-over when a problem is encountered is also reduced. Set-up time reduction makes the production chain more efficient and less susceptible to loss due to a fault in the operation. This also allows the production cycle to closely monitor the customer demand. The production flexibility achieved by the JIT manufacturing system has several advantages. It reduces the downtime by reducing the changeover time. Regular care is taken about the maintenance of the machinery to reduce breakdowns. Flexibility allows for evenly distributing the work among all work stations.

Strategy 2.1 Introduce advanced material handling processes, system integration, and production scheduling used in conjunction with advanced manufacturing processes in a plant: Material handling has two functions: move the parts between production machines, and orient and position the parts accurately at the machine. Tracking the movement of materials, parts, and tools through a production line is important. In an advanced manufacturing production plant the responsibility of updating the hourly and daily production achievement of a work station and entering the data into the computer station available at the workstation is the responsibility of the production technician working at that station. System integration deals with the use of computers in the organization and management of all aspects of industrial production. System integration is the process of interfacing different types of computer hardware and making sure that different
application programs can communicate with each other. The ability to access the system and observe the production process in each station is becoming a common practice in the manufacturing plants implementing advanced technologies. Production scheduling consists of planning production operations that need to be performed in an orderly manner. It is a tool for optimizing use of resources. Scheduling leads to increased efficiency, resulting in reduction of operation process time. Efficient scheduling of resources such as machines, labor, and raw material is a must in staying competitive in the production of products.

**Strategy 2.2 Introduce the concept of lean and Just-In-Time philosophy as it relates to the operation of advanced machine tools in a manufacturing plant:** Lean is a production practice that considers the non-value added activity in a manufacturing process a waste that needs to be eliminated from the process. Lean will result in increased efficiency, decreased waste, and improving the process by implementing new ideas.

**Provide technical college instructors with modern practices in manufacturing.**

Provide technical college instructors with technical expertise, experience in decision-making, and implementation of different advanced manufacturing concepts. This will expose the instructors to problem solving and critical thinking in high-tech manufacturing practices.

**Strategy 3.1 Provide technical college instructors with manufacturing practices that result in rapid transfer of science and technology into manufacturing products and processes:** This is possible by introducing the concept of advanced material handling processes, system integration, and production scheduling used in conjunction with advanced manufacturing processes. Material handling has two functions; move the parts between production machines and orient and position the part accurately at the machine. Tracking the movement of materials, parts, and tools through a production line is important. The primary technique used to track the movement of parts and materials is bar coding. In an advanced manufacturing plant the responsibility of updating the hourly and daily production achievement of a workstation and entering the data into the computer station available at the workstation is the responsibility of the production technician working at the station.

System integration deals with the use of computers in the organization and management of all aspects of industrial production. System integration is the process of interfacing different types of computer hardware and making sure that different application programs can communicate with each other. The ability to access the system and observe the production process in each station is becoming a common practice in industry.

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such as machine, labor, and raw material is a must in staying competitive in the production of products.

**Familiarize technical college instructors with research methods and techniques to improve their teaching skills.**

The graduates of the industrial management program are required to possess high order skills in analysis, critical evaluation, professional application, and ability to solve complex problems independently. Opportunities will be provided for technical college instructors to work with the department of industrial management and technology to investigate new technologies and methods of incorporating technology concepts into the curriculum.

*Strategy 4.1 Educate the technical college instructors to be the leaders in using advanced technology to improve technical education:* Comprehensive technology-training and research initiatives in advanced technology will be provided for technical college instructors. They can try new ways of learning and teaching. Technical college instructors can evaluate, experiment, implement best practices based on research, and match learning styles with new acquired knowledge in advanced manufacturing and STEM to improve their teaching outcomes.

*Strategy 4.2 Provide opportunity for technical college instructors to develop thesis topic related to their teaching and provide workshops for their colleagues.* Opportunities will be provided for faculty members to work with the department of industrial management and technology to investigate applicable advanced technologies related to their field of teaching and incorporate them in their curriculum. Individual technical college instructors can build their skills through the department of industrial management and technology faculty expertise and available learning opportunities provided for them. They will be required to present their knowledge to their peers through workshops.

**Program Outcomes:**

The expected outcome of this project is to implement advanced technology education for technical colleges by offering a specifically designed Master’s program for technical college instructors in engineering and technology. The instructors will assume the leadership role in modifying their existing teaching curriculum and they are required to provide workshops for their colleagues as part of their educational experience to complete their thesis related to instructor’s teaching subject.

**Program description:**

In order to successfully train qualified technicians and have them perform well in high tech technical areas, advanced technology concepts should be implemented in technical colleges. The best way to achieve this goal is by offering a part-time Master’s degree in industrial management to educators in technical areas. The program provides direct exposure to related industrial
challenges in production in an application-oriented environment. The courses offered by this program provide a common core of knowledge enabling the instructors to effectively function in diverse technical learning environment. Elective courses related to methods of presentation and instruction of technical materials allows instructors to pursue topics of interest that may be of immediate professional benefits.

Master’s of Science in Industrial Management revised for the benefit of technical college instructors presents a 30-hour degree including four online courses, four on campus courses and six hours of research that is identified as two thesis courses. The program blends the technical skills, advanced technology, and STEM together, and can be completed in three years. The size of the first graduating class will be 12 students selected from area technical colleges. Instructors will be provided the opportunity to use the faculty expertise and laboratories to improve their technical skills or learn new skills related to advanced technologies.

