



Office of the Provost and
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TO: Richard Koubek, President

FROM: Jacqueline E. Huntoon, Provost & Senior Vice President for Academic Affairs

Jacqueline E. Huntoon

DATE: March 14, 2019

SUBJECT: Senate Proposal 24-19

Attached is Senate proposal 24-19, "Proposal for a new Master's in Engineering Management," and a memo stating the Senate passed this proposal at their March 6, 2019 meeting. I have reviewed this memo and recommend approving the proposal.

I *x* concur _____ do not concur

Richard Koubek, President

3/15/19

Date



Michigan Tech

University Senate

DATE: March 7, 2019
TO: Richard Koubek, President
FROM: Michael Mullins
University Senate President
SUBJECT: Proposal 24-19
COPIES: Jacqueline E. Huntoon, Provost & Senior VP for Academic Affairs

At its meeting on March 6, 2019, the University Senate approved Proposal 24-19, "Proposal for a new Master's in Engineering Management". The Senate looks forward to approval of this proposal by the administration. Please keep me informed about the decision of the administration on this proposal and feel free to contact me if you have any questions.

The University Senate of Michigan Technological University

**Proposal 24-19
(Voting Units: Academic)**

Proposal for a New Graduate Degree Program

“Masters in Engineering Management (MEM)”

Introduction

The School of Business and Economics currently offers a Master’s in Business Administration graduate degree that does not include an opportunity for students to specialize in a technical domain. The School of Business and Economics proposes a new graduate degree program: Masters in Engineering Management (MEM hereafter). We propose a technical/business (hybrid) degree program that focuses on the managerial knowledge, business literacy and other relevant skills critical for successful operations in various engineering/technology-intensive industries.

1. January 14, 2019

2. Contact

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School of Business and Economics
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3. Approval

(Not applicable)

4. General description and Characteristics

The recent success of the B.S. in Engineering Management (undergraduate enrollment growth to 80 students from its introduction in 2013) and the support from various departments at the College of Engineering and College of Sciences and Arts encourage the school to offer this degree program at the master’s level. Given the large engineering and science population at Michigan Tech, the program would be of great necessity and appeal to the University community. The intent of this degree is to add the business acumen to the technical foundation provided in STEM undergraduate programs to help create accelerate graduates’ career trajectories. The most significant difference between the MEM and the MBA graduate programs is the addition of a significant number of technical courses compared to a more general management curriculum of our traditional MBA degree. The MEM should be considered a specialized graduate degree.

The MEM can also incorporate the “stacking” of credentials. Credentials can be earned for completing the business component or the technical component of the degree program. Completion of the different components leads to awarding of the MEM degree. This stacking concept is not detailed in this proposal as it is outside the direct proposal for the introduction of this degree program.

In addition, the university strategic plan underscores the significance of developing interdisciplinary degrees and research endeavors. Stakeholders, including but not limited to alumni, members of various advisory boards, and industry leaders, echo that such a program will add value to the University as well as the School of Business and Economics (SBE). The program will provide opportunities for our engineering graduates to learn how to evaluate and manage innovation and technology in harmony with current business practices.

Student performance will be assessed using the accepted learning objectives and rubrics developed by the SBE faculty for AACSB accreditation. Each business core course will be assessed on a regular schedule. The current learning objectives are:

Goal 1: Decision Making

Objective 1a: Identify key problems, risks and opportunities in complex business scenarios.

Criterion

- 1) Students can identify key problems in complex business scenarios.
- 2) Students can identify key risks in complex business scenarios.
- 3) Students can identify key opportunities in complex business scenarios.

Objective 1b: Evaluate multiple alternatives to make appropriate executive-level recommendations.

Criterion

- 1) Students consider multiple alternatives when making recommendations.
- 2) Students make appropriate recommendations.
- 3) Students’ recommendations are executive-level.

Goal 2: Managerial Competences

Objective 2a: Generate unique and differentiated alternatives to offer business solutions under uncertainty.

