April 9, 2015

TO: Sarah Mangelsdorf, Provost

FROM: James (Jake) Blanchard, Executive Associate Dean

RE: Proposal for New Named Option: Master of Engineering in Manufacturing Systems Engineering (online program)

On April 8, 2015, the College of Engineering Academic Planning Council unanimously approved the attached proposal to offer a new named option: Master of Engineering in Manufacturing Systems Engineering.

This distance learning program is intended for those individuals that are in the early to mid-stage of their careers as manufacturing engineers and production managers, who are unable to continue their education via the traditional on-campus avenue due to work schedules, other constraints and responsibilities.

I recommend this proposed new named option.
MEMORANDUM

To: Marty Anne Gustafson, Program Director, Engineering Professional Development
Frank Pfefferkorn, Associate Professor, Department of Mechanical Engineering

From: Barry Van Veen, Lynn H. Matthias Professor and Chair, Master of Engineering Oversight Committee

Date: April 7, 2015

Re: Master of Engineering, Manufacturing Systems Engineering

Cc: Susan Hagness

This memorandum is to report that the College of Engineering Master of Engineering Oversight Committee approved and endorsed the Master of Engineering, Manufacturing Systems Engineering named option at its meeting held on April 7, 2015.

Please contact me if you have any questions.
REQUEST FOR APPROVAL OF A NEW NAMED OPTION IN MANUFACTURING SYSTEMS ENGINEERING IN THE EXISTING MASTER OF ENGINEERING DEGREE MAJOR

1.0 Summary and Requested Action

Approval from the College of Engineering Academic Planning Council is requested by the Manufacturing Systems Engineering Program and the Department of Engineering Professional Development for a new degree option that is a collaborative effort by both units. The proposed new program is a named option to be offered under the existing Master of Engineering (MEng), Engineering major degree. The proposed named option is in Manufacturing Systems Engineering, in accordance with the flexibility of the College to create and retire options within the MEng degree as part of the UW System Regents’ 1998 authorization of the MEng degree. The proposed Manufacturing Systems Engineering named option is a fully-online degree program whose academic home will be the Department of Engineering Professional Development (EPD) with its curricular content governed by the Manufacturing Systems Engineering Program (MSEP). The proposal has been reviewed and approved by:

- Manufacturing Systems Engineering Program (MSEP)
- Department of Engineering Professional Development (EPD)
- Department of Mechanical Engineering (ME)
- Department of Industrial and Systems Engineering (ISyE)
- Wisconsin School of Business.
- College of Engineering’s Master of Engineering Oversight Committee
- College of Engineering’s Academic Planning Council

A project team with members from the Executive Committee of MSEP and EPD studied the feasibility of a proposed online Master of Engineering with a named option in Manufacturing Systems Engineering (MEng MSE) in 2012 and designed the program now recommended for approval in 2015. The Program Development Team included the members of the MSEP Executive Committee and EPD shown in Table 1.
Table 1: Program Development Team

<table>
<thead>
<tr>
<th>Department</th>
<th>Name</th>
<th>Notes</th>
<th>MSEP Executive Committee</th>
<th>Contact email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Professional Development</td>
<td>Marty Gustafson</td>
<td>Program Director</td>
<td>No</td>
<td><a href="mailto:magustafson2@wisc.edu">magustafson2@wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Phil O’Leary</td>
<td>Professor and Chair</td>
<td>Yes</td>
<td><a href="mailto:oleary@engr.wisc.edu">oleary@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Wayne Pferdehirt</td>
<td>Director, Graduate Engineering Distance</td>
<td>No</td>
<td><a href="mailto:wppferde@wisc.edu">wppferde@wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Degrees</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carl Vieth</td>
<td>Director, Corporate Education</td>
<td>Yes</td>
<td><a href="mailto:vieth@wisc.edu">vieth@wisc.edu</a></td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>Neil Duffie</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:duffle@engr.wisc.edu">duffle@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Roxann Engelstad</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:engelsta@engr.wisc.edu">engelsta@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Tim Osswald</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:oswald@engr.wisc.edu">oswald@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Frank Pfefferkorn</td>
<td>Associate Professor, Director of MSEP</td>
<td>Yes</td>
<td><a href="mailto:pfefferk@engr.wisc.edu">pfefferk@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Lih-Sheng Turng</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:turng@engr.wisc.edu">turng@engr.wisc.edu</a></td>
</tr>
<tr>
<td>Industrial &amp; Systems Engineering</td>
<td>Ananth Krishnamurthy</td>
<td>Associate Professor</td>
<td>Yes</td>
<td><a href="mailto:ananth@engr.wisc.edu">ananth@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Jingshan Li</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:jingshan@engr.wisc.edu">jingshan@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Robert Radwin</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:radwin@engr.wisc.edu">radwin@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Leyuan Shi</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:leyuan@engr.wisc.edu">leyuan@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Raj Veeramani</td>
<td>Robert Ratner Chair Professor</td>
<td>Yes</td>
<td><a href="mailto:raj@engr.wisc.edu">raj@engr.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Shiyyu Zhou</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:szhou@engr.wisc.edu">szhou@engr.wisc.edu</a></td>
</tr>
<tr>
<td>School of Business</td>
<td>Mark Finster</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:mfinster@bus.wisc.edu">mfinster@bus.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Ella Mae Matsumura</td>
<td>Professor</td>
<td>Yes</td>
<td><a href="mailto:ematsumura@bus.wisc.edu">ematsumura@bus.wisc.edu</a></td>
</tr>
<tr>
<td></td>
<td>Urban Wemmerlöv</td>
<td>Kress Family Wisconsin Distinguished</td>
<td>Yes</td>
<td><a href="mailto:uwemmerlov@bus.wisc.edu">uwemmerlov@bus.wisc.edu</a></td>
</tr>
</tbody>
</table>

Key conclusions from the Program Development Team are:

- A market exists for online professional masters degrees in Manufacturing Systems Engineering, as found in a strategic market assessment completed in October 2012.
- The proposed program is expected to be financially viable long term.
- The proposed program will not draw the same students as the on-campus MS in Manufacturing Systems Engineering.
- The EPD Chair, MSEP Director, and MSEP Executive Committee have been actively engaged in program planning and are committed to this effort.

We respectfully request the committee review and approve development of the proposed program to enable UW-Madison to establish a visible leadership position in distance learning for manufacturing engineers.
2.0 BACKGROUND AND RATIONALE

2.1 Background

The Master of Science in Manufacturing Systems Engineering was established as a graduate program at UW-Madison in 1983. The program was the first of its kind in the United States, and among the first in the world. Having quickly gained national recognition, MSE was one of five U.S. programs chosen by IBM to receive grants totaling $4 million for curriculum enhancement. In 1988 the Society of Manufacturing Engineers (SME) awarded the program its prestigious LEAD award. With an enrollment of 45 students in Fall 2014, as well as nearly 500 of its graduates working in industry, the MSE Program at UW-Madison is widely acknowledged as a solid provider of versatile senior/managing engineers for advanced manufacturing firms.

The future strength of manufacturing in the United States is reliant on a technologically trained and skilled workforce. Engineering distance education is growing rapidly as a result of new delivery technologies and interest among students and employers who find traditional on-campus education impossible or inconvenient. This distance learning MEng degree with a named option in Manufacturing Systems Engineering (MSE) is being proposed for students with established work and home lives. The target audience for the new MSE named option is early to mid career manufacturing engineers and production managers working in manufacturing organizations that are not likely to interrupt their careers to study on campus.