Finally instructors will be required to select a research topic related to their teaching field and will write curriculum and design laboratory activities under supervision of graduate program advisor and committee. The instructors will be required to share their project with their colleagues at their institution.

The project goal is to train advanced technology leaders for technical colleges. Leaders who are able to implement advanced technology training in their program and successfully deliver it to the students enrolled in that program.

Master’s Program Description

The Master of Science in Industrial Management is an interdisciplinary program that prepares graduates to assume leadership roles and positions in a variety of industrial, processing, and/or manufacturing. The program will familiarize students with philosophies and strategies currently used for improving production and provide students with further technical knowledge in areas such as quality assurance, industrial safety, and automated production. Students will also become familiar with research methods and techniques commonly used to solve problems in industrial settings.

The industrial management and technology department advisory committee strongly supports any effort to implement advanced technology and STEM in the graduate curriculum. The need to identify appropriate instruction and technologies to train skilled workers to perform well in industry is becoming more important.

The revised industrial management program for technical college instructors is designed to prepare graduates as leaders in technical education. Table 1 presents the degree plan for industrial management for technical college instructors.
### Master of Science in Industrial Management
#### Technical College Instructors Degree Plan

<table>
<thead>
<tr>
<th>Industrial Management Core courses</th>
<th>18 credit hrs</th>
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<tbody>
<tr>
<td>IMEN 5300  Industrial Operations Research Methods</td>
<td>3 hours</td>
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<tr>
<td>IMEN 5320  Implementation of Advanced Technology</td>
<td>3 hours</td>
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<tr>
<td>IMEN 5320  Implementation of STEM</td>
<td>3 hours</td>
</tr>
<tr>
<td>IMEN 5335  Industrial Safety and Risk Management</td>
<td>3 hours</td>
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<tr>
<td>IMEN 5340  Automation &amp; Cellular Manufacturing</td>
<td>3 hours</td>
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<tr>
<td>IMEN 5344  Lean Production</td>
<td>3 hours</td>
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| Total Core Courses | 18 hours |

<table>
<thead>
<tr>
<th>Industrial Management Elective Courses</th>
<th>6 credit hrs</th>
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</thead>
<tbody>
<tr>
<td>EDED 5320  Multimedia Design &amp; Production</td>
<td>3 hours</td>
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<tr>
<td>EDED 5321  Instructional Technology Leadership</td>
<td>3 hours</td>
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</table>

| Total Elective Courses | 6 hours |

<table>
<thead>
<tr>
<th>Research Component</th>
<th>6 credit hrs</th>
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</thead>
<tbody>
<tr>
<td>IMEN 5306 Thesis</td>
<td>3 hours</td>
</tr>
<tr>
<td>IMEN 5306 Thesis</td>
<td>3 hours</td>
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</tbody>
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| Total Research Component | 6 hours |

| Program Requirements | 30 credit hrs |

Table 1: Master of Science in Industrial Management for Technical College Instructors

**Industrial Management Degree Course Descriptions**

**IMEN5300. Industrial Operation and Research Methods:** Examination of data analysis with emphasis on distribution, probability, simple and multiple regressions, ANOVA and other statistical analysis techniques used using industrial related data.

**IMEN5320 (Special Topics):** Implementation of Advanced Technology in Technical College Curriculum: Application of advanced technologies in technical curriculum.
IMEN5320 (Special Topics): Implementation of STEM in Technical College Curriculum: Application of science, technology, engineering, and mathematics in technology curriculum.

IMEN5335. Industrial Safety and Risk Management: An examination of risk assessment, strategies and concepts as they related to industrial and laboratory settings. Industrial safety and personal protective equipment will be addressed.

IMEN5340. Automation and Cellular Manufacturing: Survey of current trend and approaches to automation and cellular manufacturing. Emphasis will be both on computer driven machine tools and integration of automated machinery to create an automated cell.

IMEN5344. Lean Production: A study of the philosophy of lean production and Just-In-Time concept. Emphasis will be on designing strategies for lean implementation in industrial setting.

IMEN5306: Thesis Research: The course requires completion of thesis research. May be repeated for maximum of 6 semester hours.

EDED5320: Multimedia Design and Production. Provides opportunities to experience the instructional design process as applied to the development of a description computer-based instructional prototype module. Draft a comprehensive design approach and implement ideas using an authoring system. Focuses on facilitating connections between instructional design literature and practice of designing and developing instruction using multimedia technology. The use of streaming technology will target development of lessons for staff development and utilization of streaming media in school curriculum to enhance teacher effectiveness.

EDED5321. Instructional Technology Leadership: Analyzes the roles of the technology leader in an educational environment, including developing, planning, implementing and evaluating an initiative for technology integration. Emphasis will be placed on effective decision-making strategies that optimize high quality learner outcomes.

Summary

Completing a Master’s degree in industrial management would provide technical college instructors with leadership experience for developing skills necessary to implement STEM in their curriculum. It will also introduce the state of the art training and educational materials to technical college instructors.

Implementation of this proposal would contribute to increase the quality and diversity of the advanced technology and STEM education in technical colleges. It will also significantly improve educational standards and career opportunities for technical college graduates.
References