Criterion

- 1) Students suggest alternatives that are unique.
- 2) Students suggest alternatives that are differentiated from competitors.

Objective 2b: Recommend appropriate technologies in business solutions.

Criterion

- 1) Students suggest technologies that are appropriate.
- 2) Students suggest technologies that integrate with business solutions.

Objective 2c: Demonstrate ethical leadership by influencing globally aware, socially and environmentally responsible behaviors.

Criterion

- 1) Students demonstrate globally aware leadership behaviors.
- 2) Students demonstrate socially responsible leadership behaviors.
- 3) Students demonstrate environmentally responsible leadership behaviors.

Goal 3: Professional Communication

Objective 3a: Written communication is logical, concise, and comprehensive.

Criterion

- 1) Written communication has a logically flow from premises to conclusions.
- 2) Written communications are concise, minimizing repetition and extraneous information.
- 3) Written communications are comprehensive, without gaps of missing information.

Objective 3b: Oral presentation is persuasive and audience-tailored.

Criterion

- 1) Student presentations are persuasive.
- 2) Student presentations are tailored to their audiences.

Goal 4: Disciplinary Knowledge

Objective 4a: Demonstrate knowledge necessary for a MEM graduate.

Criterion

- 1) Student have acquired disciplinary knowledge in finance.
- 2) Student have acquired disciplinary knowledge in accounting
- 3) Student have acquired disciplinary knowledge in operations management and project management.
- 4) Student have acquired disciplinary knowledge in technology and innovation domains.

The program uses existing and regularly offered courses. The SBE expects the list of electives to evolve as new courses are developed. It will be a 30-credit course-based master's program; therefore, the designation of Masters in Engineering Management is appropriate.

The SBE Graduate Programs Committee started the curriculum identification process by determining the requisite skills and knowledge for a MEM graduate. From that abstract, high-level view, specific courses were identified to ensure that their contents align with the profile from an academic perspective. After reviewing over 40 similar graduate programs from other universities, five business courses were identified as key requirements for all students in the MEM. These courses span accounting, finance, operations, project management, and management of technology and innovation domains.

Students will have the flexibility to enroll in more business courses or technical courses via a set of focused electives. The program director will advise MEM students to encourage a coherent combination of electives suited to a particular domain.

Finally, a set of technical electives will augment the anticipated strong STEM background of the target student population. The proposed program balances business knowledge with an expansion of technical competency of students from various undergraduate backgrounds in engineering and science, which is not readily possible with the current Tech MBA® program. The SBE Dean and SBE Associate Dean met with Department Chairs and the College of Engineering Associate Deans from various units across campus over the summer 2018 to obtain feedback on the MEM proposal. These representatives provided guidance on courses to include (and to delete) based on relevance to the intended expertise of MEM graduates and course availability. The program director will advise MEM students to encourage a coherent combination of technical electives suited to individual career goals.

5. Title of the program: Masters in Engineering Management (MEM)

6. Rationale

- (a) We are creating this specialized graduate degree for the following reasons:
 - i. To give students the opportunity to pursue a career requiring a foundation in both engineering and business. The curriculum enables students to enhance their technical depth with technical electives while adding vital management competency and awareness.
 - ii. To introduce technical graduates (e.g. engineering undergraduates) to a subset of current business principles and processes while assessing the commercial ramifications of their technical design solutions. Their engineering skill set is augmented with essential business expertise, including knowledge of organizational behavior, cost management, and leadership skills. Thereby, future graduates of the MEM program are prepared to manage people, lead scientific or engineering operations, head complex technical projects, or pursue entrepreneurial endeavors within a high-technology context. We anticipate graduates will secure more challenging entry-level jobs employing their technical skills. The ultimate objective is, however, to provide an opportunity for graduates to rapidly

transition into upper level management positions employing their business skills.