The online MEng in MSE faces significant competition on a number of fronts. There are a large number of direct competitors from American peer institutions and European universities. In addition, there are an increasing number of options for practicing professionals to support career development. Success of the proposed program will hinge on our ability to:

- Achieve regional dominance as the thought leader in Manufacturing Engineering,
- Actively engage program alumni in student recruitment,
- Target underserved manufacturing sub-segments, particularly food and beverage manufacturing and the biotechnology sector,
- Partner with large, multi-national corporations as an ongoing source of recruits, and
- Leverage UW expertise to create a robust, engaging, world-class digital learning environment.

2.2 Rationale

To determine the feasibility of a distance-learning, Masters-level Manufacturing Systems Engineering degree program, EPD performed a market assessment in 2012. The assessment was based on an electronic consumer survey sent to approximately 7,500 professionals. The purpose of the assessment was to determine the level of interest, level of employer support, funding sources, and program design requirements for those in the target market.

Key takeaways from the survey indicated:

1. Any degree program for the target population should be fully online.
2. Employer funding for graduate education is diminishing.
3. Increasing skills to improve personal performance is the primary motivation for potential participants.
4. Most students should be able to complete the degree within three years, and it can be completed in two years.
5. Sizable proportions of respondents are considering a masters degree, and are likely to enroll within the next two years.
6. Course flexibility and the reputation of the university are key attributes that are desired by potential students.

The survey also indicated that program affiliation with a respected brick and mortar institution held great value.

The online MEng MSE program is not anticipated to have a significant affect on the enrollment in the on-campus M.S. degree in Manufacturing Systems Engineering. Existing enrollment data from MSEP and EPD suggest that the students enrolled in the on-campus and online degrees will have different demographics. The majority of the students enrolled in the on-campus degree are international students seeking a full emersion in the U.S. academic system and culture, with immediate access to internships, co-ops, and full-time employment in U.S. companies. The majority of the online students are anticipated to be domestic engineers who have been working for 2 to 5 years and want a masters education without having to quit their job and move their family.

The number of students enrolled in the on-campus M.S. in Manufacturing Systems Engineering program since Fall 2012 is given below:

<table>
<thead>
<tr>
<th>Semester</th>
<th>Total Enrollment</th>
<th>International Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall 2012</td>
<td>27</td>
<td>21 (78%)</td>
</tr>
<tr>
<td>Spring 2013</td>
<td>31</td>
<td>25 (81%)</td>
</tr>
<tr>
<td>Fall 2013</td>
<td>30</td>
<td>24 (80%)</td>
</tr>
<tr>
<td>Spring 2014</td>
<td>29</td>
<td>23 (79%)</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>45</td>
<td>39 (87%)</td>
</tr>
</tbody>
</table>

From Fall 2012 through Fall 2014 the on-campus program has had between 78% and 87% of its enrollment comprised of international students. This is in contrast to the seven online Master of Engineering and Master of Science degree programs offered by the College of Engineering that currently have 210 students enrolled (Fall 2014) but no international students. The online programs have 76% of enrolled students as non-residents, and 24% as Wisconsin residents.

To better understand these differences, an anonymous online survey of the currently enrolled on-campus MSEP students was conducted during the week of November 10, 2014 to determine their interest in a fully-online degree. There were 17 respondents (38% response rate): 3 (18%) In-State and 14 (82%) International. The survey provided the following insights into the students enrolled in our on-campus program:

- 65% are doing or plan to complete a co-op or internship during their MSE program
  - Internships or co-ops are located in WI, MN, IL, and SC
• Based on their thought process when they were applying to the UW-Madison M.S. in MSE Program:
  o 83% Probably Would Not Have or Definitely Would Not Have enrolled in a fully-online program if it had been offered to them when they applied to UW-Madison’s on-campus program
  o 18% Probably Would Have enrolled in a fully-online program if it had been offered to them when they applied to UW-Madison’s on-campus program
  o 0% Definitely Would Have enrolled in a fully-online program if it had been offered to them when they applied to UW-Madison’s on-campus program

• The numbers changed very little when the students were asked to answer the question based on what they know now:
  o 77% Probably Would Not Have or Definitely Would Not Have enrolled in a fully-online program if it had been offered to them when they applied to UW-Madison’s on-campus program
  o 18% Probably Would Have enrolled in a fully-online program if it had been offered to them when they applied to UW-Madison’s on-campus program
  o 6% Definitely Would Have enrolled in a fully-online program if it had been offered to them when they applied to UW-Madison’s on-campus program

• Reasons respondents stated for not wanting to pursue an online degree included:
  o Online degrees are not well recognized by companies
  o Cannot conduct thesis research
  o Cannot imagine engineering courses online
  o Development of relationships (i.e., networking) in person
  o Hands-on experiences
  o Prefers asking questions directly to the professor, interacting with students in class, and the whole on-campus atmosphere enhances learning

These reasons against choosing an online course of study are common for students not yet familiar with the structure of EPD’s distance programs. EPD’s instructional delivery method requires weekly direct, synchronous interaction between a professor and the students, often resulting in more live discussion, group work and networking than a typical campus lecture format. By using instructional systems designed for adult learners, courses also require students to conduct hands-on research or projects at their place of employment, providing valuable real-life applications and experiences. Finally, the consistent quality and recognition of EPD’s online graduate engineering degrees has helped UW-Madison become a recognized leader in distance engineering education.

In addition to the email survey conducted in 2012, telephone interviews with a diagonal slice of manufacturing engineering employers and industry professionals were also conducted. The manufacturing economy is in recovery, though employment growth will likely lag order performance. The concept of a degree program that combines engineering and business is desirable, though respondents were not always clear as to where a professional with that credential would fit in their organization. Global supply chain, global product development, supplier development, systems engineering, controls, and technology assessment and automation were areas of interest. The MSE program has little brand recognition in the state and region. Program alumni are an untapped potential source for recruiting and support.
Given the program’s potential, and its ability to complement, rather than compete with, existing on-campus degrees and certificates, the program was recommended for development.

3.0 NAMED OPTION DESIGN

3.1 Master of Engineering Degree

The existing Master of Engineering Degree was approved in 1998 as a way to serve both students and employers by providing specific options focused on practice-oriented Master’s degrees that would allow students to keep up with the latest science and technology and maintain their competitiveness. The Master of Engineering is a terminal degree, following a Bachelor’s degree in an ABET, Inc., accredited engineering program.

The topics emphasized by these options are expected to shift fairly rapidly as the relevant industrial practices evolve. The College of Engineering currently offers six named options in the Master of Engineering degree/major, as shown in Table 2.

<table>
<thead>
<tr>
<th>Degree</th>
<th>Major</th>
<th>Named Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Engineering</td>
<td>Engineering</td>
<td>Engineering Management (MEEM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine Systems (MEES)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Japanese</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sustainable Systems Engineering (SSE)</td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering</td>
<td></td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td></td>
<td>Polymer Science</td>
</tr>
</tbody>
</table>

These named options are offered through online instruction, and were ranked #6 in January 2015 by U.S. News and World Report in its survey of online graduate engineering programs, placing the University in the top ten for the fourth year in a row. UW–Madison’s programs were judged on factors such as a high level of student collaboration and participation, the availability of instructors to answer student questions, small class size, and the inclusion of an instructional designer dedicated to developing courses to meet online learner needs.

3.2 New Named Option in Manufacturing Systems Engineering for Master of Engineering

Using the experience gained through the existing Master of Engineering options, EPD and MSEP are requesting a new named option be added in Manufacturing Systems Engineering within the Master of Engineering degree, Engineering Major (Table 3).

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1 Graduates of allied sciences may be accepted if certain pre-requisites are satisfied.
Table 3. Proposed New Option to Structure of Master of Engineering Degree

<table>
<thead>
<tr>
<th>Degree</th>
<th>Major</th>
<th>Named Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Engineering</td>
<td>Engineering</td>
<td>Engineering Management (MEEM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engine Systems (MEES)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Japanese</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sustainable Systems Engineering (SSE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Manufacturing Systems Engineering (MSE)</strong></td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering</td>
<td></td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td></td>
<td>Polymer Science</td>
</tr>
</tbody>
</table>

4.0 ADMINISTRATIVE STRUCTURE AND GOVERNANCE

4.1 Administrative Structure

The Graduate School and the Manufacturing Systems Engineering Program will confer the named option in Manufacturing Systems Engineering within the Master of Engineering degree, Engineering major. Review of proposals for new named options and administration of existing named options for the Master of Engineering degree are governed by the Master of Engineering Oversight Committee at the College of Engineering.

The supporting operations for this named option will be managed by EPD and managed by a Program Director under the supervision of EPD’s Director of Distance Degree Programs. The Academic Director will be the Director of the Manufacturing Systems Engineering Program, who will primarily be responsible for academic advising and curriculum. A committee comprising the Executive Committee of the Manufacturing Systems Engineering Program (MSEP) and key EPD personnel will provide review and direction for this named option. An advisory committee consisting of leaders from industry, government, and other University Departments will be formed prior to degree launch. Supporting staff from EPD have also been assigned to assist in technology management, marketing, admissions, instructional design and program assistance. The work breakdown between MSEP and EPD is shown in Table 4.
Table 4. Proposed Administration of Named Option in Manufacturing Systems Engineering

<table>
<thead>
<tr>
<th>Program Functions – Lead Organization</th>
<th>EPD</th>
<th>MSEP</th>
</tr>
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<tbody>
<tr>
<td>Academic Director</td>
<td>X</td>
<td></td>
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<tr>
<td>Program Director</td>
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<td>Degree Approval Process</td>
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<td>Financial Administration</td>
<td>X</td>
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<tr>
<td>Marketing</td>
<td>P</td>
<td>S</td>
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<td>Course Content Development</td>
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<td>P</td>
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<tr>
<td>Instructional Systems Design for Course Development</td>
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<tr>
<td>Instruction and Teaching Assistance</td>
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<td>P</td>
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<tr>
<td>Admissions Communications</td>
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<tr>
<td>Acceptance Communications</td>
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<td>Program Requirements for Graduation</td>
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<tr>
<td>Academic Advising</td>
<td>S</td>
<td>P</td>
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<tr>
<td>Course/Instructor Availability and Scheduling</td>
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<td>Advisory Board</td>
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<td>Orientation</td>
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<td>S</td>
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<td>Course Enrollment and Tuition Communications</td>
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<td>Technical Support</td>
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<td>Student Records</td>
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<tr>
<td>Graduation</td>
<td>S</td>
<td>P</td>
</tr>
</tbody>
</table>

X = Responsible  P = Primary  S = Secondary

EPD = Department of Engineering Professional Development
MSEP = Manufacturing Systems Engineering Program

4.2 Assessment and Continuous Improvement

MSEP and EPD are committed to using an assessment strategy that will ensure high impact to students and their employers, and high quality of services to students, faculty, and alumni. The planning committee will build upon and adapt evaluation methods currently employed by EPD. Elements of the assessment program will include:

- Mid-course surveys for all new courses to enable early detection and corrective action to ensure course content and logistics are responsive to students’ needs and interests.
- An end-of-semester evaluation of each course by students and the instructor, focusing on achievement of learning outcomes and additional outcomes established for the program.
- A detailed programmatic evaluation by students at graduation.
- An impact survey conducted 9-12 months after graduation that includes graduates, and workplace supervisors and/or professional peers.

Feedback from all sources will be reviewed yearly with faculty, staff and the program advisory committee to identify opportunities and actions for continuous quality improvement. Performance of this program will also be reported annually to the College of Engineering Master of Engineering Oversight Committee. Regular reviews of the program will also be conducted and
reported to the Provost’s Office and involve the Graduate School as part of the periodic reviews of the Master of Engineering degree.

5.0 ADMISSIONS AND DEGREE REQUIREMENTS

5.1 Admission Requirements

An admissions committee will be assembled for the degree including faculty from EPD and members of MSEP’s Executive Committee. Each application will be individually reviewed by its members. The committee will include the Director of Engineering Distance Degree Programs (Wayne Pferdehirt), the program director for this degree, the academic program director who is also the director of MSEP (Frank Pfefferkorn), the Director of Student Services for the Department of Engineering Professional Development (Gary Henderson), and other faculty from MSEP may be assigned by the MSEP Executive Committee.

The admission requirements for the MEng MSE named option were created to meet or exceed the requirements for admission to the Graduate School. They are:

- A BS degree from a program accredited by the Accreditation Board for Engineering and Technology (ABET)
- A minimum undergraduate grade-point average (GPA) of 3.00/4.0 on the equivalent of the last 60 semester hours (approximately two years of work).
  - Applicants with less than a 3.0/4.0 may be admitted at the discretion of the department
- Applicants whose native language is not English must provide scores from the Test of English as a Foreign Language (TOEFL). The minimum acceptable score on the TOEFL is 580 on the written version, 243 on the computer version, or 92 on the Internet version.
- International applicants must have a degree comparable to an approved US bachelor's degree. Applicants from an international institution must have a strong academic performance comparable to a 3.00/4.0 for an undergraduate or master's degree.
- At least two years of work experience in or related to manufacturing
- Three letters of recommendation

Exceptions to any of these requirements could be made on an individual basis at the discretion of the admissions committee. Each student recommended for admission by the committee must then receive admission approval from the Graduate School.
5.2 Degree Requirements

The requirements for completion of a Master of Engineering degree are given in Table 5.

Table 5. Degree Requirements for MEng in MSE

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Graduate Degree Credit Requirement</td>
<td>30 credits</td>
</tr>
<tr>
<td>Minimum Graduate Residence Credit Requirement</td>
<td>16 credits</td>
</tr>
<tr>
<td>Minimum Graduate Course Work (50%) Requirement</td>
<td>At least 15 credits of degree course work must be graduate level courses (specifically designed for graduate students)</td>
</tr>
</tbody>
</table>

The curriculum provided in Section 6.0 outlines the specifics of how these requirements will be met. Up to 6 credits of prior coursework at the graduate level or credits of prior coursework in the curriculum from an undergraduate degree completed at the University of Wisconsin-Madison will also be accepted. Prior coursework must be approved by the program’s Academic Director and comply with the Graduate School’s policy for acceptance of graduate work from other institutions.

5.3 Satisfactory Progress

The Graduate School requires that students maintain a minimum graduate GPA of 3.00 in any course taken as a graduate student at 300 or above (excluding research, audit, credit/no credit, and pass/fail courses), unless probationary admission conditions require higher grades. In addition, to fulfill the Master of Engineering degree requirements, any individual class in which the student receives a ‘C’ or lower must be repeated.

The Graduate School also considers Incomplete (I) grades to be unsatisfactory if they are not removed during the subsequent semester of enrollment; however, the instructor may impose an earlier deadline.

A student may be placed on probation or suspended from the Graduate School for low grades or for failing to resolve incompletes in a timely fashion. In special cases the Graduate School permits students who do not meet these minimum standards to continue on probation upon recommendation and support of their advisor.
The proposed program has been designed to meet the learning outcomes shown in Table 6. The goal is to give students the cross-functional expertise required to drive creative product and process development, efficient production, and timely delivery to the customer.

Table 6. Learning Outcomes for Named Option in Manufacturing Systems Engineering

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Knowledge and Skills</th>
</tr>
</thead>
</table>
| Knowledge        | • Articulates, critiques, or elaborates the theories, analysis methods, and approaches to designing, analyzing, and solving problems in manufacturing systems  
                    • Identifies sources and assembles data pertaining to challenges in manufacturing systems  
                    • Understands manufacturing systems in a global context |
| Skills           | • Selects and/or utilizes the most appropriate technologies, methodologies and practices  
                    • Evaluates or synthesizes information pertaining to manufacturing challenges  
                    • Communicates clearly in ways appropriate to manufacturing and management |
| Professional Conduct | • Recognizes and applies principles of professional engineering competencies in change management, project management, leading teams and fostering innovation |

Assessment of these learning outcomes will be conducted using several methodologies. At the course level, students’ exam and project performance will be monitored yearly by the Academic Director and the advisory board. On the program level, end-of-semester evaluations given during each course will focus on achievement of learning outcomes. At graduation, a detailed programmatic evaluation by students will look at achievement of all program learning goals, with an additional impact survey conducted 9-12 months after graduation. A yearly report will be generated for the Master of Engineering Oversight Committee.

6.1 Courses

Table 7 provides a summary of the proposed curriculum in relation to extant courses either offered within the College of Engineering or Business School and categorizes them relative to the perceived effort to make them distance learning-ready for the MEng MSE named option program. The proposed 30-credit curriculum consists of 30 core credits and 0 electives. Of the 30 core credits, 24 are offered for graduate credit, allowing the curriculum to meet the graduate school requirement for greater than 50% of the total credits to be taken at the graduate level.

The “options” listed under Quality Engineering and Accounting Principles refer to courses that the Development Team can choose from to satisfy the Learning Objectives. Courses marked as distance learning-ready have an existing course suitable for manufacturing systems engineering students that is being delivered or is planned for delivery on a distance-delivery model. There are two courses in the proposed curriculum that are currently delivered online for on-campus
students. These courses may be considered distance learning ready as they only need to open a section for distance learners. Courses marked as distance ready but requiring modification require some modifications of existing distance-learning course materials to best suit this student group. Courses marked as having an on-campus course version require development of distance-learning course materials based on existing course structure and learning goals.

Table 7. The Proposed MEng MSE Named Option Curriculum

<table>
<thead>
<tr>
<th>No.</th>
<th>Course Topic/Title</th>
<th>Dept.</th>
<th>Course</th>
<th>Credits</th>
<th>Status (Date Available)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connected Learning and Digital Proficiency</td>
<td>EPD</td>
<td>705*</td>
<td>1</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>2</td>
<td>Creating Breakthrough Innovations</td>
<td>EPD</td>
<td>702*</td>
<td>1</td>
<td>Distance Learning Course Under Development (Fall 2016)</td>
</tr>
<tr>
<td>3</td>
<td>Industrial Data Analytics</td>
<td>ISyE</td>
<td>691*</td>
<td>3</td>
<td>Modification to Existing Distance Learning Course* “Advanced Robotics” is distance learning ready. Automation and evaluating new technologies will be added. (Spring 2017)</td>
</tr>
<tr>
<td>4</td>
<td>Sustainable Approaches to Complex Systems</td>
<td>OTM</td>
<td>770*</td>
<td>4</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>5</td>
<td>Automation, Robotics, and Evaluating New Technologies</td>
<td>ME</td>
<td>739*</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Quality Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 1: Quality Engineering and Quality Management</td>
<td>EPD</td>
<td>518</td>
<td>3</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td></td>
<td>Option 2: Inspection, Quality Control and Reliability</td>
<td>ISyE</td>
<td>512</td>
<td>3</td>
<td>Offered on Campus (Sum 2017)</td>
</tr>
<tr>
<td></td>
<td>Option 3: Introduction to Quality Engineering</td>
<td>ISyE</td>
<td>575</td>
<td>3</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>7</td>
<td>Accounting Principles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Option 1: Accounting Principles</td>
<td>ACCT</td>
<td>300</td>
<td>3</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td></td>
<td>Option 2: Engineering Economic Analysis and Management</td>
<td>EPD</td>
<td>611*</td>
<td>3</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>8</td>
<td>Managing Change</td>
<td>EPD</td>
<td>700*</td>
<td>1</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>9</td>
<td>Project Management</td>
<td>EPD</td>
<td>707*</td>
<td>1</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>10</td>
<td>Leading Teams</td>
<td>EPD</td>
<td>709*</td>
<td>1</td>
<td>Distance Learning Ready</td>
</tr>
<tr>
<td>11</td>
<td>Supply Chain &amp; Logistics</td>
<td>ISyE</td>
<td>691*</td>
<td>3</td>
<td>Offered on Campus ISyE 691 is a developmental course number. Professor Krishnamurthy plans to make this a formal course and develop a distance learning section. (Spring 2018)</td>
</tr>
<tr>
<td>12</td>
<td>Production Systems Analysis</td>
<td>ISyE</td>
<td>615*</td>
<td>3</td>
<td>Offered on Campus ISyE/ME 615 is being transformed from an industry-project-based course to a case-study-based course in preparation for development of a distance learning section. (Spring 2018)</td>
</tr>
<tr>
<td>13</td>
<td>Capstone Course: Design and Analysis of Manufacturing Systems</td>
<td>ISyE/ME</td>
<td>641*</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* Course is offered for graduate credit. In total, 24 credits of the proposed curriculum is in classes designated as graduate, meeting the >50% requirement.

* Modification of some course materials is necessary to best serve manufacturing systems engineering students.
6.2 Learning Objectives

In addition to the program learning outcomes and assessment plan outlined in Section 6, Table 8 provides a summary of learning outcomes for each course in the proposed MEng with a named option in MSE curriculum. These outcomes will be assessed at the course level in support of the overall learning goals.

Table 8. Learning Objectives (Student Achievements and Capabilities) for Courses in the MEng with a Named Option in MSE Curriculum

<table>
<thead>
<tr>
<th>Core Courses</th>
<th>Student Achievements and Capabilities</th>
</tr>
</thead>
</table>
| Connected Learning and Digital Proficiency | • Understands and manages supporting networks  
• Understands and manages learning and work activities in the digital environment  
• Manages personal and shared information in the digital environment |
| Creating Breakthrough Innovations    | • Creates and environment of intellectual and technical curiosity  
• Challenges established technologies and practices – exploits opportunities to reuse / repurpose existing technologies in novel ways  
• Translates innovations into viable business opportunities, assuring predictable and reliable technical implementation  
• Leading and participating in geographically distributed teams |
| Industrial Data Analytics           | • Understand the different data types in practices and their limitations  
• Understand and be able to implement various data-driven modeling techniques such as regression, classification, and principal component transformation.  
• Understand the concept of model complexity and trade-off between model bias and variation.  
• Be aware of some advanced data processing techniques such as support vector machine, bagging, and boosting.  
• Improve problem solving capability using realistic industrial datasets |
| Sustainable Approaches to Complex Systems | • Learn analytical techniques for improving the sustainability of operations for complex systems  
• Understand how sustainability can impact quality, cost and value in design and manufacturing processes |
| Automation, Robotics, and Evaluating New Technologies | • Evaluate, chose, and integrate automation and robotic equipment into manufacturing systems  
• Design automation and robotic equipment for manufacturing applications  
• Analyze, design and simulate manufacturing equipment control at multiple levels including process, motion, task, cell and system control  
• Communicate knowledgeably with experts in the various disciplines associated with manufacturing automation and robotics |
## Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Student Achievements and Capabilities</th>
</tr>
</thead>
</table>
| Quality Engineering            | • Evaluate different systems for improving quality and productivity in manufacturing and service organizations including Kaizan and TQM.  
  • Demonstrate quality management and planning tools to define quality problems and opportunities, implement measurable solutions and foster team-based strategies for continuous improvement.  
  • Define the elements of a quality management system and address organizational change strategies.  
  From ISyE 512:  
  • Understand statistical process control problems and their impacts, and formulate problem solving strategies;  
  • Validate collected data, select and benchmark underlining processes;  
  • Perform preliminary data analysis and suggest quality improvement plans;  
  • Implementation of the SPC techniques based on hand-on examples and software interface. |
| Accounting Principles          | • Understand different accounting systems  
  • Understand cash-flow and financial analysis  
  • Understand managerial accounting practices related to cost behavior  
  • Interpret financial data, budgets and basic accounting and cost systems including activity-based costing and life-cycle cost analysis.  
  • Demonstrate understanding of investment analysis using time value of money, discounted cash flow, ROI, inflation, depreciation and taxes.  
  • Apply planning and control models to data sets for decision-making. |
| Managing Change                | • Identify the common elements of change management models  
  • Engage a systematic process to manage change impacts associated with a sustainable engineering initiative / project  
  • Employ standard change management tools and templates that support sustainable engineering change management activities. |
| Project Management             | • Engages a systematic and planned approach to project management  
  • Applies industry standard project management methods, processes, and tools  
  • Manages critical elements of a project plan to include scope, deliverables, schedule, resources, communications, finance, and risk  
  • Implement effective project measurement systems. |
| Leading Teams                  | • Engages methods and techniques to build trust, cooperation, and team affiliation among team members  
  • Engages methods and techniques to effectively work across organizational and cultural boundaries  
  • Establishes technical systems and structures to enhance the functionality and effectiveness of team activities. |
| Supply Chain & Logistics       | • Develop ability to build models to understand tradeoffs involved in design and operation of supply chains.  
  • Develop analytical and problem solving skills by integrating knowledge from different areas of operations research. |
| Production Systems Analysis    | • Understand production system modeling principles  
  • Understand performance analysis procedures and be able to use analytical tools  
  • Understand continuous improvement procedures and be able to carry out bottleneck analysis  
  • Understand lean buffer implications and design principles  
  • Understand system-theoretic properties of production systems. |
Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Student Achievements and Capabilities</th>
</tr>
</thead>
</table>
| Capstone Course: Design and Analysis of Manufacturing Systems | • Introduction to modern manufacturing strategies such as Lean Manufacturing and Quick Response Manufacturing; Implementing quick response in production; Tools for manufacturing system analysis; Lot sizing and capacity planning; Material planning and production inventory control; Supplier and Customer strategies; Quick response in Office Operations; Rapid new product introduction; Supply chain strategies for product variety.  
• Course will involve comprehensive industry case study assignments that will be used to illustrate practical treatment of theoretical concepts covered in class |

6.3 Student Degree Planning

This program will not use the cohort model: students can take courses in various sequences. The market assessment indicated that this program should be designed so that it can be completed in two years and would be completed by most students in three years. Therefore, the sample plan of study (Table 9) is structured into a two-year degree program. This plan assumes students take six terms (fall, spring and summer) for degree completion. The following student course plan outlines a hypothetical course progression.

Table 9: Sample 30-credit MEng with a Named Option in MSE Curriculum that can be Completed in Two Years

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Term 1</td>
<td></td>
<td>Fall Term 4</td>
<td></td>
</tr>
<tr>
<td>Sustainable Approaches to Complex Systems</td>
<td>4</td>
<td>Accounting Principles</td>
<td>3</td>
</tr>
<tr>
<td>Connected Learning and Digital Proficiency</td>
<td>1</td>
<td>Project Management</td>
<td>1</td>
</tr>
<tr>
<td>Creating Breakthrough Innovations</td>
<td>1</td>
<td>Leading Teams</td>
<td>1</td>
</tr>
<tr>
<td>Change Management</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring Term 2</td>
<td></td>
<td>Spring Term 5</td>
<td></td>
</tr>
<tr>
<td>Industrial Data Analytics</td>
<td>3</td>
<td>Supply Chain &amp; Logistics</td>
<td>3</td>
</tr>
<tr>
<td>Automation &amp; Robotics and Evaluating New Technologies</td>
<td>3</td>
<td>Capstone Course: Design and Analysis of Manufacturing Systems</td>
<td>3</td>
</tr>
<tr>
<td>Summer Term 3</td>
<td></td>
<td>Summer Term 6</td>
<td></td>
</tr>
<tr>
<td>Quality Engineering</td>
<td>3</td>
<td>Production Systems Analysis</td>
<td>3</td>
</tr>
</tbody>
</table>

6.4 Course Delivery

The MEng MSE named option is to be offered as a distance-learning program, using the software and methods previously developed and tested for the award-winning Master of Engineering programs as a baseline. The primary delivery mechanism is via asynchronous internet delivery, supplemented with weekly synchronous web conferences and discussion forums for each course.

The UW College of Engineering Moodle Platform or Desire2Learn (Learn@UW) can be used as a learning management system, as students can now access courses on either platform through their web-based course dashboard. A degree “portal,” or “community website” will also be

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3 Each student would not have an identical progression as a result of personal choices with regards to degree duration and courses per semester.
developed that will act as the single entrance site for students to access student services, technical support, and courses.

New students will be encouraged to attend an optional 1-day orientation program on campus offered in conjunction with orientation for the on-campus MS-MSE program. This program will be designed to help students get off to a strong start in the program, improving their success and retention. The orientation will also build student-student, student-instructor, and student-staff relationships, and will strengthen the bond between students and UW faculty and research. However, since many working students may be unable to attend this orientation, all relevant informational sessions will be recorded for distance review. As another element of our assessment plan, the student retention, time-to-degree and grades will be tracked between attendees and distance reviewers to determine whether this orientation program is effective in improving student performance and retention.

6.5 Faculty Plan

The instructors in Table 10 have been identified for proposed program courses and are in support of the program. Many of the instructors were also on the development committee.

Table 10. Proposed Course and Faculty Plan for MEng MSE Named Option

<table>
<thead>
<tr>
<th>No.</th>
<th>Course Topic/Title</th>
<th>Dept.</th>
<th>Course</th>
<th>Credits</th>
<th>Instructor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connected Learning and Digital Proficiency</td>
<td>EPD</td>
<td>705</td>
<td>1</td>
<td>Mark Millard</td>
</tr>
<tr>
<td>2</td>
<td>Creating Breakthrough Innovations</td>
<td>EPD</td>
<td>702</td>
<td>1</td>
<td>Business School</td>
</tr>
<tr>
<td>3</td>
<td>Industrial Data Analytics</td>
<td>ISyE</td>
<td>691</td>
<td>3</td>
<td>Shiyu Zhou</td>
</tr>
<tr>
<td>4</td>
<td>Sustainable Approaches to Complex Systems</td>
<td>OTM</td>
<td>770</td>
<td>4</td>
<td>Mark Finster</td>
</tr>
<tr>
<td>5</td>
<td>Automation, Robotics, and Evaluating New Technologies</td>
<td>ME</td>
<td>739</td>
<td>3</td>
<td>Mike Zinn, Neil Duffie, and TBD</td>
</tr>
<tr>
<td>6</td>
<td>Quality Engineering</td>
<td>EPD</td>
<td>518</td>
<td>3</td>
<td>Harry Steudel</td>
</tr>
<tr>
<td></td>
<td>Option 1: Quality Engineering and Quality Management</td>
<td>EPD</td>
<td>512</td>
<td>3</td>
<td>Kaibo Liu</td>
</tr>
<tr>
<td></td>
<td>Option 2: Inspection, Quality Control and Reliability</td>
<td>ISyE</td>
<td>575</td>
<td>3</td>
<td>Terry Mann</td>
</tr>
<tr>
<td>7</td>
<td>Accounting Principles</td>
<td>ACCT</td>
<td>300</td>
<td>3</td>
<td>John Wild</td>
</tr>
<tr>
<td></td>
<td>Option 1: Accounting Principles</td>
<td>EPD</td>
<td>611</td>
<td>3</td>
<td>Charles Krueger</td>
</tr>
<tr>
<td>8</td>
<td>Managing Change</td>
<td>EPD</td>
<td>700</td>
<td>1</td>
<td>Carl Vieth</td>
</tr>
<tr>
<td>9</td>
<td>Project Management</td>
<td>EPD</td>
<td>707</td>
<td>1</td>
<td>John Davis</td>
</tr>
<tr>
<td>10</td>
<td>Leading Teams</td>
<td>EPD</td>
<td>709</td>
<td>1</td>
<td>Business School</td>
</tr>
<tr>
<td>11</td>
<td>Supply Chain &amp; Logistics</td>
<td>ISyE</td>
<td>691</td>
<td>3</td>
<td>Ananth Krishnamurthy, Leyuan Shi</td>
</tr>
<tr>
<td>12</td>
<td>Production Systems Analysis</td>
<td>ISyE</td>
<td>615</td>
<td>3</td>
<td>Jingshan Li</td>
</tr>
<tr>
<td>13</td>
<td>Capstone Course: Design and Analysis of Manufacturing Systems</td>
<td>ISyE/ME</td>
<td>641</td>
<td>3</td>
<td>Ananth Krishnamurthy</td>
</tr>
</tbody>
</table>

EPD offers a unique model for new instructors and online course development designed to provide an exceptional level of support. Faculty will receive up to one month of funding from
EPD for developing new courses or adapting campus courses to the online delivery method used in the MEng MSE named option curriculum: typically used in the summer. In addition to financial support, faculty will be provided with instructional design and technical support for developing materials before and after instruction. As an additional benefit, participating faculty will have unrestricted use of all online course materials, enabling their use for on-campus instruction.

Figure 1 shows the revenue sharing model used for online courses offered in the College of Engineering (CoE). This revenue sharing follows the established CoE Credit Courses at a Distance revenue sharing model, which assumes that one quarter (25%) of the tuition revenue generated by graduate students enrolled in this program will be returned directly to the department and instructors teaching courses, to be distributed at their discretion. Another 25% will be used to provide partnering faculty with instructional technology and support, student services, and teaching assistance. 10% is returned to campus as required for 131/non-pooled programs, and 15% will be allocated to the College of Engineering to support the development of future CoE distance learning initiatives. The remaining 25% will be used to support the administration of the MSE program with marketing, academic director compensation, and website support (Figure 1).

![Figure 1. Revenue Sharing Model between the Manufacturing Systems Engineering Program, EPD, Faculty and Student Services.](image)

6.6 Student Services

Proactive and highly responsive student services are critical to the success of online degree programs. It is essential that from a prospective student’s first inquiry, through application, admission, and their entire program of academic study, students feel personal attention to their interests and needs. In an online environment, students who feel isolated, frustrated, or
unsupported will fail to complete courses or will readily transfer to another program. Keeping students engaged, progressing, and confident that their learning goals are being met is critical to student success and to the viability of the program itself.

Meeting the student services needs of the MEng MSE named option students will require a well-coordinated effort between EPD and MSEP. EPD, as the College’s lead department in outreach to practicing engineers, will have lead responsibility for design and coordination of student services for the proposed program. Student services provided directly by EPD will include:

- communications with prospective students
- assisting applicants with admission
- leading review of applications by a program admission committee of EPD and MSEP faculty
- coordination of student issues with the Graduate School, Financial Aid, Registrar, and other campus offices
- coordination with library services from Wendt Commons, computer-related services from Computer-Aided Engineering, and other resources as needed
- ensuring students with special needs have access to needed services (e.g., McBurney Center)
- ensuring that students have adequate and timely documentation to secure tuition reimbursement from employers
- assisting students with course registration
- instructional technology support, including effective and efficient use of online tools used in program courses.

MSEP will take the lead in academic advising, including:

- helping students choose a plan of study to meet their learning goals;
- determining the acceptability of prior credits students desire to transfer and use toward meeting degree requirements
- determining the suitability of alternative courses at UW or other universities to meet program requirements
- helping MEng MSE named option students connect with relevant teaching and research resources within the College of Engineering (e.g., seminars, research projects, student groups, faculty and students with similar project interests)

7.0 COLLABORATIONS AND PARTNERSHIPS

This program is supported by multiple groups. In addition to EPD and MSEP, the Department of Mechanical Engineering, Department of Industrial and Systems Engineering, College of Engineering and the Wisconsin School of Business support this project.
8.0 ENROLLMENT PROJECTIONS

8.1 Anticipated Affect on On-Campus Enrollment

The new online MEng degree in Engineering: Named Option Manufacturing Systems Engineering is not anticipated to have a significant affect on the enrollment in the on-campus M.S. degree in Manufacturing Systems Engineering. Existing enrollment data from MSEP and EPD suggest that the students enrolled in the on-campus and online programs in Mfg. Sys. Engr. will have different demographics (see Sec. 2.2). The majority (greater than 80%) of the students enrolled in the on-campus degree are international students seeking a full emersion in the U.S. academic system, culture, and immediate access to internships, co-ops, and full-time employment in U.S. companies. None of the 210 students enrolled (Fall 2014) in the seven online Master of Engineering and Master of Science degree programs from the College of Engineering hailed from outside the U.S. The majority of the online students in the M.Eng. in Engineering: Named Option Manufacturing Systems Engineering are anticipated to be domestic engineers who have been working for 2 to 5 years and want a masters education without having to quit their job and move their family.

8.2 Anticipated Online Enrollment

Based on the results of EPD’s market survey and our experience with existing online Master of Engineering options, we project that the MEng MSE named option enrollment will consist of a mix of early to mid-career engineers studying at a distance. These will be students who would be unlikely to resign their jobs and move to Madison to pursue a graduate degree.

The program anticipates matriculating 15 students in its first year. Enrollment in subsequent years is assumed to be 25 new students per year. These Base Case levels are “reasonable estimates” based on experience to date with other CoE distance degree programs. Enrollment targets will be set higher (30+) and if achieved, will substantially improve program financial performance.

The program is assuming it will achieve 90% retention and successful degree completion by matriculated students. EPD experience with existing online degree programs has demonstrated that this retention rate is achievable with high-quality courses and proactive student services.

9.0 BUSINESS PLAN

As part of the feasibility study completed by EPD, a Business Plan was developed to examine the financial viability of the proposed program and explore the required logistics, program management, and program support needed to achieve a high-quality, sustainable program that delivers strategic benefits to MSEP, EPD, the College of Engineering, the Division of Continuing Studies, and the UW-Madison campus.
The program will require substantial investment in the early years as course development proceeds and enrollment builds. The following assumptions were considered when building a Base Case for revenue and expenses:

- proposed flat rate tuition of $1600 per credit (highest anticipated tuition tier)
- majority of students will enroll in 9 credits/year (roughly three years to graduation)
- anticipated enrollments of 25 new students per year by year three
- revenue distribution according to the current tuition revenue sharing model
- EPD Program Director at 25% appointment for administrative and marketing management
- MSEP Program Director at 25% appointment for online program support
- 12.5% appointment for an additional MSEP program associate, in addition to EPD 10% appointed program associate

Using these assumptions, the anticipated negative cash flows last for the first two years after approval and break even by the third year of student enrollment. Steady-state operations are net positive (Figure 2). Program marketing may also be able to improve financial performance beyond the Base Case by achieving higher than budgeted enrollment from a growing national market.

![Figure 2: Projected Revenues and Expenses](image-url)
APPENDIX A

Letters of Support
March 20, 2015

Frank Pfefferkorn, Associate Professor  
Director, Manufacturing Systems Engineering Program  
Department of Mechanical Engineering (Rm 1031, Mech Eng Bldg)  
College of Engineering  
University of Wisconsin-Madison

Dear Professor Pfefferkorn:

I am writing to communicate support from the Wisconsin School of Business for the development and offering of a new online program in Master of Engineering – Manufacturing Systems Engineering (MSE). We are pleased that the contributed distance learning-ready course OTM 770 *Sustainable Approaches to Complex Systems*, taught by Professor Mark Finster in our OIM department, is included in the curriculum. This course will help prepare engineers to apply improvement techniques within the context of complex systems, and to understand the relationships between sustainability and quality, cost, and value in the engineering design of processes. We also support the inclusion of Accounting 300, which offers an entirely on-line delivery aimed at students outside the School of Business.

Our support for the current curriculum is premised on Prof. Mark Finster continuing to offer OTM 770. Should – at some point in the future – that no longer be the case, we would need to open discussions about whether the OIM department (or another department in our school) will continue to offer a sustainability-oriented online course that fits the MSE program.

Sincerely,

Larry W. Hunter  
Senior Associate Dean

xc: James Morris  
Chair, Department of Operations and Information Management

Terry Warfield  
Chair, Department of Accounting and Information Systems
March 17, 2015

To: Frank Pfefferkorn  
Program Director, Manufacturing Systems Engineering Program

From: Phil O’Leary, Department Chair  
Wayne Pferdehirt, Chair, EPD Curriculum Committee

Subject: EPD Support for Master of Engineering New Named Option in Manufacturing Systems Engineering

We are writing to formally convey the support and partnership of the Department of Engineering Professional Development (EPD) in development of the proposed Master of Engineering option in Manufacturing Systems Engineering.

EPD has appreciated the opportunity to work as part of the team to explore development of this new online degree program. We believe this new program show strong market interest, aligns well with College of Engineering research and instruction strengths, and offers synergies with the College’s strategic initiatives in advanced manufacturing.

The EPD Curriculum Committee voted unanimously to express its support for the proposed program at the Committee’s February 25, 2015 meeting.

EPD looks forward to working with you and associated faculty and staff in developing the new program and making it a valuable addition to the College of Engineering’s online graduate degree offerings.
March 15, 2015

Frank Pfefferkorn  
Associate Professor, Department of Mechanical Engineering  
Director, Manufacturing Systems Engineering Program  
University of Wisconsin - Madison  
1031ME, 1513 University Avenue  
Madison, WI 53706-1572

Dear Professor Pfefferkorn,

The Department of Industrial and Systems Engineering voted unanimously (16 in favor, zero opposed or abstaining) to support the development of a new online Master of Engineering in Manufacturing Systems Engineering. Several of our faculty would be happy to participate in the program (providing coursework in areas such as data analysis, quality engineering, and manufacturing and production systems), pending availability of sufficient resources to accommodate the additional students, and at the discretion of the department.

This program will complement our existing degree programs. Since the target students are practicing engineers unable to come to campus for graduate study, the program will provide our department with new students and new sources of connection to industry.

We appreciate the anticipated support of the Department of Engineering Professional Development in the areas of instructional design and delivery for teaching in a virtual learning environment. We are convinced that our department’s participation in this important effort will deliver strategic advantages to the College, to the University of Wisconsin, and most importantly to our students, their employers, and society at large.

We look forward to moving ahead with you and the other departments involved in this endeavor.

Sincerely,

Vicki Bier, PhD  
Professor and Chair
March 2, 2015

Frank Pfefferkorn  
Director, Manufacturing Systems Engineering Program  
Department of Mechanical Engineering  
1031ME, 1513 University Avenue  
Madison, WI 53706-1572

Dear Prof. Pfefferkorn,

It is my pleasure to provide this letter confirming the Department of Mechanical Engineering’s strong support for the development of a new Masters of Engineering in Manufacturing Systems Engineering degree option that will be delivered exclusively online. We believe this initiative will provide working engineers with the opportunity to expand their critical skills in the manufacturing area. These skills encompass an array of important areas of engineering, including those of Mechanical Engineering.

This program will complement our existing degree programs. Because the target students are practicing engineers unable to come to campus for graduate study, it will provide our faculty new connections to industry and expand the reach of the university beyond the boundaries of the state.

We appreciate Engineering Professional Development’s partnership in this endeavor through their assistance with instructional design, funding of teaching assistants, and the delivery support for teaching in a virtual learning environment. The cooperation between our two departments in this important and timely effort will deliver strategic advantages to the College, University, and most importantly to the students, their employers, and society at large.

We look forward to moving ahead with you in this endeavor.

Sincerely,

Jaal Ghandhi  
Professor and Chair
From: Frank E. Pfefferkorn  
Director  
Manufacturing Systems Engineering Program  
College of Engineering


I have been the director of the Manufacturing Systems Engineering Program at the University of Wisconsin-Madison since July 2012. My first objective was to develop and create and offer a Manufacturing Systems Engineering degree through an online instructional platform – greatly enhancing our ability to support practicing professionals in the manufacturing sector. I immediately partnered with the Department of Engineering Professional Development and engaged the MSE Program’s Executive Committee. On 4 December 2013 the Manufacturing Systems Engineering Program’s Executive Committee approved the plan for creating a new fully-online Master of Engineering named option in Manufacturing Systems Engineering.

The Manufacturing Systems Engineering Program has developed this proposal for a new degree option that is a collaborative effort with the Department of Engineering Professional Development. The proposed new program is a named option to be offered under the existing Master of Engineering (MEng), Engineering major degree. The proposed named option is in Manufacturing Systems Engineering. The proposed Manufacturing Systems Engineering named option is a fully-online degree program whose academic home will be the Department of Engineering Professional Development (EPD) with its curricular content governed by the Manufacturing Systems Engineering Program (MSEP).

If you have any further questions about the proposed program please do not hesitate to contact me.

Sincerely,

Frank Pfefferkorn, Ph.D.  
Associate Professor, Department of Mechanical Engineering  
Director, Manufacturing Systems Engineering Program  
(608) 263-2668  
frank.pfefferkorn@wisc.edu
APPENDIX B

Approval Checklists

UW-Madison Requirements and Process for Academic Programs with Non-Pooled Tuition
Revised March 28 2015
APPENDIX A. CORE CRITERIA CHECKLIST
FOR ACADEMIC PROGRAMS WITH NON-POOLED TUITION

1. New and Additional Student Enrollments to Support Program Costs
   ✓ The program must bring in NEW and ADDITIONAL students. Overall enrollment in all other school/college programs must not be eroded. The program cannot compete with or draw students away from existing programs that support the central tuition pool.
   ✓ Faculty/staff must plan for sufficient enrollments to have enough tuition to cover instructional, direct student support costs, and any other fixed or required costs. Experience shows that enrollments of at least 30 students are necessary to have enough tuition to meet direct program costs.
   ✓ School/college Budget Officers must be involved in planning and must approve plans and budgets for these programs before the program is submitted to the school/college APC for academic approval.

2. Designed for Non-Traditional Students
   ✓ Has an applied, practice-oriented curriculum, or integrates practice with theory
   ✓ Is offered in a modality that allows non-traditional audiences to attend (evening, weekend, online, intensive, or some combination)
   ✓ Has demonstrated a workforce demand for the program graduates
   ✓ Has defined learning goals that are oriented to market considerations
   ✓ Has a clearly defined curriculum that is “self-contained”, meaning that program students are confined only to courses from the approved, prescribed curriculum
   ✓ Has a clearly defined (often lockstep) curriculum with few options or electives that follows a predictable timeline for offerings and completion

3. Distinctly Identifiable Program (Code) With Governance Approval
   ✓ The program must be distinctly identifiable in the student record system, either as a degree/major or as an option of a degree/major, or as a Capstone certificate.
   ✓ The program must develop a proposal for the academic approval process, during which it must demonstrate that the school/college Dean and Budget Officer are aware and supportive of the program being run on a non-pooled tuition model.
APPENDIX B. ADDITIONAL REQUIREMENTS CHECKLIST
FOR ACADEMIC PROGRAMS WITH NON-POOLED TUITION

Use this checklist in conjunction with the Core Criteria Checklist

If core criteria are met, the program must adhere to the additional requirements below.