- iii. To aid students with technical majors in broadening and diversifying career opportunities that were previously unavailable to purely technical graduates. Discussions with alumni often reflect regret at the missed opportunity to study business earlier in their careers. With business credentials on their resumes, engineering graduates will differentiate themselves from their peer group.
- (b) In addition, the MEM program will contribute to the SBE's vision to produce tech-savvy business graduates and business-savvy tech graduates. The MEM program takes advantage of a business school embedded in a technological university. While the Bureau of Labor Statistics does not track Engineering Management as a separate category, the related job title of Industrial Engineers can provide relevant information. According to the Bureau of Labor Statistics, this career field is growing faster than the national average (10% growth rate) over the next decade. Furthermore, the number of jobs in this field is very large compared to other engineering fields. We anticipate strong career placement for MEM graduates.

7. Discussion of related programs within the institution and at other institutions

The Tech MBA® courses currently offered by the School of Business and Economics will provide a foundation for the proposed program where engineering and science students are exposed to business aspects of engineering, technology, and innovation.

By definition, a MBA degree provides broad coverage across the spectrum of business disciplines. An MBA is widely considered to be a generalized graduate program with equal representation of the primary core functions (and theoretical foundations) applied in most business schools. The MBA is more attractive for a career that requires overall business knowledge. Indeed, our prior Tech MBA® program required 10 business courses, whereas the MEM degree requires only a portion of the Tech MBA® courses.

By definition, a M.S. degree is a focused, deeper and more precise degree program. In this case, the MEM is focused on technical knowledge and abilities combined with the primary business content required for expertise in management of operations within technical industries. Students will be able to extend their technical education through graduate courses in the various engineering and science disciplines. This degree requires a strong background in a technical domain through the electives selected. Students will be encouraged to choose courses that present a logical connection, appealing to recruiters in a well-defined industry or area. Graduates will more likely remain in supervisory levels within a technical unit as a career path. In other words, the proposed program balances business knowledge with the technical competency of students from various undergraduate backgrounds in engineering and science, which is not the intent of the current Tech MBA® program.

The following institutions in the State of Michigan offer programs that are primarily engineering-centric, and generally lack core business components:

- Lawrence Technological University - Master of Engineering Management,
- University Detroit Mercy - Master of Science in Technical Management,
- University Michigan Dearborn – Master of Science in Engineering Management,
- Western Michigan University - Master of Science in Engineering Management,
- Wayne State University – Master of Science in Engineering Management, and
- Eastern Michigan University - Master of Science in Engineering Management.

Michigan State University also offers a Master of Science program in Operations and Engineering Management, but the curriculum is primarily business focused.

The proposed program will be hosted in the School of Business and Economics with a focus on providing students with a unique opportunity to further develop their skill sets in their respective engineering and science fields as well as expand required knowledge in business, innovation, and technology management. Class projects will provide opportunities for MEM students to interact with MBA students on a regular basis.

8. Projected enrollment

The enrollment is projected to be 20 students in the first year, with a gradually increasing enrollment of +5% each year until the program plateaus with an estimated 40 students admitted annually.

9. Curriculum design

The proposed program is a 30-credit course-based degree.

Business Requirements (15 credits)

- 1 BA 5300: Financial Reporting & Control
- 2 BA 5400 Financial Risk Management & Decision Making (Prereq: BA 5300)
- 3 BA 5610: Operations Management
- 4 MGT 4600: Management of Technology and Innovation
- 5 ENG/OSM 4300: Project Management
OR BA5650 Project Management

Focused Electives (6 credits)

- 1 BA 5200: Information Systems Management & Data Analysis
- 2 BA 5700: Managing Behavior in Organizations
- 3 BA 5800: Marketing, Technology & Globalization
- 4 CEE 5350: Life Cycle Engineering
- 5 MEEM 4650: Quality Engineering OR
OSM 4650: Six Sigma Fundamentals OR
MEEM 5650: Advanced Quality Engineering
- 6 MGT 3800: Entrepreneurship