Note: Not all new programs are suited for the non-pooled program requirements. New programs that seek to take advantage of a wide range of course and curricular/program offerings on campus and are not market-oriented should be developed under traditional (101) pooled tuition funding models.

1. Fiscal Requirements:
   - School/college budget officer has approved the budget and fiscal plan.
   - School/college dean and budget officer are committed to assuming fiscal responsibility for costs not covered by non-pooled tuition to the program. The school/college will back up the budget with a commitment to cover any costs not met from tuition from other sources.
   - The program structure fits within standard academic administrative structures and allocates expenses of the program so that the program does not create additional burdens on traditional/101 program resources or student services such as advising, ESL, Registrar’s Office, Bursar’s Office, Graduate School and other support services.
   - Programs have two options for tuition. One option is to charge standard graduate tuition according to the UW-Madison tuition schedule. This includes standard rates for WI resident, MN, and non-resident students and any compulsory fees that apply. Or, for fully online programs, they have the option of charging all students one of tuition tiers (Appendix D). Although not currently allowed, it is potentially possible in the future the tiered tuition may be available to face-to-face programs.
   - Because students who have graduate assistantships receive tuition waivers, some non-pooled tuition graduate degree programs choose to prohibit students from accepting a graduate assistantship (RA/TA/PA). If a program allows their students to take graduate assistantships they/it must forgo the tuition revenue. To ensure full receipt of non-pooled tuition and to counter challenges from students, the program must adhere to the following:
     - The program faculty/staff must disclose this program policy to students in the recommendation of admission letter, program website, program handbook, and program orientation.
     - Please see Appendix E for links and Appendix F for a sample of a specific non-pooled program template for a recommendation of admission letter and a
general template for a program handbook. The program faculty/staff must provide details on this and any other program policies the program handbook in at least the following areas: satisfactory progress (good standing) requirements, any ways to return to good standing, and a program grievance process if done does not already exist.

2. **Requirements for International Students:**

   ✓ Programs may not admit students who need ESL services without building sufficient ESL support into their fiscal model, and having an explicit MOU with the ESL provider about funding to support the ESL services.

   ✓ Graduate degree/major programs must use Graduate School standards for English Proficiency. Capstone certificates should be designed so that admission requirements ensure that ESL support is not needed.

   ✓ If the program is NOT completely online and admits international students, the program is responsible for honoring federal visa regulations related but not limited to: length of stay requirements for visa requests, online course restrictions for visa holders, and waiting for federal program approval (up to a year) if the program represents a new degree type or capstone certificate previously not offered at UW-Madison.

3. **Requirements for Program/Course Enrollment:**

   ✓ Non-pooled tuition program students can only be enrolled in one program at a time; enrollment in a second major, named option, certificate program, or courses beyond the prescribed program curriculum is not permitted. Non-compliance with this requirement will jeopardize the receipt of tuition for a non-pooled program. Regular audits will be conducted to ensure these requirements are met.

   ✓ To ensure full receipt of non-pooled program tuition and to counter challenges from students who want to be dually enrolled, the program must adhere to the following:

     ✓ The program must provide information to students about prohibitions on concurrent program enrollment and out-of-program course enrollment. Programs must note this in recruiting materials, in recommendations of admission, on the program website, program handbook, and program orientation.

     ✓ Please see Appendix E for links and Appendix F for language for a specific non-pooled program template for a recommendation of admission letter and a general template for a program handbook. The program faculty/staff must provide details on this and any other program policies in the program handbook in at least following areas: satisfactory progress (good standing) requirements, ways to return to good standing, and a program grievance process if one does not already exist.
✓ The program communicates to students each semester prior to course enrollment the expectation that students can enroll only in program courses and not in courses outside the approved, prescribed curriculum.
✓ For students who enroll in the non-pooled program and then decide they want to pursue traditional/101 programs that allow dual enrollment, the program must help the student transfer to a different program(s) that allow such activity.
APPENDIX C. IMPLEMENTATION CHECKLIST
FOR ACADEMIC PROGRAMS WITH NON-POOLED TUITION

Review compliance with core criteria and additional criteria outlined for all non-pooled programs before proceeding with this implementation checklist.
All three checklists should accompany the academic proposal when it is submitted to the Provost and Dean of the Graduate School and Provost for approval by GFEC and UAPC respectively.
The checklist will be reviewed again at the implementation meeting.

1. **Program description:**
   ✓ Program Name: Manufacturing Systems Engineering
   ✓ Department/Academic Unit Home: Department of Engineering Professional Development
   ✓ School/College: College of Engineering
   ✓ Type of Program (Capstone, Master’s degree, Master’s degree option, Other): named option under Master of Engineering (MEng), Engineering major degree
   ✓ Mode of Delivery - Face-to-Face or Online : 100% Online
   ✓ Format of Delivery – compressed, evening/weekend, part-time, other: Online
   ✓ Start Dates
     a. Accept applications: [projected] Spring 2016
     b. Enroll students: [projected] Fall 2016
     c. Web content is live: [projected] Summer 2016
   € Program handbook is complete: No
   ✓ Non-pooled program leadership:
     d. Program Faculty Director: Frank Pfefferkorn (ME, MSEP)
     e. Program Coordinator: Wayne Pferdehirt (EPD)
     f. Other key staff who will need to be included in communications: Carl Vieth (EPD), Phil O’Leary (EPD), Gary Henderson (EPD)

2. **Fiscal Basics**
   ✓ If the program is face-to-face, the program charges standard graduate tuition according to the UW-Madison tuition schedule.
   ✓ If the program is on-line, the program has selected ONE of the available tuition tiers for per credit tuition. Selected per credit tuition rate: $1,600/credit
   ✓ The program tuition has NO non-standard features.
   € The program faculty/staff and school/college budget officer have completed the “item type” form.
Planed enrollment generates enough paid tuition to cover instructional costs, direct student support costs, and any other fixed or required costs. Although detailed fiscal plans are not required in the academic program proposal, it is helpful to provide the following summary:

**Fiscal Annual Summary**
Planned enrollment: 25 per year (matriculating 25 students per year)
Est paid tuition: $1,000,000 (at steady state: Fig. 2 on Page 20)

Core Instructional costs:
Direct student support costs:
Overhead assessment/allocation:
Total costs: approximately $510,000 (at steady state: Fig. 2 on Page 20)

Excess tuition available for reinvestment: $490,000 (at steady state: Fig. 2 on Pg. 20)

Briefly list planned reinvestment uses:
- Development of new distance learning degrees in engineering
- Development of new distance learning courses in engineering
- Improvement of distance learning courses in engineering

### 3. Administrative Basics – This section will be completed by APIR and Graduate School Staff
- The program has been approved by the school/college governance process. Date:
- The program has been approved by the Graduate Faculty Executive Committee. Date:
- The program has been approved by the University Academic Planning Council. Date:
- Program Code/Name Specifics
  - Program Name:
  - Plan Code:
  - Subplan Code (if applicable):
  - Effective date for first enrollment:
  - Nontraditional?
  - Online/Distance?
  - Educational Innovation?
- Program has provided content for the Graduate Catalog including details for their “Satisfactory Progress and Program Requirements” chart
- Program has provided content for the Graduate School website and the campus Career Portal