Prerequisites

MA 3710: Engineering Statistics (or any other statistics course)
(CEE 3710 Stats for Civil Engineering)

Technical Electives (9 credits)***Civil & Environmental Engineering**

- 1 CEE 5710: Modeling and Simulation Applications
- 2 CEE 5404: Transportation Planning
- 3 CEE 5417: Transportation Design
- 4 CEE 5501: Environmental Process Engineering
- 5 CEE 5730: Probabilistic Analysis and Reliability
- 6 CEE 5760: Optimization Methods in Civil/Env. Engineering
- 7 EC 3400: Economic Decision Analysis

Chemical Engineering

- 1 CM 3310: Process Control
- 2 CM 5100: Applied Mathematics for Chemical Engineering
- 3 CM 5300: Advanced Transport Phenomena
- 4 CM 5400: Advanced Reactive Systems Analysis
- 5 EC 3400: Economic Decision Analysis

Computer Science

- 1 CS 3712 Software Quality Assurance
- 2 CS 4712 Data Mining
- 3 CS 5471 Computer Security
- 4 CS 5841 Machine Learning
- 5 EC 3400: Economic Decision Analysis

Electrical & Computer Engineering

- 1 EE 3261: Control Systems
- 2 EE 5300: Mathematical & Computational Methods in Engineering
- 3 EE 5451: Cyber Risk Assessment Critical Inference
- 4 EE 5500: Probability and Stochastic Processes
- 5 EE 5511: Information Theory
- 6 EE 5521: Detection Estimation
- 7 EE 5821: Computational Intelligence
- 8 EE 5230: Power Systems Operations

Mechanical Engineering

- 1 MEEM 3600: Introduction to Manufacturing
- 2 MEEM 5680: Optimization I
- 3 EC 3400: Economic Decision Analysis

* This list of technical electives is an example; other courses are open for consideration. Students will need to satisfy the course prerequisites in selection of their technical electives.

10. New course descriptions

There will be no new courses added for the program.

11. Model schedule (Business courses only)

	Fall	Spring
Business requirements	BA 5300: Financial Reporting and Control MGT 4600: Management of Technology and Innovation	BA 5400: Financial Risk Management and Decision Making BA 5610: Operations Management OSM 4300: Project Management
Focused electives	Focused Elective 1 Technical Elective 1 Technical Elective 2	Focused Elective 2 Technical Elective 3

Reference the MTU course catalog for the semesters in which the focused and technical electives are offered.

12. Library and other learning sources

The library and other learning resources will be identical to those for current students.

13. Faculty resumes

<http://www.mtu.edu/business/people-groups/faculty/robert-hutchinson/>
<http://www.mtu.edu/business/people-groups/faculty/manish-srivastava/>
<http://www.mtu.edu/business/people-groups/faculty/howard-qi/>
<http://www.mtu.edu/business/people-groups/faculty/ulrich-schmelzle/>

14. Description of available/needed equipment

No new or specific equipment needed for the program.

15. Program costs

The proposed program leverages the Tech MBA® program and other courses currently offered by engineering and science programs. Therefore, no specific additional cost will be incurred from the program. Administrative costs will be covered by the School of Business and Economics.

16. Space

No new space is needed. The Graduate Computing Lab in the Academic Office Building will be available for MEM student use.

17. Accreditation requirements

Michigan Tech is accredited by the Higher Learning Commission (HLC)(<https://www.mtu.edu/provost/accreditation/hlcommission/>). Individual programs may, in addition, seek and receive professional accreditation (<https://www.mtu.edu/provost/accreditation/professional/>).

This program will be reviewed and accredited by AACSB (Association to Advance Collegiate Schools of Business).

18. Planned implementation date

Fall 2019

19. Program specific policies, regulations, and rules

(Not applicable)

Introduced to the Senate:
Approved by the Senate:
Approved by Administration:
Approved by Board of Trustees: