Executive Summary

March 4, 2015

The Master of Global Engineering Leadership Graduate Studies Committee (MGELGSC) unanimously approved the proposal to add Radar Systems as a new technical track offering by the Electrical and Computer Engineering department. The Radar Systems technical track will consist of four, three credit hour courses for a total of twelve credit hours. This meets the program requirements that each technical track consist of 11-13 credit hours.

For questions contact either:

Bob Mick
Director of Professional Programs
Mick.15@osu.edu
614-292-0393

Dr. Avraham Benatar
MGEL Faculty Director
Benatar.1@osu.edu
614-292-1390

Master Global Engineering Leadership Graduate Studies Committee Members

Dr. Avraham Benatar	Materials Joining Track Coordinator
Dr. Trevor Brown	John Glenn School of Public Affairs
Dr. Yann Guezennec	Automotive Systems Engineering Track Coordinator
Bob Mick	College of Engineering
Dr. Rajiv Ramnath	Enterprise Services &Architecture Track Coordinator
Dr. Beth-Anne Schuelke-Leech	John Glenn School of Public Affairs

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Master Global Engineering Leadership (MGEL)
New Technical Track Proposal:
Radar Systems

Providing Radar Systems Expertise for Engineering Professionals

Rationale:

The Master Global Engineering Leadership (MGEL) technical track in Radar Systems will provide post graduate training in radar systems engineering to enhance the global engineering leadership training of participants. Students in the track are expected to be drawn from:

- Engineers in business and industry
- Public or private sector employment
- Mid-career retraining
- PhD training
- Those who want either or both a broad understanding and technical depth

The department of Electrical and Computer Engineering (ECE) has a long history in teaching and research in and around the subject of radar systems. The state of Ohio has a considerable investment in sensors generally and radar specifically representing a 2.5 billion dollar industry. Extensive radar systems activity at Wright Patterson Air Force Base and the need for training a large personnel base in the area further motivate this proposal.

An MGEL track with specialization in radar systems is consistent with the College's land grant mission for engineers who want to be able to respond to rapidly changing technical and global conditions and to accelerate their careers in industry or the public sector. The radar systems track will prepare professionals in radar systems engineering, equipping them to play key roles in innovative and challenging technical projects within their organizations. The courses offered are designed to enable students to be equipped with all the necessary knowledge to enable them to play a leading role in research and development in industrial and government institutes. Graduates will be equipped to advance to technical leadership positions through the effective application of their technology, analytical and radar system design skills.

Admission Requirements:

Beyond the standard MGEL admission requirements, student in the track are required to have completed their undergraduate training in electrical and computer engineering, or to have past experience with radar systems development.

Structure and Curriculum:

The MGEL Radar Systems technical track will consists of four courses at three credit hours each for a total of twelve credit hours. This meets the program requirement that each technical track consist of 11-13 credit hours and enabling MGEL students to meet the required number of credit hours to graduate from the degree program.

Engineers who complete the MGEL track in Radar Systems will:

- be current in the latest radar systems engineering knowledge and related advances
- be equipped with the technical tools to tackle advanced radar problems
- be able to apply knowledge more effectively toward new innovations and directions
- be able to recognize and address the impact and importance of global radar developments
- know how to communicate technical material to both technical and nontechnical audiences
- be able to lead technical teams and projects

Courses

5010: Wireless Propagation and Remote Sensing: (3) cr hrs Practical methods for predicting tropospheric, ground wave, and ionospheric propagation, including refraction, reflection, and extinction effects. Study of remote sensing systems and their applications. Prereq: 3010 (312), or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

5011: Antennas: (3) cr hrs Electromagnetic radiation; fundamental antenna parameters; dipole, loops, patches, broadband and other antennas; array theory; ground plane effects; horn and reflector antennas; pattern synthesis; antenna measurements. Prereq: 3010 (312), or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

5013: An Introduction to Radar Systems: (3) cr hrs Introduces the fundamentals of radar such as the main concepts and techniques used in modern radar systems. The class is a survey course exposing students to a wide range of radar applications and design issues. Prereq: 3050 (352), and 3010 (312) or 3010.01, and Stat 3470 (427); or Grad standing in Engr.

5206: Medical Imaging and Processing: (3) cr hrs Introduction to medical imaging techniques (CT, MRI, PET, ultrasound), including data collection, image reconstruction, physics of tissue interactions, and digital processing of medical images. Prereq: 3050 (352). Prereq or concur: 3090 or 582, or Grad standing in ECE, BiomedE, or Biophys.

Note on Medical Imaging and Processing Course:
Medical and radar imaging are based upon similar principles, constructing high resolution pictures from multiple measurements, compensating for unwanted motions and using the same mathematical toolsets through advanced digital signal processing techniques. Consequently, medical imaging is a course regularly taken (often under advisor recommendation) by those studying radar who are able to benefit from both the direct and indirect relationships that unite these disciplines.

Prerequisites
The prerequisites for this specialization track are the same as those listed in each course.

Faculty Teaching Technical Track Courses
Dr. Chris Baker - An Introduction to Radar Systems
Dr. John Volakis - Antennas
Dr. Brad Clymer – Medical Imaging and Processing
Dr. Fernando Teixeira – Wireless Propagation and Remote Sensing

Delivery:
All courses will be offered 100% online but will also be taught simultaneously with (at least for initial offerings) on-campus sections. Online processes will be developed in conjunction with ODEE instructional designers, including options for remote presentation of projects required in the courses. All of these courses are already taught using electronic presentation materials, and ECE 5206 offerings already include videotaping of lectures.

Program Administration and Support:
Prof. Chris Baker will serve as the track coordinator, and will serve as the lead POC for college MGEL personnel. Administrative issues related specifically to track courses will be addressed by existing ECE support staff. Additional funds as required (expected to be minimal given existing distance learning equipment already available) will be identified from ECE department sources.

Commitment and Letters of Support:
ECE GSC
ECE Chair
AFRL

Department of Electrical & Computer Engineering

Prof. Andrea Serrani
Chair of Graduate Studies
412 Dreese Laboratory
2015 Neil Avenue
Columbus, OH 43210-1272

Phone (614) 292-4976
Fax (614) 292-7596

October 27, 2014

Bob Mick
Director of Professional Programs
The College of Engineering
165 Hitchcock Hall
2070 Neil Avenue
Columbus, OH 43210

Cc: Prof. Joel T. Johnson
Chair, Department of Electrical and Computer Engineering
205 Dreese Labs
2015 Neil Avenue
Columbus, OH 43210

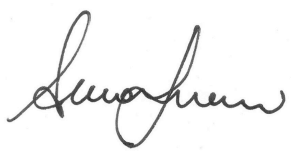
Dear Bob,
The Graduate Studies Committee has reviewed the Proposal for a Radar Systems Track within the Masters of Global Engineering Leadership (MGEL) program, submitted by Prof. Chris Baker.

After careful examination of the documentation submitted to the Commitee, and throrough evaluation of the admission requirements and the proposed curriculum, the Committee has expressed its full, unanimous and enthusiastic support to the proposed track. In particular, the Commitee recognizes the strategic importance of a Radar Systems Track within the MGEL, in the light of longstanding synergetic collaborations between the Department of Electrical and Computer Engineering (especially, the ElecroScience Lab) and various industrial partners and governmental institutions (particularly, the Air Force Research Laboratories at Wright-Patterson AFB.) The Commitee also praises the specific selection of the courses within the track, which provide both breath and depth in the curriculum, as well as the choice of Prof. Baker as Track Coordinator.

Please, do not hesitate to contact me, should additional information become necessary.

Sincerely,

Andrea Serrani
Professor and Graduate Studies Chair



THE OHIO STATE UNIVERSITY

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johnson.1374@osu.edu

November 5th, 2014

Bob Mick
Director of Professional Programs
The College of Engineering
165 Hitchcock Hall
2070 Neil Avenue
Columbus, OH 43210

Dear Bob,

I am writing to express my support for the proposed Radar Systems Track within the Masters of Global Engineering Leadership (MGEL) program. The Department of Electrical and Computer Engineering has identified graduate level distance learning as a high priority strategic initiative, and the Radar Systems Track represents an important step toward our goals. We believe the track will experience strong support due to the Department's international reputation in radar systems and our strong partnerships with industry and government in this area.

Please feel free to contact me if you require any additional information.

Sincerely,

Joel T. Johnson
Professor and Department Chair
Electrical and Computer Engineering

From: SCHNEIDER, STEPHEN W ST-00 USAF AFMC AFRL/RY
To: Volakis, John
Cc: Mick, Robert
Subject: MGEL in Radar Systems
Date: Tuesday, July 29, 2014 7:29:55 PM

Dear OSU Masters in Global Engineering Leadership Program:

I am writing to express my personal support for the creation of a Radar Systems track in the Masters of Global Engineering Leadership (MGEL) program as proposed by the Department of Electrical and Computer Engineering. I first learned of the prospects for this program during discussions with Professor John Volakis and was immediately interested as it provides an opportunity to ensure/enhance the competency of our workforce in this area of critical interest to the Air Force Research Laboratory (AFRL) well into the future.

Obtaining qualified personnel who are well trained in radar systems engineering is a significant challenge and there are few/no universities that offer a tailored curriculum to teach the necessary background/skills/expertise required to contribute to this relevant area. I have long been interested in establishing a radar systems focused masters level training program to meet these needs and a program at The Ohio State University that provides distance education to our personnel located in Dayton, and at other AFRL locations is of great interest. Since many of our personnel perform both technical and project management functions, the MGEL is particularly attractive as it provides a combination of leadership and engineering education.

I expect that a good number of AFRL personnel would jump at the opportunity to participate in this program offered at one of the nation's premier institutions. Knowing the quality of education delivered at The Ohio State University by professors/researcher prominent in this field, I will definitely recommend it to my colleagues.

Please feel free to contact me if you have questions about these recommendations.

Sincerely,

Stephen W. Schneider, Ph.D., ST
Chief Scientist (Act'g), Sensors Directorate
Air Force Research Laboratory

office 937/528-8831
cell 937/212-2788

THE OHIO STATE UNIVERSITY

A Proposal for a Professional Master's Degree of Global Engineering Leadership

The Ohio State University

From the
College of Engineering at
The Ohio State University
In partnership with the
John Glenn School of Public Affairs

September 2013

For questions contact:

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Master of Global Engineering Leadership

Executive Summary

The proposed Master of Global Engineering Leadership (MGEL) is a professional degree aimed at practicing engineers seeking to increase their management and leadership skills along with their technical expertise in today's rapidly changing global business environment. The MGEL degree will prepare professionals in engineering disciplines to effectively lead innovative or challenging technical projects within their organizations. Its integrated curriculum of business, public policy, engineering and professional skills is designed to provide technical leadership and critical thinking skills to allow the graduate to operate at the interface of engineering, technology, science, and business in service to society. A multi-term integrative project develops applied skills while at the same time creating an understanding of the relevance of individual projects to the larger context of both the organization and the global business and public sector environments. Graduates will be equipped to advance to technical leadership positions through the effective application of their technical, analytical, management and communication skills. The program is designed for working professionals and delivered completely online with the exception of one-day on campus sessions for orientation and graduation.

Master of Global Engineering Leadership

I. Introduction and Overview

The College of Engineering (CoE) at The Ohio State University (OSU), in partnership with the John Glenn School of Public Affairs and in collaboration with Fisher College of Business faculty and instructors propose a new professional master's degree in Engineering. The curriculum proposed will provide essential skills and experiences at the graduate level for practicing engineers to allow them to respond to the challenges of the 21st century.

a) Designation

The degree will be called the Master of Global Engineering Leadership (MGEL).

b) Rationale

The proposed degree is a professional degree at the post-baccalaureate level aimed at practicing engineers. It is not a research degree (and thus the Master of Science degree is not appropriate) and it does not fit into any existing master's degree program at The Ohio State University. The title Master of Global Engineering Leadership is intended to convey both the technical aspects of an engineering degree and the equally important management and leadership skills necessary to succeed in a global environment that is changing rapidly in technical areas as well as in economic, social and political domains.

The target audience for the MGEL degree is engineers in business, industry and government who have worked in the field for five to ten years. More recent graduates will also be considered for the program based on their qualifications and experience, but the focus is on early to mid-career engineering professionals. Prospective students may be employed in either the public or private sectors (for profit or non-profit). They aspire to benefit their organizations through both technical and management skills, to become familiar with the international ramifications of their work and to become leaders and innovators within their organizations. Their personal goals include gaining technical leadership skills, enhancing their flexibility, practicing life-long learning and improving their competitiveness in the global marketplace.

The objective of this advanced engineering degree program is to provide technical and leadership skills to help engineers succeed in the 21st century's global environment. In the words of the National Academy of Engineering[1], we will educate "…engineers who see themselves as global citizens, who can be leaders in business and public service, and who are ethically grounded."

A variety of professional bodies in Engineering have called for the development of leadership skills among engineers, including the National Academy of Engineering and the Accreditation Board for Engineering and Technology (ABET).

[1] National Academy of Engineering. 2004. The Engineer of 2020; Visions of Engineering in the New Century. Washington, DC: The National Academies Press, p. 5.

The OSU College of Engineering's (CoE) Performance Plan of 2006 was also influenced by the National Academy of Engineering's report, The Engineer of 2020[2], and its call for life-long learning and more professional skills in the engineering curriculum. The current CoE Strategic Plan explicitly calls for the development of this new degree. The time since the Performance Plan was first written has been spent in designing the MGEL.

The MGEL serves the College's land grant mission by providing engineers who can work in interdisciplinary and international teams to respond to rapidly changing technical and global conditions. It is intended for engineers who want to accelerate their careers in industry or the public sector and be better prepared for the inevitable challenges they will face in the evolving global environment. Our research (discussed below) indicates that industry, alumni and students support this degree program. We agree that "Challenges will abound, but opportunities also will exist if engineering takes the initiative to prepare for the future"[2] and we intend this degree as part of the College's response to these challenges.

c) Purpose, Focus and Significance

The purpose of the Master of Global Engineering Leadership degree is to prepare professionals in engineering disciplines to effectively lead innovative or challenging technical projects within their organizations. Its integrated curriculum of engineering and professional skills is designed to provide technical leadership and critical thinking skills to allow the graduate to operate at the interface of engineering, technology, science, and business in service to society. A multi-term integrative project develops applied skills while at the same time creating an understanding of the relevance of individual projects to the larger context of both the organization and the global business and public sector environments. Graduates will be equipped to advance to technical leadership positions through the effective application of their technical, analytical, management and communication skills.

The MGEL curriculum has been carefully designed to deliver knowledge in the most flexible and effective ways for working professionals. The delivery mechanisms are crucial to the structure and quality of the degree and will be discussed further below.

The MGEL's integrated professional core and technical track structure has several significant distinguishing characteristics. It:

- integrates business, policy, global issues and technical knowledge into the core,
- provides a strong technical focus through the specialization tracks,
- provides an optional international experience,

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[2] National Academy of Engineering. 2004. The Engineer of 2020; Visions of Engineering in the New Century. Washington, DC: The National Academies Press NAE, The Engineer of 2020, p. 4.

- requires a multi-term integrative project to bring technology and professional skills together,
- is delivered with a focus on the best pedagogical practices and flexibility for working students by using the College of Engineering's experience in distance delivery and the Fisher College of Business's model of intense delivery for experienced professionals. This intense online delivery mode is significant and crucial to the MGEL's purpose and focus.

Engineers who complete this curriculum will:

- be current in the latest engineering knowledge and related advances in their selected technical fields;
- be able to apply knowledge more effectively in innovative directions;
- recognize and address the impact and importance of global trends in their fields;
- know how to communicate with both business and technical specialists;
- be able to apply the fundamentals of managerial accounting to manage projects to success;
- be trained to successfully lead technical teams in a global and international setting;
- be able to lead technical teams and projects in the context of their enterprise's overall strategic mission, whether in the public or private sector;
- recognize the important aspects of business-government relations for their organizations;
- understand intrapreneurship and entrepreneurship to advance new products and services.

The Ohio State University's Master of Global Engineering Leadership degree will offer students an innovative technical education linked with professional skills via an integrative technical project. The technical material will be offered by OSU's outstanding engineering faculty augmented in some cases by industry professionals. The professional skills will be provided in part by faculty in the College of Engineering (engineering ethics and professionalism, for example), but largely by the content area experts in the John Glenn School of Public Affairs and faculty and instructors from the OSU Fisher College of Business. This ensures the highest quality material and instruction. The integrative project will tie the professional core and the technical tracks into one cohesive educational experience. The word "integrative" is used intentionally to indicate that the project itself will be an important tool for pulling together or integrating the technical and professional aspects of the course work. The delivery by distance education technology provides the ideal environment for working professionals. Optional national and international opportunities allow students to further tailor the curriculum to their needs.

The College of Engineering at The Ohio State University has a long-standing tradition of offering state-of-the-art instruction via distance and extended learning technologies. This degree program will simultaneously make use of this experience and advance knowledge in this area by working with the Engineering

Education Innovation Center (EEIC) in the College to develop and test new ways to use the technologies (see Appendix D, letter of support from the EEIC Director). The John Glenn School will take advantage of the College of Engineering's experience and infrastructure in distance education to teach their courses in the MGEL degree program. Similarly, faculty and instructors from The Fisher College of Business will also use distance education technologies to teach the business courses. This teaching methodology will allow working students the flexibility to undertake the degree at their own pace (within limits described in Appendix C) and location. Web conferencing capabilities through Carmen Connect, one-day on-campus sessions for orientation and graduation will help to provide experiences essential to the quality of the education and the development of professional networks. Appendix D includes a letter of support from the John Glenn School of Public Affairs as well as a letter of concurrence from The Fisher College of Business allowing their faculty and instructors to teach the business courses. If the John Glenn School of Public Affairs makes the decision to withdraw from the program or to not allow their faculty to teach in the MGEL program, the CoE is prepared to quickly hire lecturers/instructors with graduate standing in the Graduate School to teach the core courses. This should guarantee the continuity of the program.

The proposed MGEL program will also expand the visibility and reputation of the State of Ohio and The Ohio State University in the field of post-graduate training in the professional practice of engineering and in online education. The program will draw a cadre of professional resources to the college that will enhance engineering education across the board. The program will integrate existing knowledge and resources across university departments, colleges, centers and schools and leverage these resources with industry connections.

d) Vision

The OSU MGEL degree program will provide outstanding educational opportunities for technical leaders in engineering fields. It will prepare graduates to respond to the challenges of the 21st century by providing the highest quality course content in technical areas and by helping graduates develop the professional and critical skills they will need to respond to this changing international environment.

II. Proposed Curriculum

The proposed curriculum will result in a tagged Master's degree as described in The Ohio State University Graduate Handbook (Semester version, XIV.1, pg. 48). It will be delivered in distance education methods while including opportunities for group interactions through web conferencing to help students apply the content to team solutions of engineering problems as well as to provide networking opportunities. In addition to being the most appropriate pedagogical model, providing the MGEL curriculum in this format will increase the pool of potential students and offer better service and more flexibility for these students as well.

The minimum of 31 semester credit hour program is designed for completion in one year (two semesters) if taken full time. Students have the flexibility of taking the curriculum on a part time basis over a period of two to three years (a maximum of four years) unless the Graduate Studies Committee formed specifically for this program grants an extension (see Appendix C). The degree program consists of a set of common core classes, a variety of technical tracks from which students may choose and an integrative project, including course work on project management. Students may also earn up to 3 hours of credit for previous course completed elsewhere. Previous course work (see section II-d for more details) can be used to replace a technical track course or professional (core) course.

The curriculum includes three components (see Figure 1) (see Appendix A for sample curricula):

a) ***The Core (16-17 hours):*** This integrated core includes business, public administration and engineering courses including topics such as engineering leadership, innovation, intrapreneurship/entrepreneurship, project management and teambuilding, accounting, legal issues, engineering ethics and professionalism. These courses draw on OSU's significant strengths in the John Glenn School of Public Affairs as well as the OSU College of Engineering.

The overall structure is illustrated in Figure 1. The courses and special experiences to be offered in the core include:

- John Glenn School of Public Affairs
  - PUBAFRS 6050 Management in Public Agencies[3] (4 credits)
  - PUBAFRS 5750H The Business-Government Relationship[4] (3 credits)
- OSU College of Engineering in collaboration with Fisher College of Business faculty and instructors
  - ENGR 6210 Leadership and Team Effectiveness[5] (3 credits)
  - ENGR 6220 Accounting/Finance for Engineers (3 credits)
  - ENGR 6230 Technology Strategy & Innovation Management (3 credits)
- OSU College of Engineering
  - ENGR 7200 Engineering Ethics and Professionalism (1 credit)
  - ISE 6801 Project Management (3 credits)
  - Special events and on-campus experiences, including orientation and graduation ceremonies

The syllabi for all new courses can be found in Appendix H.

Note that ENGR 7200 Engineering Ethics and Professionalism has an entire section (Section 13) devoted to global issues. The syllabus for ENGR 6230 Technology Strategy & Innovation Management is highlighted where global issues are explicitly covered.

[3] Students may elect either this course or the Leadership and Team Effectiveness course in Engineering.
[4] Possible one week intensive course in Washington, DC as a substitute http://www.washcampus.edu/
[5] Students may elect either this course or the Management in Public Agencies course in the Glenn School depending on whether they are focused on the public or private sector.

b) ***Technical Tracks (10-13 hours):*** In addition to the required core, each student will choose a technical track to guide his or her choice of in-depth technical elective courses. These technical tracks will be identified on the student's transcript to make them more marketable within their industry or public sector. Each student will have an advisor within the track who will act as the student's faculty mentor. Most tracks will be interdisciplinary and will include emerging areas such as automotive systems, energy and sustainability, information systems, advanced materials and systems engineering/project management. Three technical tracks have been approved for the first year of the program (see Figure 1); however, additional tracks will be added in future years. The tracks are made up of *technical* and *multi-disciplinary* courses. The technical courses utilize advanced principles and the newest developments together with the skills provided in the core to take trained engineers to a new level of understanding and practice of their profession. Together with the integrative project, the track courses prepare professionals for life-long learning in a changing technological world. (Currently approved tracks are detailed in Appendix B. The process for adding new tracks, evaluating existing tracks and removing existing tracks is given in Appendix C. It will also be possible for students to create individualized tracks under the guidance of their faculty advisors and with the approval of the MGEL Graduate Studies Committee, as discussed in Appendix C.)

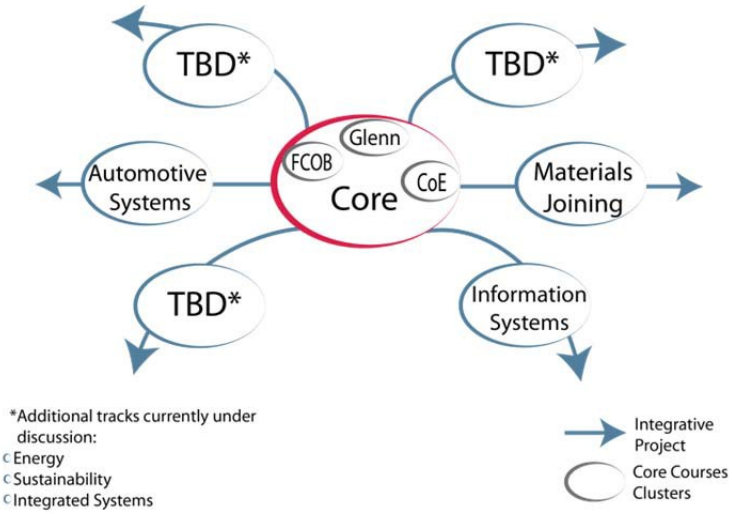

Figure 1: Masters of Global Engineering Leadership: Core and Technical Tracks

A complete list of faculty involved in the teaching of all the above courses can be found in Appendix I. This list includes department, rank as well as email information.

c) ***Integrative project (5 hours):*** The integrative project develops solutions for real- world challenges, applies principles learned through the core and track courses and introduces project development, project management and project assessment. The project serves to knit together the professional core and the advanced technical tracks. Each technical track will have an integrative project class and ISE 6801 will act as the project management class that will provide the basis for students to pursue these projects. The first year, the integrative project will use existing course numbers for Group Studies at the graduate level (e.g., ECE 8194, CSE 8194, etc.). In the future, if needed, course numbers specific to the MGEL program will be created.

Summary of MGEL

- Minimum of 31 graduate credit hours (semester hours)
- Full time or part time
- All courses taught in distance education format. One day on-campus sessions for orientation and graduation with the cohort they enter the program.
- Faculty mentorship

d) ***Curricular Options:*** Several additional options will be available to students.

MGEL Certificates of Specialization: Certificates of specialization (hereafter referred to as certificates) can provide milestones to help motivate students through the degree program. In addition, some certificates have specific academic or industry requirements and are widely recognized as valuable in themselves. Faculty may propose programs that award certificates to students upon completion of specific sets of courses. Such certificate programs must be in accordance with academic and industry standards. Each MGEL certificate proposal must be reviewed and approved by the MGEL Graduate Studies Committee. Appendix C provides the process by which certificates may be proposed within this program.

International Experiences: Students will have the opportunity to undertake an international experience during their degree program (at extra cost). These opportunities will take advantage of the College of Engineering's connections with research and industrial labs around the world. If students elect to take an international experience they may receive (i) course credit (up to 6 credits) and replace technical track courses or professional (core) courses or (ii) a Certificate. The amount of credit will vary depending on the specific experience selected. Students will receive course credit if they chose to take pre-approved (by MGEL-GSC) course(s) at international institutions.

For example, programs at OSU's Center for Automotive Research provide the opportunity for students in related tracks to experience global viewpoints from renowned faculty from Europe and Asia. Currently, the international partners are: Swiss Federal Technical University, ETH-Z, Zürich, Switzerland (Certificate in Advanced Propulsion Systems); Forschungsinstitut für Kraftfahrwesen und Fahrzeugmotoren Stuttgart, in cooperation with the University of Stuttgart (Certificate in Powertrain Modeling and Control); Korea Advanced Institute of Science and Technology (KAIST) (Certificate in Automotive Noise, Vibration, and Harshness). In some cases students will experience this international component through distance education facilities (e.g. lectures by and discussions with faculty in foreign institutions), but there will also be on-site opportunities available at several foreign universities and firms. These foreign site opportunities will be optional at extra cost and will work through the appropriate University offices when formal agreements are necessary.

III. Administrative Arrangements (Details on processes are in Appendix C)

The MGEL degree will be granted through The Ohio State University Graduate School and will be subject to all Graduate School rules and requirements. It will be administered by the College of Engineering through the Professional Programs Office. The MGEL Graduate Studies Committee (GSC) will be established within the College to coordinate the operation of the program.

a) Graduate Studies Committee (GSC)

The MGEL-GSC will be made up of the track coordinators (faculty), the College of Engineering Director of Professional Programs, the MGEL Faculty Director, a faculty member teaching in the program from the Fisher College of Business and the John Glenn School of Public Affairs, and a few additional non-voting members (see Appendix C for the selection processes for these positions). All voting members of this committee will have graduate faculty status with the Graduate School. The MGEL Faculty Director will act as the chair of the GSC. The GSC will handle all tasks normally associated with a graduate studies committee (admissions, new courses, progress of students, and so on). In addition, it will evaluate and must approve any proposed tracks, any changes to existing tracks and any proposed certificate programs. It is also responsible for evaluation of all courses, tracks and certificates in the degree program. It is essential that all aspects of the MGEL degree adhere to the highest standards. It should also be very responsive to industry and student needs. Evaluation will be continuous and ongoing.

The proposed program will be developed in partnership with the Office of Distance Education & eLearning (ODEE). Instructional designers at ODEE are trained in evaluating online courses across the 41 Quality Matters standards (QM; qmprogram.org/rubric). QM is an internationally recognized rubric and peer-review process to evaluate the design of online and blended courses. By developing with the QM rubric and aligning critical course components, course designers and instructors will have a solid, peer-accepted scaffold from which to build activities for students to achieve desired learning outcomes.

b) Industry Advisory Board (IAB)

An Industry Advisory Board will be established to ensure the quality of the program and the ability to meet requirements. This Board will advise the MGEL Faculty Director, the Director of Professional Programs and the MGEL-GSC as well as taking part in the educational programs of the degree. (See more details in Appendix C, section 2.)

c) MGEL operations

The Director of Professional Programs in the College of Engineering will be responsible for day-to-day operations of the program and will perform the following duties:

- coordinate events and advising; schedule on-campus events and distance education classrooms; handle certification programs and all administrative details;

- coordinate with the college and departments to manage the program on a day to day basis;
- establish and chair the industry advisory board along with the faculty director;
- undertake strategic marketing activities. Identify and pursue new student pools and cohorts (e.g., international, governmental agencies, etc.);
- establish industry sponsors in collaboration with track coordinators and faculty collaborators to ensure the quality of the curriculum through sponsored practice and curriculum research efforts;
- initiate tactical marketing and industry sponsored events to showcase successes and develop local and national interest in the program;
- coordinate with the CoE Departments, John Glenn School of Public Affairs, Fisher College faculty, and other OSU entities that play a role in the degree program (e.g. the Graduate School and the Office of Minority Affairs);
- manage the core review and quality processes along with the faculty director;
- work with the Office of Distance Education and eLearning to develop and maintain the MGEL distance learning infrastructure and to build on existing distance learning capabilities;
- aggressively pursue opportunities for additional funding for the MGEL. This would include funding for content areas, professional skills, international experiences and the best possible distance education program to reach new pools of students.

The MGEL Faculty Director will perform the following duties:

- chair the MGEL-Graduate Studies Committee;
- oversee the approval and evaluation of tracks and the selection of track coordinators. Assist, in collaboration with the Professional Programs Director and MGEL-GSC, in the establishment of an industry advisory board for MGEL program. In collaboration with track coordinators, identify on-going enhancements based on performance evaluations of students and instructors in each individual track.

The track coordinators will be responsible for the development and oversight of their specific technical tracks. Each technical track will have a track coordinator. The technical tracks that are already approved as part of the degree program are listed in Appendix B with details of their curricula and the track coordinator's name.
The track coordinators will perform the following duties:

- organize and facilitate the development of the track;[6]
- act as the primary adviser for all students enrolled in the track;
- serve on the MGEL GSC;
- Help identify and target specific associations and industry populations to whom the track can be marketed;
- assist the Director in activities aimed at providing additional funds for the track.

d) Proposed appointments:

- The Director of Professional Programs will act as the administrative director and a faculty director will be appointed by the Dean of the college.
- The track coordinator for each technical track (acts as advisor to all students in track). These positions will be considered for release time depending on student numbers and in accordance with College and Departmental policies.

IV. Evidence of Need

The Engineer of 2020[7] report argues that "…engineering schools must … play a continuing role …in facilitating lifelong learning perhaps through offering "executive" technical degrees similar to executive MBAs". The MGEL degree is designed to be this "executive" technical degree that will help to fulfill the needs identified by the National Academy of Engineering (NAE) in its publications. Similarly the report Engineering for a Changing World by James J. Duderstadt (President Emeritus of the University of Michigan) argues the need for the US to be preeminent in "leadership in all aspects of engineering"[8]. Duderstadt points out the need for engineers to play a more active role in policy in our heavily technology-oriented life style. For this to occur, engineers must learn to use nontechnical as well as technical skills in their roles in industry and in day to day life. The MGEL degree has been designed to provide this kind of education for practicing engineers. We expect the degree to play an important role in creating the future engineer envisioned in these national publications.

We have undertaken significant primary and secondary research among employers and prospective students to determine the need for this degree program and the particular niche that it can fill. This research is summarized below.

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[6] This will include coordinating faculty members in designing and submitting the track for approval by the MGEL GSC. Proposals for new tracks will be developed with broad consultation, including faculty, alumni, student and industry representatives. Evidence of market demand will be required.

[7] National Academy of Engineering. 2005. Educating the Engineer of 2020; Adapting Engineering Education to the New Century, Washington, DC: The National Academies Press, p. 55.

[8] Duderstadt, James J. for the Millenial Project at the University of Michigan. 2008. Engineering for a Changing World. Ann Arbor, MI: The Millennium Project, 2001 Duderstadt Center, The University of Michigan. http://milproj.dc.umich.edu/

a) ***Primary research (survey and interviews):*** Engineer's Council, representatives of all student organizations in the College participated in a brainstorming session early in the development of the curriculum (May, 2006). The Council's comments and suggestions formed the earliest versions of the degree and are still reflected in the structure and contents. Students were particularly interested in communications, management skills and project management. A late draft of the program was presented to Engineer's Council in fall, 2007. The College's Graduate Studies Chairs' Committee (GSCC) has also heard several presentations on the degree, provided valuable input and has endorsed the letter of support included in Appendix D.

The College of Engineering hired Lang Consulting Group to assist with the research on the need for the degree and the material it should include. Lang Consulting Group performed a preliminary industry survey (completed in April, 2007 and included in Appendix E) indicating great interest in the degree. Respondents also emphasized the need for "leadership" rather than "management" and the importance of a strong technical component to the degree.

The College of Engineering's External Advisory Council (its industry advisory board) has heard two presentations on the proposed degree with additional opportunities for members to provide input. One of the presentations included time for lengthy discussion and suggestions from the members. The Council's response has been overwhelmingly positive and was part of the information used to focus the core curriculum.

Based on Engineer's Council input, the College GSCC's comments, the Lang report, the External Advisory Council's suggestions, discussions with a wide variety of experts and internal deliberations, the MGEL committee developed a more complete draft of the degree's curriculum. The committee then designed a survey and sought opinions from practicing engineers and managers in industry. The survey requested a rating for and comments on how essential each potential skill set would be to the respondent's business and the need for this type of degree. Over 50 participants from the following organizations and companies responded:

Aerospace industry: Boeing, NASA, GE Air-conditioning
industry: Trane, Emerson
Ground Vehicle industry (automotive and truck): Honda, GM, Ford, BorgWarner, ArvinMeritor, International Engine & Truck
Pharmaceutical/Medical: Wyeth, Ortho Organizers
Research and Development and Instrumentation: Battelle, Data Physics, Ansol, Bishop

The respondents emphasized the need for the curriculum to include elements of leadership, ethics and project management as key skills in addition to the technical courses. The MGEL core is made up of topics that on average 75% of these respondents felt were necessary/essential to the degree. The project management components of the integrative project were deemed even more important as 91% viewed them as necessary/essential. The MGEL has been designed to meet these explicit industry needs.

The survey also asked about the overall need for this degree and the committee used the

results as an indicator of industry demand for both the degree and for engineers who hold the degree. Roughly 90% of those responding agreed that this kind of degree is necessary and important. A few of the responses are quoted below:

- I think such a program is an excellent idea as I see a real need for this type of education in the industry. … This type of program therefore would fill a crucial gap.
- The MGEL program would be a very welcome addition to the practicing engineers - the specific skill sets would, to a certain aspect, depend upon the particular targeted industry. For instance the automotive industry is faced with a shrinking cycle time and product development needs to deliver a perfect paper design which is Best in the World (BIW) from all aspects - cost, quality, performance, functionality, flexibility, and commonality. One of the skill sets, in addition to a commodity project plan, to achieve this is a 30, 60 90 day look ahead plan which requires risk assessment skills. This avoids last minute surprises which derail progress. I used this with success.
- MGEL is a very creative idea and there should be a lot of interest.
- It is a very interesting program that you are developing at OSU. It would be very successful if it is offered as part time as well as full time for the benefit of corporate employees.
- In my opinion, if you are looking to educate leaders in engineering, you want to emphasize classes in leadership, team building, and strategy to enhance the engineering classes in a MS degree. I do think that novel courses, such as management of innovation, could be a key course in turning out leaders of technology groups…A good leader knows how to get the in-depth skills needed on his team. The main aspect you would want to get through to the students is true leadership skills….
- In my opinion, it is a terrific idea. Ideally, it should suit people who have some experience (4-5 years).
- I gave my answers based on the Technology organization at GE thinking about technical leaders and what I've learned about what it takes to be successful. I hope this information is useful. I think this is a great idea and I look forward to hearing more about it as the program develops.
- This new degree program sounds great!

The preliminary research, survey results and discussions with our partner units at OSU helped the committee create the final version of the curriculum. Based on the range of students, industries and employers consulted and the strongly positive nature of the responses, the committee is convinced of an excellent market for the degree and for students who attain it.

Employers are a crucial part of the demand for the degree, but so are students. In addition to meetings with student leaders through Engineers Council, the committee worked with Lang Consulting Group to develop and conduct a web-based survey for students and alumni. Of the 794 respondents, forty-five percent of the respondents felt this degree would be beneficial to their careers. One third of the respondents were likely to enroll in the program in the next five years, a very strong indicator of interest. Nearly

two thirds felt that their employers would be likely to help pay for the degree. A large majority of the respondents (81%) were alumni, indicating strong support among the target population of practicing engineers. However current students and alumni are equally likely to enroll in the program so there is strong interest among the newest engineers as well.

b) ***Secondary Research (Examination of Published Materials and Websites)***

The College of Engineering's first analysis to determine whether there was a need for this type of degree was conducted in 2007. A second analysis including all similar programs at peer and aspirant universities was conducted in 2012. In fall 2009 some of these materials were revisited in determining the price point for the degree.

Both the 2012 and 2007 reports are included in Appendix F. They showed:

a. Many universities among our peers and aspirants offer a degree in the overall category that we are calling Masters of Technology (MOT) into which the MGEL fits. There are a variety of models and this is clearly an area in which the best institutions are represented. Ohio State brings special strengths to its offering of the MGEL and should be competitive.
b. These top-tier institutions sometimes provide MOT-type engineering degrees in distance modes (see examples in the appendix), but often do not partner with other Colleges on their campuses to provide the professional skills. Sometimes they do not include the on-campus experiences that are so important for a cohort to build its network, or the degree may be entirely on- campus and thus unsuited for working adults. Few universities offer degrees in a format that allows students who are not resident on campus to complete the degree. Even fewer provide this format and also have the partnerships that we have developed with business and public policy units on their campuses. All are expensive. Our research indicates significant opportunities in the Midwest as we initiate our program.
c. In Ohio, Case Western Reserve University offers a Masters of Engineering including some similar components to those in the core of the MGEL, including being aimed at working professionals and containing some management and leadership skills. The degree is available through evening classes and DVDs but it does not include the partnerships with other content area specialists such as the Fisher College of Business and the John Glenn School. Nor does it focus on the mix of pedagogical methods that the MGEL will use. Case Western's Master of Engineering and Management focuses on specific fields such as biomedical, healthcare and biosciences and is aimed at students just finishing their undergraduate engineering degrees rather than working engineers. Our technical tracks will focus on the fields in which Ohio State has a comparative advantage, such as automotive systems and materials joining, among others. Thus the MGEL meets a need that is not currently met in Ohio. (Several other of Ohio's state universities have recently proposed or plan to propose related degrees, though none is extant at the moment. Each of these is different from the others and will specialize in particular areas. They will all strengthen engineering education in the state.)

d. National and global statistics support robust growth in enrollment in master's level distance education programs.
e. Despite cost-cutting measures, educational benefits are not being eliminated by employers.

In summary, many of the best engineering schools in the country provide a program of this type, often by distance methods. This could be seen as daunting competition, but we view it as an indication that OSU should be in this market and should be capitalizing on its unique strengths. Although these other masters programs exist and offer degrees that combine business and engineering skills they rarely offer the level of partnership that we have achieved with the John Glenn School of Public Affairs. Our surveys of industry found enthusiastic support for the MGEL, as designed and offered by Ohio State. The same is true of the surveys of our alumni and students. We believe that this proposal brings something special to this type of degree and that it is important for the state of Ohio and for the University that the College of Engineering move forward to offer it.

V. Prospective Enrollment and Student Demand

a) Demand

The previously cited study of current students and OSU alumni gives indications of strong demand for this program. Many of the students surveyed have followed up on their own by contacting the Dean's office to inquire about when the program will be available. Student leaders from Engineer's Council have made inquiries as well. Finally, several major corporations have already notified us that they wish to enroll cohorts of their students in the degree program.

Our research and analysis convinces us that the program will easily enroll 20 to 30 new students in its first year and that this number should grow to 50 fairly quickly. Most students will be part time. We expect to sustain the program at that level by keeping the curriculum up-to-date and providing a high quality degree and excellent customer service.

b) Access and Retention of Underrepresented Groups

Excellence cannot be achieved without diversity and the diversification of the engineering student body is a major priority for the College of Engineering as indicated in the College's Strategic Plan. According to this goal, the College will "Increase the diversity of students, faculty and staff". The college has a well- established and nationally-respected Minority Engineering Program (MEP). It was founded as part of a national effort to increase the representation of African- Americans, Hispanic-Americans, and Native Americans in the professional engineering population. MEP offers a wide range of programs and services to assist in the recruitment, retention, motivation and graduation of minority students. Some of these include: academic and personal counseling, an early-warning monitoring system, a test and reference library, skills-building workshops, and social activities.

Similarly, the College of Engineering established the Women in Engineering (WiE) Program to encourage young women to consider engineering as a career choice, to recruit women into undergraduate and graduate programs, to support women as they matriculate through the engineering programs, and to assist women as they transition to the workforce after graduation. The resources that reside within these two programs are very effective in their charges and their services will continue to evolve as the needs of the MGEL degree emerge. In addition, the MGEL will have access to OSU's many resources for recruiting and retaining under-represented groups. These include, among others the Graduate School and its recruiting officer, Ms. Cyndi Freeman-Fail and the OSU Office of Diversity and Inclusion. Linkages with national organizations of minority and women engineers (such as the National Society of Black Engineers, the Society of Hispanic Professional Engineers, and the Society of Women Engineers) are already in place and thriving in the College. The College actively recruits from these organizations and also works from GRE lists and the Summer Research Opportunity Program (SROP) lists. The Graduate Engineering Minority (GEM) program is another source of potential students.

In the marketing of the program we will use all of OSU's resources and make every effort to recruit members of underrepresented groups. Our survey of students and alumni indicate that women are as interested in this degree program as men. While relatively few minorities responded to the survey (about 50 respondents), more than 70% said they were likely to enroll in this degree program. The MGEL offers an outstanding opportunity to enhance the careers of female and minority engineers and, in the process, create more role models to improve the diversity of engineering in general.

Consistent with the University's Diversity Plan, efforts to recruit and retain engineers who are members of the GLBT community are receiving increasing emphasis in the College of Engineering. Recruitment efforts through an established link with the National Organization of Gay and Lesbian Scientists and Technical Professionals will be engaged to assist in bringing additional diversity to the MGEL program. Retention efforts for GLBT engineers are beginning to be addressed within the context of the College's evolving diversity plan and within the College's updated Performance Plan.

VI. Available Resources and Additional Resource Needs

The MGEL degree program must have sufficient teaching, administrative and support staff to provide the high quality experience that the students will need and expect. The pedagogical issues of teaching returning, highly skilled professionals are different from those of normal classroom teaching. In order to ensure continuous assessment of courses, high quality distance education facilities, excellent on-campus experiences, and superior customer service, the MGEL degree will require higher tuition than normal degree programs (see the budget model and request for a differential fee category in Appendix G). Optional additional experiences, such as a week of intensive study in Washington, DC or two week international internship opportunities will require additional fees from the students.

a) Existing resources for MGEL

- The MGEL will use current faculty in the OSU College of Engineering, the John Glenn School of Public Affairs, and the Fisher College of Business. These relationships have already been developed as can be seen in the attached letters of support and concurrence (Appendix D). Appropriate courses have been identified or created (see the sample curricula in Appendix A.)

- The College of Engineering will work through its existing office of Distance Education to provide the infrastructure for the distance education courses. This office has a long-standing tradition of offering state-of-the-art instruction via distance and extended learning technologies. Additionally, several College centers are already engaged in research resulting in curriculum developments. This degree program will build on and advance the College's efforts in these areas. Portions of the proposed degree program will be delivered via extant college, university, state, national, and global networks (data, voice, and video). Infrastructure and expertise from other university units, such as the Office of the Chief Information officer, the office of Technology Enhanced Learning and Research and the Java Club—a network of instructional technology experts across the university – will be used.

- Funds generated by the degree will flow through the OSU budget model to College and the School involved in the teaching. Needed additions to the distance education infrastructure and staff will be supported by revenue generated by the program.

b) Additional Resources Needed

Areas where new material and knowledge need to be developed have also been identified. These may include:

- advanced technical classes that integrate the different parts of the curriculum;
- development of the integrative project to reflect challenges faced by professionals;
- conversion of existing classes to distance formats;
- development of new classes.

The following resources will be needed:

Clinical faculty: High caliber clinical faculty with professional knowledge and expertise will be needed to address some of the gaps in existing instructional knowledge. It is not enough to approach teaching in the MGEL as if it were the same as teaching any other graduate program. New research in teaching methods and field practice are needed to create instructional content and techniques that will establish OSU as an advanced teaching institution for this population of students. Some funds for this may be generated from program revenues, but MGEL faculty and the Director will also actively seek grants in these areas. The College of Engineering's Engineering Education Innovation Center (EEIC), Directed by Professor Robert Gustafson, will be a valuable resource (see letter of support from Dr. Gustafson in Appendix D).

Program development grants: The creation and aggressive improvement of existing courses as well as the development of new courses will be supported through a small

grant competition (normally $5k-$10k). Grants may be awarded for:

- improvement and update of core course content;
- integrative grants involving curriculum development across more than one discipline;
- proposal writing for the development of new tracks;
- creation of content in an on-line format.

The College of Engineering has a pool of money that will act as the seed money for the initial grants (see Appendix G for budget model). A continuing pool of funds will be created from student fees generated by the MGEL.

Sponsorship of integrative project development: Industry sponsorship of integrative projects will be encouraged. In addition to approaching traditional industry sponsors, including firms with their own cohorts of students in the MGEL program, new sponsor concepts will be pursued.

Global experiences (optional): Specific project and internship opportunities within multinationals will be solicited to provide students experiences. The College already has significant global contacts and experience in short term international exchanges. The college's global studies manager oversees the College's international programs, making this a logical linkage.

c) Budget model

The facilities, faculty and special programming for the MGEL will require resources beyond normal graduate tuition and subsidy. We will request a differential fee category for this program as detailed in the budget model in Appendix G.

As the demand for seats increases, the number of faculty needed to teach courses in the MGEL program will also increase. However, as demand for seats rise, so will revenues. Thus, dollars for hiring instructors will follow the demand. Additional qualified instructors (clinical faculty) will be added to the program on an as-needed basis. They will obviously be eligible to teach graduate courses.

VII. Assessment Plan

The MGEL administration will continuously assess all of the program's activities. This will be accomplished in several ways.

The most important measure is the satisfaction of the customers. This means that every class will be evaluated each time it is offered and track coordinators will be responsible for annual reports to the Director of Professional Programs and MGEL faculty director about the quality of teaching in the track and how continuous quality improvement is being handled. In addition, every graduate will be asked to fill out an anonymous exit survey and have an exit interview with the Professional Programs Director. Students who leave the program without graduating will also be requested to meet with the Director of Professional Programs and

faculty director. Customer satisfaction also means making sure that employers are satisfied. To some extent this will be shown by the hiring record of the MGEL graduates. However the MGEL Director, Professional Programs Director and track coordinators will also undertake surveys of and interviews with the employers of MGEL alumni and students to make sure that the MGEL is remaining current with their needs and providing the quality of education necessary. In addition, project sponsors will be asked to evaluate the quality of the work provided and the Industry Advisory Board will provide oversight.

The MGEL Graduate Studies Committee will have a curriculum assessment plan which will consider both the core and existing and new tracks in the degree. Each existing track will be explicitly examined for retention every three years.

Faculty involved in the program will have constant opportunities to evaluate the distance education facilities and other aspects of the program. The Director of Professional Programs and faculty director will summarize these evaluations in an annual report to the Dean of the College of Engineering.

All constituencies will be asked to evaluate the level of customer service, the ease of use of the distance education facilities and products, the value of the different aspects of the program and the overall quality of the degree on a regular basis. It will be the responsibility of the Director of Professional Programs to summarize all evaluations in an annual report, to determine in consultation with the GSC and the Dean when there are problems requiring action and to determine what action should be taken.

VIII APPENDICES

Appendix A Sample Curricula (minimum of 31 hours)

Sample curriculum -- full time student--1 year

	Orientation	Fall	Hrs	Spring	Hrs	Maymester or Summer	Cr Hrs	Total
Year 1	Orientation	PUBAFRS6050	4	Ethics	1	optional internship		
		Accounting/Finance	3	PUBAFRS 5750H	3	optional DC experience		
		ISE 6801	3	Technical	3			
		Technical	3	Technical	3			
		Innovation & Technology	3	Technical	3			
		Integrative Project	1	Integrative Project	4			
Total Hours			17		17			34

Sample curriculum -- part time student-- 2 years

	Orientation	Fall	Hrs	Spring	Hrs	Maymester or Summer	Cr Hrs	Total
Year 1	Orientation	Leadership	3	ISE 6801	3	optional internship		
		Accounting/Finance	3	PUBAFRS 5750H	3	optional DC experience		
		Ethics	1	Technical	3			
Total Hours			7		9			16
		Fall	Hrs	Spring	Hrs	Maymester or Summer	Cr Hrs	Total
Year 2		Innovation & Technology	3	Technical	3			
		Technical	3	Technical	3			
		Integrative Project	2	Integrative Project	3			
Total Hours			8		9			17
								33

Sample curriculum - part time student -- 3 years

	Orientation	Fall	Hrs	Spring	Hrs	Maymester or Summer	Cr Hrs	Total
Year 1	Orientation	Leadership	3	ISE 6801	3	optional internship		
		Accounting/Finance	3	PUBAFRS 5750H	3	optional DC experience		
Total Hours			6		6			12
		Fall	Hrs	Spring	Hrs	Maymester or Summer	Cr Hrs	Total
Year 2		Ethics	1	Technical	3	optional internship		
		Innovation & Technology	3	Technical	3	optional DC experience		
Total Hours			4		6			10
		Fall	Hrs	Spring	Hrs	Maymester or Summer	Cr Hrs	Total
Year 3		Integrative Project	2	Integrative Project	3			
		Technical	3	Technical	3			
Total Hours			5		6			11
								33

Appendix B: Technical Tracks

Track 1: Materials Joining (*Track Coordinator: Prof. Avi Benatar, MSE*)

Materials Joining science and engineering is a rapidly expanding field that is critical to the manufacturing community. The Welding Engineering (WE) program at The Ohio State University (OSU) has a long history of teaching and research in materials joining and of supplying top-notch welding engineers to the worldwide manufacturing community. In the WE program at OSU, engineers are trained in areas of process technology, materials science, design, inspection, and quality control. This program is designed to provide professionals from a wide range of engineering and technology backgrounds with the skills necessary to excel in materials joining.

The WE program at OSU is unique and multidisciplinary, with courses containing elements of materials science, process technology, design, joining of plastics and polymeric composites, and nondestructive evaluation. Online offering of many of these courses started in 1998 and in 2003 a web-based Master of Science degree was established at OSU. The materials joining track is designed to give a breadth of knowledge in this area and it will consist of the following four core courses:

WELDENG 7001 Physical Principles of Welding Processes I (3)
WELDENG 7101 Welding Metallurgy I (3)
WELDENG 7201 Engineering Analysis for Design and Simulation (4)
WELDENG 7406 Welding of Plastics and Composites (3)

These courses are offered online at the same time that the on-campus course is taught using OSU's learning management system, Carmen. The course lectures are recorded in the classroom and then archived on the course Carmen website for access and review by distance and on-campus students. In the asynchronous mode, you view and listen to lectures from the course website using a “self-study” format. Carmen includes a Content area where course materials (syllabus, notes, technical papers, pre-recorded lectures, prior exams, etc.) are provided. It also includes a Discussions area that is used to ask and answer questions, a Dropbox for uploading assignments, online Quizzes, News postings, and a Grades area where students can view their grades online.

Below is a brief description of the core courses:

7001 Physical Principles in Welding Processes I G 3: Study of the application of physical principles in engineering of arc welding processes and equipment. Prereq: Grad standing, or permission of instructor. Not open to students with credit for 4001 (500) or 600.

7101 Welding Metallurgy I G 3: Application of physical metallurgy principles to nonequilibrium thermo-mechanical conditions associated with welding in structural alloys and focus on carbon steels. Prereq: Grad standing, or permission of instructor. Not open to students with credit for 4101 (610) or 611.

7201 Engineering Analysis for Design and Simulation G 4: Fundamentals of engineering analysis of heat flow, thermal and residual stresses, and fracture and fatigue with applications to design and simulation in welding and manufacturing. Prereq: Grad standing, or permission of instructor. Not open to students with credit for 4201 (620) or 621.

7406 Welding of Plastics and Composites G 3: Theory and practice in welding of plastics and polymeric composites, including theory and analysis of welding processes, part and joint design, and process selection. Prereq: 4201 (620), or permission of instructor. Not open to students with credit for 4406 (706).

Track 2: Automotive Systems Engineering: (*Track Coordinators: Prof. A. T. Conlisk and Giorgio Rizzoni, MAE*)

OBJECTIVE

This document describes possible specializations in the area of Automotive Systems Engineering (Track 2), and is loosely based on The Automotive Systems Engineering Specialization (ASES) program at The Ohio State University. The ASES program was formulated to provide an interdisciplinary graduate level education in the engineering discipline of primary interest to the student, while focusing on the application area of automotive systems. Specializations are a mechanism by which degree-granting programs can have "concentration areas" denoted on a student's transcript. Currently, the Departments of Mechanical and Aerospace Engineering and Electrical and Computer Engineering participate in the interdisciplinary ASES. In the coming year, there is a plan to include other departments in this program, thanks to a recent GATE center award from the U.S Department of Energy.

It is envisioned that the specializations proposed herein will not in any way alter or supersede normal degree program graduation requirements, but instead will offer focused technical options within the Track for Automotive Systems Engineering.

Proposed Specializations

The following are the proposed requirements (summarized in the table below):

- Students are required to take at least one course of a focus two-course sequence. If a student takes the two courses, he/she will have the required 12 credits for a technical track.
- A student may choose to take one course of the two-course focus sequence. In this case, the student fills out the coursework portion of their degree requirements with "expertise area" courses, some of which should be drawn from the focus area courses. A partial list of suggested expertise area courses will be made available to the student in a separate document.
- Up to three (3) hours of independent study credit (pass/fail) is available through self-paced short-course/seminars on state-of-the-art topics which fall outside the normal focus courses listed herein. Moreover, these short course/seminars offer an opportunity for review of prerequisite content relevant to the course listed in automotive systems. Details of the technical content of these seminars and faculty staffing will be addressed subsequently.

The requirements on the number of focus course/sequences and expertise areas serve to increase the breadth of skills that the graduate engineers can apply to complex automotive problems. At the same time, the student will better understand the perspectives, capabilities, and approaches of other engineering disciplines as well as their relevance to automotive systems. These requirements are flexible enough to provide some depth within engineering disciplines of primary interest to the student. It is expected that participating students will choose elective courses so that the programs of study have an appropriate focus on an automotive-related

discipline in addition to the breadth of scope resulting from the focus area courses and expertise area requirements.

TRACK REQUIREMENTS (12 credits)

Courses	Credit Hours
Focus Sequence* (2 courses)	6
Expertise area courses	3-6**
Self-pace seminars (review and related automotive topics)	0-3***

* If a student takes courses in two focus sequences, the total required hours (12) for the track is satisfied.

** If a student completes only one focus sequence, he/she must complete at least one more course from the list of focus area courses, outside the focus area from which a sequence is chosen.

*** A student can complete up to 3 credits of a self-pace seminar. These credits can be used to complete the 12 credits required for the track (approved by track coordinator) or to fulfill prerequisites for courses in a focus sequence. The latter option does not count toward the 12 required credits.

Focus Course Sequence Requirement

A student completes a focus sequence by selecting at least one course from one of the focus areas listed below. Course prerequisites for focus courses may be waived by the course instructor for participants in the new program. In cases where this is not so, students should either take the prerequisite course or (if possible) take one of the short course/seminar offerings meant for review and preparation.

Focus sequences consist of basic courses of critical importance to automotive systems in areas matching the research focus areas of the OSU Center for Automotive Research (CAR):

Focus Area 1: Advanced Propulsion Systems (APS)

ME7383 Electrochemical Energy Conversion and Storage Systems for Automotive Applications

Electrochemical energy storage (batteries) and conversion (fuel cells) systems for automotive applications covering state of the art principles of operations and modeling. Prereq: 6526 (726), or Grad standing in Engineering, or permission of instructor. Not open to students with credit for ME 788 or distance learning version 7383.02.

ME 7384 Energy Modeling, Simulation, Optimization and Control of Advanced Vehicles

Fundamentals of advanced propulsion vehicles (HEV, PHEV, BEV, FCV), covering motivation, architectures, taxonomy and components, energy analysis, modeling, simulation, optimization and supervisory control/energy management principles. Prereq: graduate standing, or permission of instructor. Not open to students with credit for ME 784 or ME 785.

Focus Area 2: Powertrain Modeling and Control (PMC)

ME 7236 Powertrain Dynamics

Overview of dynamics and control of automotive powertrain systems. Emphasis on subsystem interactions. Analytical and numerical methods for dynamics of gas exchange, fueling, combustion and exhaust, and mechanical engine and transmission systems. Prereq: Grad standing, or permission of instructor. Not open to students with credit for ME 781.

ECE 5554 Powertrain Control Systems

Application of digital control system theory, from viewpoints of input-output and state variable representations, to realistic problems in automotive powertrain systems

Focus Area 3: Noise, Vibration and Harshness (NVH)

ME 7260 Automotive NVH I

Integrated study of vibrations, acoustics, digital signal processing and machinery dynamics based on case study approach; examination of design, manufacturing, material, performance, and economic considerations. Prereq: Sr or Graduate standing in Engineering, or permission of instructor. Not open to students with credit for ME 777 or ME 778.

ME 7262 Automotive NVH II

Integrated study of vibrations, acoustics, signal processing and dynamics based on case study approach; continuation of ME 7260 with focus on experimental and design methods. Prereq: ME or ME 777, or Sr or Graduate standing, or permission of instructor. Not open to students with credit for ME 778 or ME 779.

Other focus areas are envisioned for the future, from several other individual courses currently offered. It is important to note that all of the courses listed above are currently delivered via distance education asynchronously in the semester of the live offering. Finally, an intent is to also offer a Certificate in the three areas above to students who take the focus sequence, and three seminars chosen from a specified list (this is especially attractive to students who do not complete all degree requirements).

Expertise Area Requirements

If a student takes only one course of the focus sequence(s) noted above, then he/she is required to take additional credit hours of interdisciplinary expertise area course work, at least three hours of which must be drawn from the list of focus areas (except for students choosing to take two focus sequences). A list of expertise area courses will be made available to each student. The student should work out a plan and a recommendation will then be forwarded by the technical track coordinator to the MGEL Graduate Studies Committee for approval.

Seminar on Automotive Topics

Students may receive up to three (3) credit hours (pass/fail) of independent study by participating in self-paced short course/seminars. Requirements include a written report (response to supplied questions) on the material presented in the lectures. Although the short course/seminars are self-paced (video streamed and/or delivered via DVD), each is to be completed within a set time period (for example, 4-7 weeks). These Seminars may also be delivered in weekend mode.

Track 3: Enterprise Services and Architectures (ESA): *(Track Coordinators: Dr. Jayashree Ramanathan and Dr. Rajiv Ramnath, CSE)*

Description of ESA Technical Track

Enterprises and businesses rely on complex architectures and technologies to deliver services, execute business strategy, improve organizational agility, and competitiveness. The Ohio State University's new Enterprise Systems and Architectures (ESA) track, delivered online, will prepare professionals for growth in this exciting career field. ESA is increasingly recognized by organizations as a strategic component of information technology and business planning and execution. The MGEL professional program together with the ESA track of eleven credits (four courses) offers both a solid technology foundation and skills to operationalize alignment of technology components and all parts of an organization with business strategy and goals. ESA courses in Applied Distributed Computing and Mobile Application lay the technology foundation. The course in Software Engineering provides skills in the designing enterprise software and related process practices. Finally, the Enterprise Services and Architectures course takes a life-cycle approach to service improvement. Collectively the courses provide skills to analyze operational performance; design and manage processes and product lines; govern, lead and manage projects and portfolios; and use tools and data more effectively for activities such as decision-making, collaboration and social networking. The track courses complement the hands-on project that develops communication and management skills through developing a business case, considering all stakeholder perspectives and techniques for identifying areas of IT innovation and requirements relevant to a particular organization.

All delivery will be a combination of Distance and Face-to-Face format. All courses have to be converted to the Distance/Face-to-Face format along with the design of some new content. The track will consist of a total of 11 credit hours. The courses to be offered are listed below.

Title	Description
Enterprise Software Engineering (CSE 5231 – 2 credits)	Principles of design, implementation, validation, and management of computer software; emphasis on reading and discussing papers from relevant journals and proceedings; industry best practices such as ITIL. Term project required. The specific focus will be on the engineering of enterprise software systems.
Applied Enterprise Distributed Computing for Engineers and Scientists (CSE 5234 – 3 credits)	Introduction to distributed enterprise systems and technology frameworks, design of applications based on technology frameworks, including XML, Object Relational Mapping (ORM), Enterprise Java, WebServices, Enterprise Integration Via the Enterprise Service Bus, Mobile Computing.

Introduction to Databases (CSE 5241 – 2 credits)	Database systems use; logical design; entity-relationship model; normalization; query languages and SQL; relational algebra and calculus; object relational databases; XML; active database; database design project.
Enterprise Services and Architectures (CSE 5235 – 3 credits)	Modeling/analysis of complex enterprises; enterprise patterns (workflow, broker, warehousing); methods for service performance improvement and decision making using best practices such as Lean and TOGAF. Use of intelligent methods such as OWL/ontologies, data mining, machine learning etc. Emerging topics in semantic cyber infrastructures and social computation. Case studies involving industry-sponsored complex architecture projects and solution design addressing multiple stakeholder needs.

References

a) http://www.prweb.com/releases/2012/4/prweb9421163.htm
b) http://www.cmu.edu/academics/distance-learning.shtml

Institute for Software Research. The Executive and Professional Education program at the School of Computer Science's Institute for Software Research provides executive and distance learning opportunities in a range of subjects, including systems engineering, enterprise architecture and global software engineering.

c) http://www.ce.csueastbay.edu/certificate/enterprise_architecture/index.shtml
d) http://www.networkworld.com/news/2010/111810-enterprise-architects.html
e) http://it.toolbox.com/blogs/thinking-out-loud/should-universities-teach-enterprise- architecture-part-two-3230
http://www-01.ibm.com/software/data/bigdata/

Appendix C: Processes

1) Selection of Personnel

a) **Faculty Director**

The MGEL Faculty Director will be selected by the Dean of the College of Engineering in consultation with the College Executive Committee, the College Graduate Studies Chairs' Committee and the MGEL Graduate Studies Committee (MGEL-GSC). The MGEL Faculty Director will serve at the pleasure of the Dean in a half time administrative role. The MGEL Faculty Director will have graduate faculty status with the Graduate School.

b) **Administrative Staff**

The Director of Professional Programs will be selected by and report to the Dean of the College of Engineering.

c) Track Coordinators

Each Track Coordinator (with graduate faculty status) will be nominated by the faculty involved in that track. The nomination must be approved by the MGEL Faculty Director and the MGEL-GSC before it becomes effective. Track Coordinators will receive a course load reduction for their work on the track depending on the number of students involved in the track.

d) MGEL-GSC

The MGEL-GSC will be made up of the track coordinators, the College of Engineering Director of Professional Programs, the MGEL Faculty Director , a faculty member teaching in the program from the Fisher College of Business and the John Glenn School of Public Affairs and a few non-voting members (see section 9 for details). All voting members of the MGEL-GSC will have graduate faculty status with the Graduate School. The MGEL Faculty Director will act as the chair of the GSC. The MGEL-GSC will handle all tasks normally associated with a graduate studies committee (admissions, new courses, progress of students, and so on). In addition, it will evaluate and must approve any proposed tracks, any changes to existing tracks and any proposed certificate programs. It is also responsible for evaluation of all courses, tracks and certificates in the degree program. Once new technical tracks are approved by the MGEL-GSC, the next step in the approval process will be the Graduate School and the Council on Academic Affairs.

It will also be the responsibility of the MGEL-GSC to develop an advising sheet for our full- and part-time students.

2) Industry Advisory Board

The MGEL will benefit from a strong industry advisory board to ensure that the degree is relevant to the needs of industry. Industry advisory board members will be nominated by MGEL-GSC members and other faculty involved in the degree. The MGEL Faculty Director will make final appointments in consultation with the Director of Professional Programs and the Dean of the College. The Board will meet at least once a year to review the degree program. Members of the Board may take part in courses as guest lecturers or instructors (assuming the member has the appropriate appointment at OSU); they may nominate topics for integrative projects and will have an active role in evaluation of the degree, its components and its outcomes.

3) Admissions

a) MGEL Entrance Requirements

The Masters of Engineering Leadership program normally requires a candidate to have a BS in Engineering from an accredited program (ABET, CAB) at a college or university. The admissibility of a candidate with a BS not in engineering will be evaluated by the MGEL-GSC acting as the admissions committee for the degree program.

Applicants for admission to the MGEL degree program must have a cumulative point hour ratio for undergraduate work of at least 3.0 (4.0 scale). Applicants with cumulative point hour ratios for undergraduate work below 3.0/4.0 must submit results for the GRE General Test to be considered for admission. Individual tracks may have higher minimum requirements. Students will be admitted to the MGEL program and will be informed at that time if they need to take extra courses to be admitted to the technical tracks of their choice. Admitted students will be able to change technical tracks in the first semester after admission.

The MGEL-GSC may request applicants with a BS engineering degree from a non-ABET or non-CAB (Canadian Accreditation Board) accredited program to submit the results of the GRE Engineering Test.

Applicants with non-engineering BS degrees will usually be required to take specified makeup work before their applications will be considered for graduate admission. These applicants may also be required to submit the GRE General Test and/or Subject Test results regardless of grade point average. When required, Engineering Test scores are preferred, but applicants may submit GRE Subject Test results in their specialty area.

b) **Professional Work Experience**

Students applying to the MGEL will normally have at least a year of post-BS work experience in an engineering-related job. The MGEL GSC may, however, choose to admit exceptional students directly from the BS. Any such student must have significant internship, co-op, or work experience that will enable them to bring something to the classroom and will allow them to appreciate the professional skills that make up the MGEL core. This will normally imply at least two internships or co-op experiences; however the exact requirement may vary by student at the discretion of the MGEL GSC.

4) Student Progress

Students will normally complete the degree in no more than four years, with most completing it in a shorter period of time (See Appendix A for sample curricula). Student progress will be tracked by the student's track coordinator. Each year the track coordinator will report progress on each student in the track to the MGEL Faculty Director. The Director and the track coordinator will work together to ensure that all students make good progress toward completion of the degree. Exceptions to the four year limit must be approved by the MGEL GSC and may be for one year at a time, not to exceed six years.

5) New Track Approval

a) **Background**

The Masters of Engineering Leadership (MGEL) degree was developed as a way to assist practicing engineers to enhance their careers with additional technical training as well as training in professional skills as those skills apply to engineering. An important component of the MGEL degree is the technical track that students select for themselves, assuming the student has the appropriate technical background. All such technical tracks must be approved by the MGEL-GSC. This section of the appendix describes the process by which a new technical track may be proposed for the MGEL degree.

b) **Process**

All proposals should specify a coordinator for the track who will be responsible for dealing with correspondence about the proposal and for acting as the track director when the track is approved. Changes to this coordinator at any time during the proposal process or after approval must be nominated to the MGEL Faculty Director and MGEL-GSC for their approval.

Each proposal should first go to the Graduate Studies Committee(s) of the graduate program(s) associated with the track for discussion and approval. It should also receive approval from the department chair(s) associated with the courses in the track. When the

proposal comes to the MGEL-GSC it must include letters of support from affected program GSCs as well as from the Department Chair(s) of affected department(s).

The MGEL-GSC will be particularly concerned with the fit of the proposed technical track with the goals of the MGEL degree. It will also pay close attention to integration of the MGEL core curriculum into the track courses and the quality of the integrative project. The MGEL-GSC is also responsible for making sure that all proposed courses in the track will be available via distance (or at least that there are realistic plans and a relatively short time line for making them available by distance). The MGEL GSC will consider proposals for other means of offering classes that take into account the convenience of working professionals, but it is not obliged to approve them. The MGEL GSC will consider the proposal, request clarification if necessary and make a decision as expeditiously as possible.

The proposal should contain, at a minimum, the following information:

- Rationale. What is the rationale and value of the proposed new track? What is the market demand for this track (evidence will be required)?
- Admission Requirements. Any admission requirements, above and beyond those of the MGEL program and Graduate School should be clearly defined.
- Structure and Curriculum. The name and structure of the track should be described, as well as the educational goals and objectives. The content should meet the criteria for the program and fit in the overall context of the program core and track requirements. The content should be interdisciplinary. Content developed with industry input and/or professional collaboration and with demonstrated value to industry is preferred.
- Delivery. A discussion of the delivery formats (distance, types of interactions etc.) should be provided.
- Program Administration and Support. Describe the administrative support for the program and how the program staff will interact with college MGEL personnel. Also, describe any expected financial requirements and sources of funds.
- Commitment and Letters of Support. The willingness to teach and support the classes for a specific period should be indicated, as well as a demonstrated interest in sustained improvement of the content (e.g. area of research or past activity), interest in on-going coordination of content. In addition to letters of support from affected GSC Chairs and Department Chairpersons, letters of support from industry are encouraged.

c) **Individualized Tracks**

Students may propose individualized tracks of study in special circumstances. These tracks must be developed in consultation with a faculty advisor and must be focused on technical courses. They should cover the same issues as a proposal for a new track and should have the support of the Graduate Studies Committees of the appropriate

disciplines. The MGEL-GSC will consider the proposal and provide feedback to the student. The MGEL-GSC must approve any individualized track.

6) MGEL Certificates of Specialization

Certificates of Specialization may be proposed for completion of certain sequences of courses. Any certificate to be offered in connection with the MGEL degree must be proposed to the MGEL-GSC by the track coordinator. This proposal must include justification for the idea of a certificate for this topic, the courses included in the sequence and the amount of work involved to obtain this certification. If there are any nationally or internationally recognized certifications involved these must be clearly delineated and the way in which this certification program matches the requirements of the national or international bodies explained. Permission from those bodies must also be obtained and included in the proposal. University guidelines should be carefully followed.

7) Credit for previous course work

Students may obtain up to three semester hours of credit for class work outside of the MGEL curriculum. An application for such credit must be developed in consultation with the student's advisor and may substitute course work (core or technical tracks). Careful documentation will be essential. The decision to grant credit or not and the amount of credit granted will be made by the MGEL-GSC upon application of the student.

8) Course and Track Evaluation

All courses and tracks must be evaluated on a regular basis. In the early years of the program, Track Coordinators will be responsible for evaluating each class in their track using student evaluations, peer evaluations and interviews with employers and industry representatives. For the first three years of a track's existence, the Track Coordinator will prepare an annual report describing these efforts, any problems identified, and actions taken to rectify the problems. This report will be delivered to the MGEL Faculty Director.

In addition to the student evaluations (conducted every time the course is offered), each course will be peer reviewed (faculty participating in MGEL program) at least every third year and the Track Coordinator will also conduct an evaluation of the course with employers whose employees have taken it. Track Coordinators will provide reports annually to the MGEL Faculty Director.

The GSC will evaluate every track on a regular schedule starting at the end of the third year of the program's existence and continuing on a rotating basis. Tracks may be discontinued if evaluations are poor or if student numbers are low. Such discontinuation requires a 2/3 vote

of the MGEL GSC. Tracks may also be placed on hold if the GSC and MGEL Faculty Director believe that its challenges are temporary and soluble. Reinstating a track that has been placed on hold will require a majority vote of the GSC.

9) <u>Partner Colleges and Schools</u>

A key strength of the MGEL program is its ties to partner Colleges and Schools within OSU. It is important that these relationships be carefully fostered by the Director of Professional Programs, the MGEL Faculty Director and the MGEL-GSC. Each college and school will be asked to identify one nonvoting representative to the MGEL-GSC so that their interests and concerns can be represented on the committee. The MGEL Faculty Director will also meet with each of these representatives (individually or as a group) at least once a year to discuss how the program is going and any concerns or issues that the partners' representatives wish to bring forward.

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October 20, 2012

Prof. Jeffrey Chalmers
Chair, CCAA
2070 Neil Ave.
CAMPUS

Ref: Proposal for Masters of Global Engineering Leadership

Dear Prof. Chalmers,

The Graduate Studies Chairs (GSCh) in the College of Engineering (CoE) strongly support the proposed professional degree "*Masters of Global Engineering Leadership (MGEL)*." All the GSCh have read the proposal and are eager assist with its implementation. Also note that this proposed degree has been endorsed by our alumni, the CoE Advisory Council and others.

This program will involve not only the CoE, but also the Fisher College of Business as well as the Glenn School of Public Affairs. The purpose of the Masters of Global Engineering Leadership degree is to prepare professionals in engineering disciplines to effectively lead innovative or challenging technical projects within their organizations. Its integrated curriculum of engineering and professional skills is designed to provide technical leadership and critical thinking skills to allow the graduate to operate at the interface of engineering, technology, science, and business in service to global society. A multi-term integrative project develops applied skills while at the same time creating an understanding of the relevance of individual projects to the larger context of both the organization and the international business and public sector environments. Graduates will be equipped to advance to technical leadership positions through the effective application of their technical, analytical, management and communication skills.

The proposed MGEL program will expand our offerings to working professionals, which is part of our strategic plan. The delivery mode will have both online as well as on-campus courses. The on-campus courses will be taught using the Executive MBA model of intense multiple-day sessions that meet on weekends. The initial offering of this program will have 3 technical tracks; however, additional tracks will be developed based on demand and expertise available in the college. If necessary, instructors with extensive industrial experience will also be hired.

A new MGEL-Graduate Studies Committee (MGEL-GSC) will be created and will be made up of the track coordinators, the College of Engineering Distance Education Director and the MGEL Director. The MGEL Director will act as the chair of the MGEL-GSC. The MGEL-GSC will handle all tasks

normally associated with a graduate studies committee (admissions, new courses, progress of students, and so on). In addition, it will evaluate and approve any proposed tracks, any changes to existing tracks and any proposed certificate programs. It is also responsible for evaluation of all courses, tracks and certificates in the degree program. It is essential that all aspects of the MGEL degree adhere to the highest standards. It should also be very responsive to industry and student needs. Evaluation will be continuous and ongoing. An Industry Advisory Board will be established to ensure the quality of the program and the ability to meet requirements. This Board will advise the MGEL Director and the GSC as well as taking part in the educational programs of the degree. The Director of the MGEL program will be responsible for day-to-day operations of the program. The Associate Dean for Graduate and Professional Education, Roberto G. Rojas will act as the Interim Director of the MGEL program until it has become established.

This new degree fits one of the goals of our college's strategic plan; namely, increasing our offerings of professional programs. The CoE-GSCh support this program and believes it will be an outstanding addition to our degree programs.

Thank you for your consideration.

Sincerely,

Jerry Brevick, ISE; Suliman Dregia, MSE; David W. Wood, CBE; Gagan Agrawal, CSE; Tunc Aldemir, Nuclear; Carol Smidts, MAE; Mark McCord, CEGE; Jason Kentner, Larch; Jay Martin, FABE; Samir Ghadiali, BME; Fusun Ozguner, ECE; Mei Zhuang, Aero; Stephen Turk, Arch; Maria Conroy, CRP; Roberto G. Rojas, Associate Dean, Graduate and Professional Education

Graduate Studies Chairs
College of Engineering

THE OHIO STATE UNIVERSITY
EEIC
ENGINEERING EDUCATION INNOVATION CENTER

244F Hitchcock Hall
2070 Neil Avenue
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Phone: 614-292-0573
FAX: 614-247-6255
Gustafson.4@osu.edu

24 September 2012

Roberto G. Rojas,
Associate Dean for Graduate and Professional Education
Professor, Electrical & Computer Engineering
College of Engineering
The Ohio State University

RE: Support of MGEL Degree Program Proposal

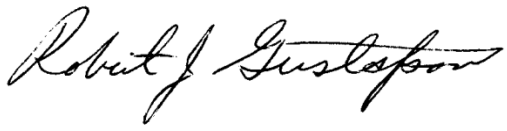
Dear Roberto:

The proposed Masters in Global Engineering Leadership certainly has the full support of the Engineering Education Innovation Center (EEIC). Students attracted to this program will benefit from the creative and innovative combination of course and experiences within the degree program model. This has the hallmarks of an experientially based educational program of the type that can be motivating to students and of great value to their careers.

The EEIC sees multiple ways that we can be collaborative in the development and offering of courses needed for this degree program. The EEIC's experience with innovation in educational programs will be a real asset to the MGEL program. We have instructional staff members with the type of industry and academic experience needed for this program.

The model developed is consistent with what we have recently learned through alumni surveys and study about the needs of engineering graduates to be leaderships in the application of engineering in global environment. The focus on advanced engineering skills with attention of global needs and constraints along with the heightened attention to professional skills will meet identified needs.

Respectfully,



Robert J. Gustafson, P.E., PhD
Honda Professor for Engineering Education
Director, Engineering Education Innovation Center
Professor, Food, Agricultural and Biological Engineering
The Ohio State University

THE OHIO STATE UNIVERSITY
JOHN GLENN SCHOOL OF PUBLIC AFFAIRS
glenn.osu.edu

August 27, 2012

Prof. David B. Williams
Dean and Presidential Professor
College of Engineering
2070 Neil Ave.
CAMPUS

Ref: Master of Global Engineering Leadership (MGEL)

Dear David;

I am writing to indicate the John Glenn School of Public Affairs' strong support for the College of Engineering's proposed Masters of Global Engineering Leadership. We are happy to cooperate with Engineering in developing this new degree.

The Glenn School will provide two classes for the degree program and teach those classes using the EMBA model of intense weekend sessions. The classes include: *PUBAFRS 6050* Management in Public Agencies (3 credits) and *PUBAFRS 5750H* The Business-Government Relationship (3 credits). We understand that the College of Engineering will request a special fee category for this degree and the fee for credit hours generated by courses will pass to the John Glenn School of Public Affairs. In addition, the College of Engineering will provide funds for course development for the first offering.

We look forward to working with the College of Engineering on this new masters degree and hope to develop additional cooperative ventures as we move forward.

Sincerely,

Charles Wise

Charles Wise
Founding Director
John Glenn School of Public Affairs

THE OHIO STATE UNIVERSITY FISHER COLLEGE OF BUSINESS

September 5, 2013

To: Avi Benatar

From: Karen Hopper Wruck

RE: Letter of support from Fisher College

Thank you for the materials received with regard to your proposed MGEL degree program. Over the years during which this proposal has been developed, we have worked with the College of Engineering and made recommendations regarding content and structure for the business-related courses to be delivered as part of this degree program. Over time, the planned format of delivery has evolved and the proposal has undergone various revisions. As we understand the current proposal, the plan is to launch the MGEL Program with the first set of students in place as early as Autumn 2014, pending required approvals. Further, we understand that:

- This program is a graduate masters degree program and is to include at least three business-related courses that cover the topics of: (1) Leadership in Business, (2) Team Effectiveness in Business, (3) Accounting, (4) Finance, and (5) Technology Strategy and Innovation.

- The curriculum delivery mode is either through live video streaming to students remotely attending the class at the same time as regular full-time students sitting in the classroom or through video-capture of lectures (augmented with voice and visual aids) that can be accessed online by students.

The College of Engineering already has most, if not all, of the Engineering classes needed to launch the MGEL program in place and currently offered to full time students on the Columbus campus. Thus, for the College of Engineering, the cost of offering these classes to MGEL students is the incremental cost of taping the classes and making any additional on-line content and other on-line resources available to MGEL students.

Fisher, in contrast, does not have the necessary courses in place for full time students. The content required for the MGEL program is not delivered in any of our current graduate programs in the sequence required by MGEL nor is it customized for graduate students in an Engineering Masters Program. Thus, we are unable to follow the delivery model that the College of Engineering is adopting for the MGEL program.

We do, however, concur with the offering of these three courses in the MGEL program and with the request to allow the College of Engineering to work with individual business faculty to develop and offer versions of business courses appropriate for the MGEL program and to approach Fisher faculty as part of this effort. We will be happy to facilitate introductions to Fisher faculty to help facilitate the development and delivery of these courses in the MGEL program.

Office of the Dean

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fisher.osu.edu

APPENDIX E

Summary of Industrial Survey: Evidence of Need

ABET has increased the importance of professionalism in its standards for accreditation. In addition, the National Academy of Engineering has issued a report on "The Engineer of 2020: Visions of Engineering in the New Century" (Link: http://www.nae.edu/19582/Reports/25876.aspx). The report recommends that "To maintain the nation's economic competitiveness and improve the quality of life for people around the world, engineering educators and curriculum developers must anticipate dramatic changes in engineering practice and adapt their programs accordingly." Indeed, the addition of the MGEL program with its professional core, technical tracks and integrative project will augment Ohio State's response to this increasing importance, but also will expand the visibility and reputation of the State of Ohio and The Ohio State University in the field of post-graduate professional practice of engineering. Furthermore, the program will focus a cadre of professional resources that can also be made available to enhance the undergraduate engineering educational experience.

In order to identify the leadership and business contents, the committee designed a survey and sought opinions from experts, practicing engineers and managers. The survey sought opinions and comments on the required skill set (in terms of essential, necessary, somewhat important, and business college offering) on the following topics: management, accounting/budgeting, business/project plans, logistics, supply chain management, quality management, *preneurship (intra- and entre- preneurship), marketing, strategic thinking/planning, globalization, leadership, human resources, team building, communications, negotiation, ethics, public policy, international operations, project development, project management, project assessment, legal issues, (intellectual property, business law, patent and copyright law), strategy, power and politics, product development, risk management, organizational behavior, labor relations, regulation of publicly traded companies, regulation and compliance of design, broad case studies that cover multiple areas, system view, and innovation. By and large, the respondents suggested elements of leadership, ethics and project management as the key skills needed. Over 50 participants from the following organizations and companies responded:

- Aerospace industry: Boeing, NASA, GE
- Air-conditioning industry: Trane, Emerson
- Ground Vehicle industry (automotive and truck): Honda, GM, Ford, BorgWarner, ArvinMeritor, International Engine & Truck
- Pharmaceutical/Medical: Wyeth, Ortho Organizers
- Research and Development and Instrumentation: Battelle, Data Physics, Ansol, Bishop

Some comments (received along with surveys) that stressed a need for such a program are cited below:

Sample of Comments

- I think such a program is an excellent idea as I see a real need for this type of education in the industry. In my experience, unless they have a prior technical background, many MBA graduates tend to lack the technical expertise and thus are missing a piece of the puzzle to truly be able to see the big picture. On the other hand, many engineers tend to remain in the engineering realm. This type of program therefore would fill a crucial gap.

- The MGEL program would be a very welcome addition to the practicing engineers - the specific skill sets would, to a certain aspect, depend upon the particular targeted industry. For instance the automotive industry is faced with a shrinking cycle time and product development needs to deliver a perfect paper design which is Best in the World (BIW) from all aspects - cost, quality, performance, functionality, flexibility, commonality... One of the skill sets, in addition to a commodity project plan, to achieve this is a 30, 60 90 day look ahead plan which requires risk assessment skills. This avoids last minute surprises which derail progress. I used this with success.

- MGEL is a very creative idea and there should be a lot of interest.

- It is a very interesting program that you are developing at OSU. It would be very successful if it is offered as part time as well as full time for the benefit of corporate employees.

- In my opinion, if you are looking to educate leaders in engineering, you want to emphasize classes in leadership, team building, and strategy to enhance the engineering classes in a MS degree. I do think that novel courses, such as management of innovation, could be a key course in turning out leaders of technology groups. I do not think regular business or law courses would be value added here. A good leader knows how to get the in-depth skills needed on his team. The main aspect you would want to get through to the students is true leadership skills, not management skills.

- In my opinion, it is a terrific idea. Ideally, it should suit people who have some experience (4-5 years).

- I gave my answers based on the Technology organization at GE thinking about technical leaders and what I've learned about what it takes to be successful. I hope this information is useful. I think this is a great idea and I look forward to hearing more about it as the program develops.

- This new degree program sounds great!

Name: _____
Company: _____
Date/Time: _____

DRAFT 1/11/07

EXECUTIVE MASTER OF ENGINEERING DEGREE INDUSTRY INTERVIEWS

INTRODUCTION, EXPLAIN PURPOSE, THAT YOU'LL BE RECORDING, ETC.

1. First, could you tell me a little about your company? PROBE: What type of work does _____ do? How many people work for _____? How many locations? How many engineers do you employ? What type of engineers? Do you know how many have advanced degrees? How many have MBAs?

2. What is your position? How long have you been with the company? IF AN ENGINEER, ASK: What engineering degrees do you have? What other degrees? *Are you responsible for hiring engineers?*

3. As I mentioned in my email, the Ohio State College of Engineering is proposing a new executive master's degree program for practicing engineers. I'm going to read you a description of the program and find out what you think about it.

The Executive Master's Degree Program would include:

- *short, intense courses in executive management skills, such as engineering leadership, budgets, interpersonal communications and globalization*
- *elective courses to form technical tracks in engineering specialties*
- *a Capstone project*
- *optional certifications in specialty areas, such as global engineering* leadership, professional engineering tools or quality and risk management

Other features are:

- *the program will be available on a part-time or full-time basis*
- *the program will be available on-site and/or via distance learning*
- *the program will require nine months to three years to complete depending on each student's schedule (full or part-time)*

4. What is your general impression of this proposed new master's program?

5. How would you see this program benefiting engineers and this industry?

6. What skills would you like to see in graduates from this program?

7. Do you have any thoughts about the distance learning aspect of this program?

8. Does your company offer a tuition reimbursement program? Please describe it. Do your engineers participate—particularly for masters programs? How likely would it be for your company to reimburse engineers for all or part of the tuition to pursue this degree?

9. If you were going to promote this master's degree program to businesses like yours, what benefits would you emphasize?

What might be reasons why you might NOT take this degree or recommend it to others in your firm?

10. What advantages would this Master's degree program have over an MBA degree program?

11. Do you have any additional thoughts or comments about the master's degree program, or the interview?

THANK AND CLOSE.

CORE REQUIREMENTS SURVEY

RAW DATA

Skill	Essential	Necessary	Somewhat Important	Fisher?	Comments
Management	13	5	2	5	* Course leading directly to PMI certification. Credential is sought after, especially in gov't. Credential is sought after, even for holders of an MBA.
					* Not clear what this topic means - i.e. management science? General management? People management?
					* Basic management skills in project management and HR.
					* Could be taught by Fisher, but must be taught by person with practical experience in engineering disciplines.
Accounting/budgeting	5	14	3	8	* Necessary evil.
					* Needs to include both financial and managerial accounting concepts.
					* Not needed.
					* Focus on time value of money and topics to support financial analysis for business case.
					* Budgeting component is essential. Broad finance/accounting knowledge is necessary. Focus finance/accounting knowledge is essential with focus on items like Internal Rate of Return(IRR), ROI, Breakeven Analysis, COGs Calculations, Inventory Turns, etc. Also developing finance/accounting skills to be able to develop forecasting models for product cost and sales volume and pricing, and methods to calculate cost of operations.
					* This would be beneficial for a technical manager
					* Budgeting/Forecasting
Business/project plans	12	9	1	5	* Dr. Ingrid Werner taught a wonderful class in International Business, with heavy emphasis in valuation and pro-forma financials that are key in considering the value of a prospective activity.

					* Development of business case.
					* Should have example plans for both technical and non-technical business activities/projects
Logistics	2	6	11	4	* Important in some areas, not all.
					* This skill has synergy with engineering background, in that eventually most engineers come across opportunity for involvement in production, especially in the setup stage. Fisher very highly ranked.
					* Not needed.
					*I recommend consolidating Supply Chain Management and logistic/operations into a single course.
Supply chain management	2	6	12	4	* Important in some areas, not all.
					* This skill has synergy with engineering background, in that eventually most engineers come across opportunity for involvement in production, especially in the setup stage. Fisher very highly ranked.
					* Not needed.
					* Design for sourcing, global supply chain management, reverse auctions
					* Would be essential for someone working in supply chain functions, for Technology awareness level is sufficient
Quality management	8	10	4	2	*Understanding robustness, product development, product life cycles, FMEAs, etc.
					* Course leading directly to 6 sigma certification. Credential is sought after, even for holders of an MBA.
					* Rigorous training in the relevant statistical techniques, rather than just a survey of management "buzz words" would be really helpful here. (i.e. quality engineering + quality management
					* TQM, effective use of quality tools such as QFD to understand voice of customer - ties with business case.
					* Should have focus on statistical process like 6 sigma
					* Reliability could fall under this category; quality is important in any technical role

***preneurship (intra- and entre-preneurship)**	7	5	8	2	* The benefits of entrepreneurship are often appropriated by those who can raise funds. Engineers need to know the principles to understand what their role is, and increase their value even if they are not directly responsible for those activities. IMHO, OSU was lacking in this field, and allowed a motley crew of local entrepreneurs to come in and indulge their tendency to promote themselves to the student body instead of engage in meaningful teaching. The addition of content from creativity experts such as Artie Isaac and economist Bruce Weinberg has been a step in the right direction - of a more rigorous, case study approach. This may not easily be replicated by the college of engineering without a sizeable learning curve.
					* Understanding IP protection and development is important.
					* Not needed.
					* Not sure I fully understand what you are thinking on this. I think it is important but not essential.
					* Could be required seminar course instead of full course or tied to leadership course. Lots of value to this student interested in some day leading a business or starting their own business, but some individuals may not see the value in it.
					* Not sure what would be covered under this topic
Marketing	6	7	9	5	* Not just marketing by itself, but the role that marketing plays in the organization, particularly in product development (e.g. house of quality, VOC).
					* People involved in the engineering function benefit from an understanding of product mix concepts, and can more effectively incorporate the right mix in designs. Buck Matthews class was very good.
					* Focus on understanding customer and market and building business plan.
					* Both domestic and international with technology bias.

Strategic thinking/planning	16	7	1	5	* These skills are necessary to be able to talk with and gain acceptance from upper management. Fisher's Michael Leiblein teaches an excellent course in the field. He has a particular rapport with scientists and engineers (has an EE background), and knows how to expand understanding.
					* An ability to think on strategic level is key for leadership and one of the things that really sets people apart.
					*Should be both business and technical focus, therefore taught by team or technical individual. Also, grouped with strategy course
					* Would say this is important for any manager
Globalization	7	9	7	5	* Unfortunately necessary in our day to be able to survive. Engineers benefit from an understanding of the costs and benefits of offshoring, approaches to deciding when it is appropriate, and methods to mitigate costs and pitfalls such as exchange rate fluctuation, political instability, corruption, etc. Mike Peng at OSU taught an excellent multinational business class.
					* Too industry specific.
					* Focus on understanding global markets and customers. Also focus on working in global environment - global engineering centers and global manufacturing, global supply chain.
					* Seems like a topic that could be tied into strategic planning, marketing and logistics/supply chain. It is a critical topic in today's market, but I feel it adds more value to discuss it in the specific courses content rather than on its own.
					* Also a big deal at GE
Leadership	17	5	2	2	* I am not convinced this can be taught, and am suspicious of anyone that claims they can teach it.
					* This is more on the job.
					* Not sure who in a college would teach this?
					* Leadership skills are another key area that sets people apart. Focus on cross-functional and global team environment.
					* Critical course that must be taught by person with strong resume of leadership experience. Could be taught by Fisher, but technical person may have more value. Also consider an industry executive to get practical experience.

					* Think its important to recognize the value of leadership no matter what the position
Human resources	2	7	13	4	* Understanding and managing people, key area is global perspective and understanding impact of and management of cultural differences.
					* Human resource planning. Acquiring and retaining talents. Reward and discipline. Flexibility
					* It is important and necessart to understand HR, but this could be done via a section of a larger course. Perhaps HR, Labor relations, and Organization Behavior could be rolled into a single course that is broken into three modules. This was done in my MBA program and it was very effective for getting the critical information across without providing excessive information to just fill a course.
Team Building	11	9	4	0	* I believe this is a leadership skill.
					* Again, who in the college? Perhaps outside.
					* Critical, need focus on cross functional, global, and virtual teams
					* Great topic as many engineers do not interact well with their teams, however, this could be a required seminar or part of the leadership course.
					* At GE, majority of technical positions involve working in a team
Communications	14	11	1	1	* In particular an intensive class in public speaking, presentation techniques, rhetoric and debate.
					* Depends on what you mean.
					* Comm. Dept.
					* Critical, need focus on communication for cross functional, global, and virtual teams
					* Key is effective communicating in gaining commitment
					* Great topic as many business people and engineers need to improve verbal, written, and body language communication.
					* Always essential to any technical position in industry
Negotiation	9	10	4	7	* You never make as much money as you do when negotiating. Roy Lewicki at OSU is considered an expert in the field, and teaches a course that no one should miss out on.

					* Internal and external skills, concensus building, getting buy in, getting good contracts
					* Could be mixed with sales course or contracts, but should provide individuals with a background and case studies in different negotiation methods.
					* Could be useful for leaders in any position
Ethics	7	10	6	4	* Military intelligence, Jumbo Shrimp, etc.
					*Should have been developed in undergraduate program.
					* Critical, particularly important with current climate in the US and managing business relations in global environment
					* Great course with both technical and business discussion points. Could be technical teacher or mixed.
					* Would consider this essential for anyone
Public Policy	0	5	13	4	* Too industry specific.
					* Not needed.
					* Important for helping develop strategic planning
					* Could be required seminar course instead of full course or tied one of the other full courses.
International operations	3	11	5	5	* Perhaps as part of a globalization course, or as a specialized elective.
					* Too industry specific.
					* Not needed.
					* Important in understanding global manufacturing, global sourcing, and global customers
					* In today's market, this is necessary
Project Development	12	8	2	1	* Perhaps as part of a PMI certification course.
					* Not needed - Company specific.
					* Not clear what this is
Project Management	14	7	0	2	* A systematic approach is crucial in all phases of project management.
					* Perhaps as part of a PMI certification course.
					* Not needed - Company Specific

					* Critical, all items are meaningless unless you can execute and get results
					* Important for future technical leaders
Project Assessment	12	9	1	0	* Perhaps as part of a PMI certification course.
					* Not needed.
					* Important in the context of portfolio management
					* Particularly in prioritization of multiple projects. Discreminate the critical ones from the discretionary
					* All three of these (project development, management, and assessment) are essential and should be taught with a technical overtone. I am a strong believer that if you can lead and manage a technical project with multi-discipline engineering, marketing, production teams then you can lead non-technical project. So a technical teacher is important
Legal issues	2	3	8	2	* I think being aware of legal matters is important, however, I tend to leave it to the experts and learn from them as I go. That said, offering an option for those who want to dive deeper into this field may be a good idea.
					* Dominated by patent attorneys.
					* Only required to a certain level or could be a whole degree!
					* Patent lawyer that is active and successful should teach this.
					* Not needed - should rely on legal dept
Intellectual property	5	7	8	3	* Dominated by patent attorneys.
					* Managing in global environment is important, impacts global engineering resources
					* Based on my experience at GE, this one would be extremely useful for a technical leader in industry
Business Law	3	7	11	3	* Dominated by patent attorneys.
Patent and copyright law	5	8	9	4	* Dominated by patent attorneys.

					* A great seminar would be enough to educate most individuals as all companies consult legal teams nowadays. Could also throw contracts into this group and make it a multiple meeting seminar
					* Based on my experience at GE, this one would be extremely useful for a technical leader in industry
Strategy	13	8	1	4	* See strategic thinking above.
					* A business school could teach this.
					* Both strategic planning and execution - the big picture in "do the right things"
					* Should be both business and technical focus, therefore taught by team or technical individuals. Also, grouped with strategic thinking/planning
Power and Politics	1	5	14	5	* Political science dept
					* ID the stakeholders and their needs (both business and personal needs
					* Could be interesting course, but these are the things a good leadership course should help eliminate in a organization. So I'd say it only somewhat important.
Product Development	12	9	2	0	* Here again, a holistic approach is essential. Looking both inside -- how each department within the organization is involved in product development, and outisde -- how the product fits in the market, fares to the competition, what are the existing relevant technologies, etc.
					* Essential course with focus on marketing and technical concepts
					* In industry, I would say this is important.
Risk management	13	7	4	4	*Financial risk management may be an important financial tool for small businesses and startups operating internationally. Rene Stulz is a world renowned leader in the field, though it is rumored that he is leaving OSU for Stanford, I believe. He teaches in the context of banking - Ingrid Werner had content included in her international business class.
					* Important part of most programs, focus on tools to better quantify and manage risk to meeting program objectives

					* Needs to review and analyze both technical, regulatory, and business risk. Best to have engineering/technical teacher
					* Based on my experience at GE, this one would be extremely useful for a techincal leader in industry
Organizational behavior	0	14	5	3	Considered a staple of MBA education. Would not recommend Fisher on this.
					* Roll into HR course.
Labor relations	1	3	14	4	* Decline of organized labor makes this less important.
					* Rely on personnel
					* Roll into HR course.
					* Would be essential for someone working in supply chain functions, for technology awareness level is sufficient
Regulation of publicly traded companies	0	3	14	6	* Rely on law dept
					* Interesting topic, but not full course. Great seminar topic.
Regulation and compliance of designs	1	5	14	1	* Rely on law dept
					* This is part of risk management for development projects
Broad case studies that cover multiple areas	7	7	7	3	* I think this is important as case studies tend to be of successes in a particular aspect - companies are reluctant to allow a case study of a failure. Broader studies would give a more realistic view of the world, along with lessons in dealing with unintended consequences of actions. These case studies may be limited in availability due to the reluctance mentioned earlier.
					* Case studies are key for the study of business.
					* ?
					* Critical to tie the education back to practical examples. Should be taught by mixed team, both technical and non-technical
					* Case studies are a good way to learn about business decisions
System view	9	8	4	1	* ?

					* Another item that sets folks apart, critical with managing cross functional and global projects
					* System engineering or business system? Both would be excellent course topics
					* Key part of GE's technology teams (i.e. systems engineers that focus on the system view of products)
Innovation	8	8	5	0	*Perhaps as part of an entrepreneurship curriculum.
					* Important but not essential, I think this can be a difficult thing to teach, focus on understanding market needs, customer needs, and creative problem solving is what is critical
					* Difficult to teach innovation. So, I'd have some discussion in the product development course, but would not make it a class
					* Important but not sure if a class is really necessary
Others:					
Management of innovation	1				* Book by Ralph Katz - specialty course
Value Creation	1				* Creating value to drive healthy business growth
Productivity Improvement	1				* A must for competitive advantage
Cross Discipline technical studies: Electrical engineering for ME(s) and SE(s)	1				* Many engineering leaders struggle with the challenges of managing outside their respected studied discipline. By requiring each discipline to study at least one of the other disciplines to develop basic understanding of critical concepts, the degree program would create better managers and leaders. Could be expanded to toher disciplines like chemical eng., etc. Same effect could occur via a systems engineering course that covers all three disciplines.
Cross Discipline technical studies: Electrical engineering for EE(s) and SE(s)	1				* Many engineering leaders struggle with the challenges of managing outside their respected studied discipline. By requiring each discipline to study at least one of the other disciplines to develop basic understanding of critical concepts, the degree program would create better managers and leaders. Could be expanded to toher disciplines like chemical eng., etc. Same effect could occur via a systems engineering course that covers all three disciplines.

Cross Discipline technical studies: Electrical engineering for EE(s) and ME(s)	1				* Many engineering leaders struggle with the challenges of managing outside their respected studied discipline. By requiring each discipline to study at least one of the other disciplines to develop basic understanding of critical concepts, the degree program would create better managers and leaders. Could be expanded to toher disciplines like chemical eng., etc. Same effect could occur via a systems engineering course that covers all three disciplines.
Systems Engineering	1				
Contracts		1		1	* Should be taught by lawyer/law school professor
Sales	1			1	* Most technical leaders/managers can not sell and it is an essential skill. Every day as a leader I interact with customers and it helps sell products. Further I have to sell my ideas, approaches to problem solving and many other things, so this is a critical skill that is often overlooked.
Statistic			1		* Refresher course to help with Quality Management and 6 sigma
Business process development		1		1	* Could be part of logistic/operations, but need to cover how to develop a technical and non-technical business process.
business cultural studies		1		1	* Most individuals in the US without global experience don't understand the business of business, how customs of each country effect the international business relationships. For example, the proper way to exchange business cards in Japan or what customs are expected when enterint an Asia business complex, etc.
Reliability	1				* Reliability is a huge part of GE, there's a strong focus on reliability at every level-entry to upper management and there is a specific organization devoted to being experts
Additional comments:					
					* I think that it is important that MSME be a prerequisite for an MEL degree. The MEL Degree curriculum needs to be very focused -- many things are best left for on-the-job training that will naturally occur.
					* Work experience (perhaps 3 years) would be a worth while prerequisite for the program. It would ensure that the students have had some exposure to these topics beforehand and their stories would enrich the learning experience.

					* Assessing and using team strengths to ensure no surprises. Regular meeting cadence for comm.

APPENDIX F

April 30, 2012 Lorrie McAllister

Distance Education in Engineering Management Program Review

Summary

This research on programs in distance education in Engineering Management informs the forthcoming Master's degree in Global Engineering that will be offered by OSU in Autumn 2013. Both Engineering Management (or similar) programs from institutions that have top-10 ranked[1] Engineering programs and institutions that may be considered to be peers of OSU's College of Engineering are included in the review. Also included are institutions that offer distance-only education programs in Engineering Management. Of the 25 institutions reviewed, 22 have graduate degrees in Engineering Management and 1 has a Certificate program. These programs are mapped below, with OSU indicated in red.

Map of institutions offering Engineering Management programs

Link to Map:

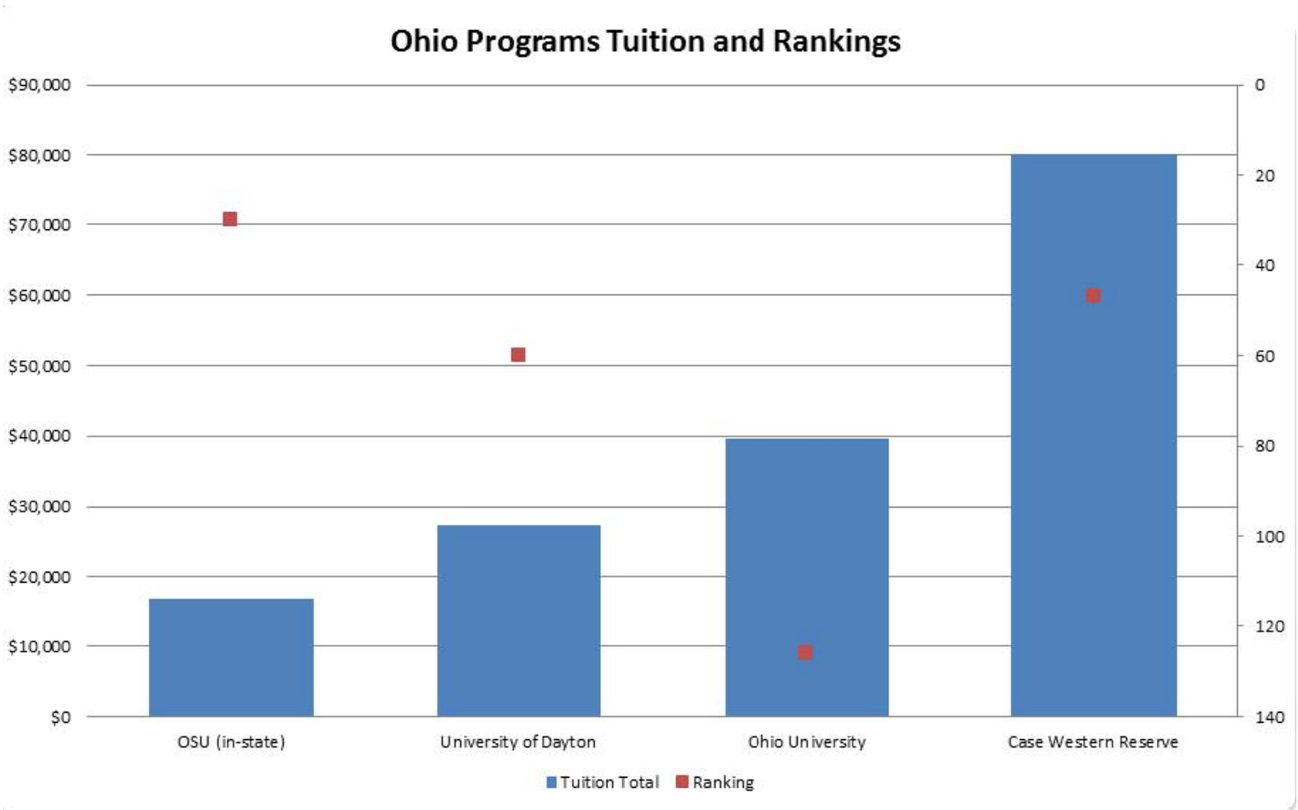
http://maps.google.com/maps/ms?msid=206307502204975922234.0004be2613aa6016c4992&msa=0&ll=36.173357,-94.658203&spn=59.313401,79.013672

This map shows a high concentration of schools with Engineering Management programs in the upper Midwest. This suggests that OSU will have a lot of competition for students within the region. There is also competition within Ohio, as three institutions (Case Western Reserve University, Ohio University, and University of Dayton) have Engineering Management programs. How can OSU's new Master's degree in Global Engineering Leadership (MGEL) program compete?

[1] Rankings are according to U.S. News & World Report 2012 ranking of best Engineering Schools, http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools/eng-rankings.

Best Value in Ohio

Tuition for the degree program at the three Ohio universities varies. It is more than $80,000 at Case Western Reserve University (CWRU), almost $40,000 at Ohio University (OU), and $27,300 at the University of Dayton (UD). If the OSU program could be completed in 1.5 years, the tuition for the span of the degree would be approximately $17,000 for an in-state student. Of these other programs in the state, OSU's Engineering program is ranked highest (30th), while CWRU is 47th, UD is 60th, and OU is 126th. This would make OSU's degree the least expensive option in the highest-ranked Engineering program in the state. For in-state



Overall Value and Flexibility

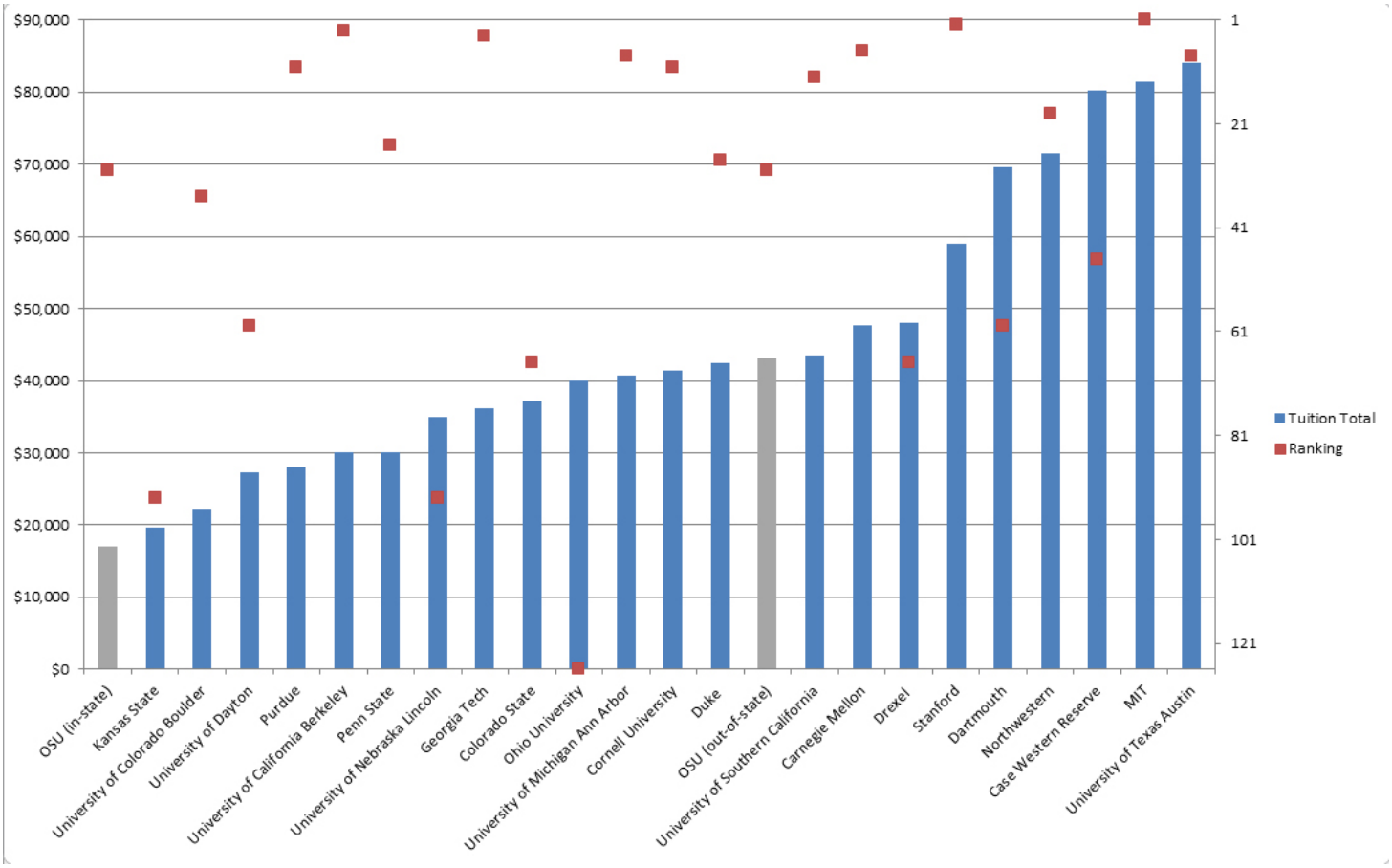
Of the 23 programs, 13 offer online-only and/or blended options (courses held online and in-person). These 13 online/blended programs are noted in light blue in the table below. This suggests that there is a lot of competition for students in the distance-education market for this degree. There are 3 programs similar to the MGEL in Ohio, 9 in the region, and 12 programs with degrees that may be earned entirely online.

Map of institutions offering Engineering Management programs, with online programs in light blue

In order to compete for students, OSU should consider offering flexible program options, including online-only and blended degree options. A model of this kind of flexibility can be found at Duke University, which offers both a campus-based experience (MEM) and a “low-residency” option (d-MEMP), which allows students to spend more time away from campus. Likewise, Colorado State University offers a DVD option in which students do not need consistent Internet connectivity to complete course requirements. Offering flexible alternatives will expand the pool of potential students beyond Ohio and ensure continuous competitive candidate pools.

Another flexible way to attract students is to offer personalized curricular experiences. Of the 23 institutions with Engineering Management or similar degrees, 14 programs enabled flexibility in the curriculum through the students’ choice of electives and customized internships and projects. Only 3 institutions emphasized flexibility and personalization in their program materials (Carnegie Mellon, Duke, Penn State), which can be achieved through electives, evening and weekend classes, self-paced programs, or rolling admission. MIT and Penn State emphasized a cohort-based approach to their programs to offer maximum networking opportunities. Of the 23 institutions, 8 programs had information about delivery mode and support (Colorado State, Drexel, Ohio University, Penn State, Purdue, UC Boulder, Dayton, USC), which helps to inform potential students what to expect regarding computer requirements and skills needed to complete the program.

The median program tuition cost across all programs (out-of-state) was $46,007. Tuition program costs by institution are graphed below with their associated ranking. Out-of-state students would pay slightly under the median ($40k) if they attended OSU’s MGEL program through a distance-education option or as a blended program.



It would be in the best interest of the MGEL program to advocate that OSU offer a "distance education" tuition rate positioned between in-state and out-of-state rates. Kansas State, Purdue, and the University of Nebraska have distance education tuition rates. Providing this option would offer a better value for non-Ohio students. However, OSU would have to ensure that the program could be delivered for costs that are in proportion to a distance education rate.

Industry Engagement

Another facet of the reviewed programs is internships and industry engagement. Of the 23 programs reviewed, 5 emphasized internships and industry engagement (CWRU, Carnegie Mellon, Duke, MIT, Dartmouth). Industry contact allows students to gain experience and make connections that can help them get relevant jobs. OSU should consider whether it is feasible to offer internships or other means of industry engagement. OSU may also consider trying to participate in the Master of Engineering Management Consortium (http://www.mempc.org/), a highly selective and forward-thinking professional graduate engineering management program dedicated to common goals that raise awareness of the MEM degree, expand its value-added opportunities, and forge business partnerships.

Note: Colorado State may have shut down their program during the course of this research. It would be informative to follow up with the school to understand their reasons for doing so.

Research Table

	Institution	Program/Degree	Online ?	Course content	Specializations / Personalization	Credits/courses	Tuition $ (assume Ohio resident)	Start	Delivery mode(s)	Ranking (US News & WR '12)
1	California Institute of Technology	no program	--							5
2	Carnegie Mellon	Masters in Engineering & Technology Innovation Management http://www.cit.cmu.edu/etim/sample.htm	no	Managerial and Engineering Economics, Strategy and Management of Technological Innovation, Product/Process Innovation, Innovation Management in Practice http://www.cit.cmu.edu/etim/Structure.htm	Silicon Valley immersion Tailored through electives E, I	Part-time, dual degree or Silicon Valley immersive experience 2 year PT or 1 year FT; 4 courses + seminar + internship	$47,600/year Total: $47,600	Fall or Spring	face-to-face	7
3	Case Western Reserve University	Master of Engineering and Management Degree http://engineering.case.edu/mem/	no	Professional development, project management, materials and manufacturing, accounting, finance, economics, six sigma, org change, stats, process design, paid internships, coaching and mentoring, individualized learning plan, staff support. Support graphic: http://engineering.case.edu/mem/sites/engineering.case.edu.mem/files/images/Picture1_0.png	Technology track and Biomedical track "unique executive coaching" +Industry collab T, I	3 semesters, 42 credits Full-time only, "Lock step" program	$40,120/year Total: $80,240	Summer	Blended. Not much info about delivery on website	47

4	Colorado State University (This program may have been discontinued)	Online Masters in Engineering Management http://www.online.colostate.edu/degrees/mechanical-engineering/engineering-management.dot	yes (online and DVD)	leadership, decision making, organizational communication, economics, supply chain management, marketing management, international business, finance, accounting, manufacturing systems	n/a	30 credits, can be completed in 2 years.	$1,243 per credit Total: $37,290 Total: $37,290	rolling	CSU uses a secure software platform called RamCT, which provides user-friendly access to course materials, discussion groups, assignments, exams, and other learner services. Many courses provide streaming videos of lectures recorded from on-campus programs. http://www.online.colostate.edu/onlinedistance/online-learning.dot	67
5	Cornell University (in MEMPC)	MENG in Engineering management http://www.cee.cornell.edu/academics/graduate/engineering_management.cfm	no	Project Management, Engineering Management Project, Engineering Management Methods, Risk Analysis and Management, Accounting and Financial Analysis for Engineers/Economic Analysis of Engineering Systems/Managerial Finance http://www.cee.cornell.edu/academics/undergraduate/loader.cfm?csModule=security/getfile&PageID=70969	specialization courses to focus on a disciplinary or functional specialty E	30 credits the program is set up to be finished in two semesters (1 year) (M.Eng) 2 years for M.S.	Professional degree (M.Eng) $41,325 Research Degree (M.S., M.S./PhD): $29,500	Fall, Spring		10

6	Dartmouth (in MEMPC)	Master of Engineering Management (MEM) http://engineering.dartmouth.edu/academics/graduate/mem/	n/a	Curriculum integrates engineering, mathematics, and core management courses. Electives typically are engineering and management courses, but students may also choose courses from Dartmouth's other graduate science departments, The Geisel School of Medicine at Dartmouth, Vermont Law School, or The Dartmouth Institute for Health Policy & Clinical Practice (TDI).	5 focus areas with personalized programs of study; internships with industry E, I	14 courses, 4 terms and summer	$13,912 per term Total: $69,560	n/a	n/a	60
7	Drexel University	Online Engineering Management Master's Degree http://www.drexel.com/online-degrees/engineering-degrees/ms-egmt/index.aspx	yes	Management Technology Marketing Engineering Law R & D Management Quality, including Six Sigma Systems Engineering Project Management Green Engineering Ethical Issues http://www.drexel.com/online-degrees/engineering-degrees/ms-egmt/curriculum.aspx	Concentration in Infrastructure Engineering Management E	16 courses (11 core, 5 elective) 48 credits	$1,000 per credit Total: $48,000	rolling	Entirely online. Demo: http://www.drexel.com/demo Online library resources; networking with other online learners	67

8	Duke University (in MEMPC)	Master of Engineering Management http://memp.pratt.duke.edu/engineering-management and Distributed Master of Engineering Management Program http://memp.pratt.duke.edu/?gclid=CO7EIIumiq8CFUMTNAodM3pq_w	yes - blended and online only option	Marketing, finance, intellectual property, business, law, entrepreneurship, management, teamwork, negotiation http://memp.pratt.duke.edu/sites/beta.memp.duke.edu/files/memp/MEM%20Brochure.pdf	Management of Technology concentrations (applied); Science and Technology concentrations Can customize with electives ++ Industry Collab E, I	MEM: 8 courses, an internship, 2 semesters of seminar and workshop series. Can be completed in 1 year, but flexible d-MEMP: distance + 3 week intensive	$5,310/course Total: $42,480	Fall, Spring	n/a	28
9	Georgia Tech	Graduate Certificate in Engineering Entreprenuership (from the College of Management) http://mgt.gatech.edu/fac_research/centers_initiatives/ee1/index.html	no	Principles of Management for Engineers, Technology Venture, Legal Issues in Engineering Entrepreneurship + electives http://mgt.gatech.edu/fac_research/centers_initiatives/ee1/ee_certificate.html	Choice of electives E	12 semester hours	Non-resident: $36,246 Total: $36,246	completed with degree program	n/a	4
10	Kansas State University	Masters in Engineering Management from Industrial and Manufacturing Systems Eng. http://www.dce.k-state.edu/engineering/masters/management/	yes	Advanced Industrial Management, quantitative problem solving methods, project management, logistics, etc. http://www.dce.k-state.edu/engineering/masters/management/curriculum	Can customize with electives E	30 credit hours; Part-time, 2-4 years.	Distance ed rate: $654 per credit hour Total: $19,620	rolling	n/a	93

11	MIT (in MEMPC)	Leaders for Global Operations http://engineering.mit.edu/education/graduate/lgo.php http://sdm.mit.edu/	no	School of Management courses + Masters in one of the following: Aeronautics and Astronautics Biological Engineering Chemical Engineering Civil and Environmental Engineering Electrical Engineering and Computer Science Engineering Systems Mechanical Engineering	n/a ++ Industry Engagement cohort-based approach I	2-year dual degree program to develop Eng Management skills	$40,732 / AY Total: $81,464	rolling	on-campus	1
12	Northwestern University (in MEMPC)	Master of Engineering Management Certificate options http://www.mem.northwestern.edu/program/program_features.html	no	basics of management, quantitative analysis, and behavioral science and choose advanced engineering electives in their area of specialization	can customize with electives and personalize curriculum E	full time or part time, 12 courses	3,980 per course Total: $70,000 to $73,000	rolling	n/a	19
13	Ohio University	Online Master of Engineering Management http://engineering.online.ohio.edu/engineering-management/	yes	Engineering, Statistics, Information Systems, Management. Curriculum: http://engineering.online.ohio.edu/engineering-management/engineering-management-degree/mem-curriculum/	flexible scheduling	20 months min. 10 courses; 34 semester course hours	Resident: $19,839/year Non-Resident: $20,502/year International: $20,502/year Total: $39 - 40,000	Fall	“Delivered via an online learning environment...Classes are taught with multimedia applications, such as videos and audio recordings from faculty members, and they incorporate real-world software applications, such as Minitab, Excel, CAD software, etc.“	126

14	Penn State University - World Campus	Engineering Management Master's Degree http://www.worldcampus.psu.edu/degrees-and-certificates/engineering-management-masters/overview	yes	Creativity and Problem Solving, Decision and Risk, Engineering Management Science, Engineering Management Strategy, Financial Studies for Engineering, Organizational Behavior, Technical Project Management http://www.worldcampus.psu.edu/degrees-and-certificates/engineering-management-masters/courses	Individualized cohort-based approach E	33 credits, 12 courses. Continuous 5- or 7-week terms over a 2-year period. Can work full-time during. "maximum flexibility"	$912 per credit Total: $30,096	Spring, Summer	http://www.worldcampus.psu.edu/how-online-learning-works	25
15	Purdue https://engineering.purdue.edu/ProEd/credit/eml	Purdue Online Engineering Management Management Program	yes	Design Optimization, Systems Modeling and Analysis, Globalization and Engineering, Quality Control, Industrial Applications of Statistics, Engineering Economic Analysis, Economic Decisions in Engineering, Safety Engineering, Human Factors in Eng, Systems Simulation, Manufacturing Economics....Global Political Economy, Cross-Cultural Communications, Global Negotiations, Accounting, Global Strategy, etc. https://engineering.purdue.edu/ProEd/credit/eml	individualized program E	33 credit hours, 21 credits must be Purdue courses	Business courses are $1,187 /credit hour; Streaming video (3 credits): $3,096 /course; Streaming video (2 credits): $2,155.00 /course; Project course: $4,128.00 Total: ~$22 - 28,000	n/a	primarily through streaming video over the internet and downloadable MPEG-4 files	10

16	Stanford University (in MEMPC)	Management Science and Engineering MS Degree http://scpd.stanford.edu/public/category/courseCategoryCertificateProfile.do?method=load&certificateId=1236449	some online some at Stanford	Students must take at least 5 courses out of the following 11: Dynamic Systems/Stochastic Decision Models, Linear and Nonlinear Optimization, Probabilistic Analysis, Stochastic Modeling/Simulation, Economic Analysis, Decision Analysis I/Engineering Risk Analysis, Accounting/Investment Science, Inventory Control and Production Systems, Organizational Behavior, Global Entrepreneurial Marketing, Strategy in Technology-Based Companies	flexible course and delivery option E	15 courses Most part-time students take an average of 3 to 5 years to complete the 45-unit requirement	$1,310/unit, 45 units for the degree Total: $58,950	n/a	n/a	2
17	University of California --Berkeley	Engineering and Project Management http://www.ce.berkeley.edu/programs/epm?destination=node/140	no	Load Engineering, Lean Construction Concepts and Methods, Lean Construction and Supply Chain Management, Law for Engineers, Civil Systems and the Environment, Management of Technology: Engineering Leadership and Teamwork, High-Tech Buildingand Industrial Construction, Business Fundamentals for Engineering, Human and Organization Factors: Risk	Master of Science Degree: Plan I (with thesis): 20 units Plan II (with exam): 24 units E	20 units for thesis option, 24 units for exam option	$7,492.25 per semester for resident $15,043.25 for non-resident Total: $30,086	Fall, Spring	face-to-face	3

				Assessment and Management of Engineered Systems, etl						
18	University of Cincinnati	no program	no							80
19	University of Colorado - Boulder Lockheed Martin Engineering Management Program	Master in Engineering Management http://emp.colorado.edu/index.htm	yes	Engineering Management, finance and accounting, project management, software project management, leadership, business planning, research methods http://emp.colorado.edu/degree/index.htm	Various electives http://emp.colorado.edu/degree/index.htm E	30 credit hours (6 core, 4 electives/ capstone)	Distance tuition: $2,223.00 per 3-credit course Total: $22,230.00		Live classes with on-campus; students are recorded in our professional studios and offered asynchronously to distance students. In addition, an Internet-based class management tool is used to facilitate the interaction between on-campus students, distance students and the professor. They use Tegrity. http://emp.colorado.edu/prospective/distance-learning-online-or-	35

									campus.htm	
20	University of Dayton	Engineering Management http://www.udayton.edu/learn/graduate/engineering/major_engineering_management.php	yes	http://www.udayton.edu/learn/graduate/engineering/major_engineering_management.php Most courses are simulcast and recorded for students' future reference.	Certificates in Six Sigma and systems engineering	36 semester hours (12 courses); can complete in 2 years	$758.00 / semester hour (in-state) Total: $ 27,288	n/a	Courses are delivered live over the Internet via Web conferencing software. Access to the live class requires only a computer with Internet access, speakers and a microphone. A two-way audio connection and an electronic whiteboard enable real-time learning. Students can ask questions, receive immediate feedback and run applications, creating a highly technical, yet highly personal environment. In addition to real-time	60

									conversation during class, students can readily access the professors by phone, e-mail, and course Web sites. http://www.udayton.edu/engineering/management_and_systems_grad/distance_learning.php	
21	University of Illinois - Champaign Urbana http://oce.illinois.edu/Controls/Midnight/SubjectViewer.aspx?subject=ENG	no program	--		self-paced and semester-based courses					5

22	University of Michigan - Ann Arbor	Construction Engineering and Management M. Eng CEM & M.S.E. CEM http://tcmp.engin.umich.edu/	no	not much info	n/a	MSE: 18 hours MEng: 18 hours	$20,334 per term out of state Total: $40, 668	n/a	n/a	8
23	University of Nebraska - Lincoln	Master of Engineering Industrial and Management Systems (Eng Management) http://www.unl.edu/gradstudies/prospective/programs/Engineering_MEng.shtml	yes	not much info	n/a	n/a	non-resident distance ed: $978.00 / credit hour Total: $35,000	fall, spring, rolling	n/a	93

24	University of Southern California	Master in Engineering Management http://mapp.usc.edu/mastersprograms/degreeprograms/ISE/MSEMT.html	yes	Core themes: Accounting, Projects and Teams, Technology, Information Systems, Engineering Economy, Enterprises, Quantitative Methods http://mapp.usc.edu/mastersprograms/degreeprograms/ISE/MSEMT.html	none mentioned	Minimum 30 units	Off-campus: $4,341 / 3-unit course Total: $ 43,410	n/a	Available via online delivery through the Viterbi School's Distance Education Network (DEN). Live courses or recorded sessions. Live instruction is interactive. http://mapp.usc.edu/distanceeducation/howdenworks.html	12
25	University of Texas - Austin	Engineering Management	yes	Managing People and Organizations, The Art and Science of Negotiations, Advanced Marketing Management, Legal Issues for Engineering Managers, Management of Projects and Processes, Strategic Decision and Risk Analysis, System Design Metrics, Engineering Economics, Engineering Management http://lifelong.engr.utexas.edu/pme/courses_enm.pdf	remote option; flexible scheduling E	36 semester hours	$40,000* for students enrolling Fall 2012 Tuition will be $42,000 for online students. Tuition rates are guaranteed for two year's duration. Total: $84,00	Fall, Spring Rolling based	Available both online and on campus	8

Note: tuition figures do not include fees.

University of Phoenix has Master of Information Systems only: http://www.phoenix.edu/programs/degree-programs/technology/masters/mis.html
How they deliver distance ed: http://www.phoenix.edu/students/how-it-works.html

Free online PhD level Engineering courses from USC: http://viterbi.usc.edu/academics/phd-courses-online/

MIT's Career Reengineering Program is an interesting model. It's a 12-month part-time program where they re-boot your skills and set you up with an internship to start you on a new or improved career path. http://web.mit.edu/professional/career-reengineering/index.html

MIT's free OpenCourseWare with many Engineering courses: http://ocw.mit.edu/index.htm MITx offers free "live" courses where students can earn a certificate. http://mitx.mit.edu/
Entreprenuership courses: http://ocw.mit.edu/courses/entrepreneurship/

Free course content from Stanford Engineering: http://see.stanford.edu/see/courses.aspx and free synchronous open courses: http://engineering.stanford.edu/transforming-education-technology
Stanford also has an entirely online non-degree option. 18 credits of these courses can be applied toward a degree, if a student is admitted.

Evidence of Impact research:

U.S. Department of Education. (2010). Evaluation of Evidence-Based Practices in Online Learning: A meta-analysis and review of online learning studies.
http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf Findings: p.17. Narrative synthesis: p.37

Kim, K. and Bonk, C.J. (2006). The Future of Online The Future of Online Teaching and Learning in Higher Education: The Survey Says… Educause Quarterly Magazine, Vol. 29, Number 4.

New iPad studies from Abilene Christian University: http://www.acu.edu/technology/mobilelearning/research/ipad-studies.html

2007: Research

1. **Trends and opportunities**
2. **Other programs in the US**
3. **Internal capabilities and assessment**

The Engineer of 2020*

Knowledge Delivery Requirements

- increasing number of engineers working in nontraditional areas that require technological competence and/or fluency in practice (e.g., management, finance, marketing, public policy, etc.)
- diminishing half-life of engineering knowledge
- growing concerns about the social and political implications of rapid technological advances and their uneven application among different constituent groups (the digital divide, medical ethics, etc.)
- shift in engineering employment from large companies to small and medium-sized companies and the growing emphasis on entrepreneurialism

*National Academy of Engineering

The Engineer of 2020

Innovation requirements

- accelerating pace of technological advances, including the increasing importance of information technology, communications science, and biological materials and processes in engineering
- globalization of economic systems and the interconnectedness of its component parts
- growing complexity, uncertainty, and interdisciplinary foundations of engineered systems
- the growth of the “services-based” component of the economy

Opportunity for OSU & Ohio

- Attract professionals as students
- Workforce with an ability to innovate
- High impact, especially for the Ohio economy
- Innovation-driven research and entrepreneurship

Competitive Research

1. **Trends and opportunities**
2. **Other programs in the US**
3. **Internal capabilities and assessment**

Other Programs in the US

- Total of 28 programs examined, including
  - OSU Peers and Aspirants
  - Additional Universities
- Criteria for program comparison include
  - Professional masters
  - Offered by College of Engineering
  - In collaboration with Business

Types of Professional Programs

1. ‘Dual degree’ – two degree programs with coordinated advising between Engineering & Business
2. Engineering with interdisciplinary requirements and advising coordination
3. Management of Technology (MOT) offered by Business
4. MOT offered by Engineering
5. Engineering with an integrated MOT core and tracks structure
   - Format of the Proposed MEL program

Summary of Professional Programs

Type of program	Schools
1. Dual degree	◆Purdue – Indiana University (Kelly) ◆CMU - MBA - Engineering Integrated
2. Engineering with interdisciplinary advising	◆ASU - Meng Partnership ($2482 per course) ◆University of Ill, Chicago - ($1605) ◆Iowa State Univ - ($1624) ◆Univ. of Michigan - Michigan Interdisciplinary and Professional Engineering (InterPro) ($16,961) ◆UCLA – Master of Science in Engineering ($3,333) ◆Stanford – SPCD ($37,110 total)
3. Business MOT	◆Berkeley - MOT Certificate ◆Georgia Tech – MOT

Summary of Professional Programs

4. Engineering MOT	◆Cornell-Master of Engineering in Systems Engineering ($5766 per course) ◆*CMU- Engineering and Technology Innovation Management ($2666 per course) ◆CASE Master of Engineering and Management ($3726 per course) ◆Iowa State Systems engineering ($1624 per credit hour) ◆MIT-SDM ($78,000 total) ◆University of Minnesota – MOT ($62,000 total) ◆UT Austin – Engineering Management ($36,000 total) ◆Univ of Illinois at Urbana-Champaign – Industrial & Enterprise Systems Engineering - ◆Univ of Wisconsin, Madison - Department of Engineering Professional Development ($40,000 total)

Summary of Professional Programs

5. Engineering with MOT core and tracks	◆*CASE-MEP ($3726) for professionals ◆*University of Chicago, Illinois – Master of Engineering ($1605) ◆*Northwestern University, Evanston – Masters of Engineering Management ($3,584) ◆*Washington State Univ - Master of Engineering and Technology Management (METM) ($1662, Corp $2955) ◆**OSU - Proposed MEL**

*Cost per 3-course hours, non-resident, distance if available. Most costs are difficult to compare.

Quality Attributes Present

Engineering 2020 Knowledge Delivery Requirements

- Relevance to industry addressing
  - Influenced by local economic opportunities (Case, U of Michigan)
  - Product/process skills (Iowa State)
  - Complex / enterprise systems (MIT, Cornell)
  - Integration of content across disciplinary boundaries as needed (Purdue-Kelly)
  - Module structure, preserving credits for technical content (Uof Minnesota)
- Integrative Project Experience addressing
  - Entrepreneurship (Berkeley)
  - Innovation (MIT)

Quality Attributes Present

Engineering 2020 Knowledge Delivery Requirements

- Globalization
  - Tools, Methods and Case Studies to address Management of shifting resources
  - International residency that focuses on the impact of globalization on the management of technology (GTech)
  - Host international conference (Cornell).
  - Offer distance curriculum globally (Stanford)
  - Knowledge to create capacity in local industry to address globalization
- Convenience for the professional
  - Acknowledged professional competence (e.g. most have no GRE req.)
  - Credit for previous work
  - Distance (DVD, On-line etc.)

Quality Attributes Present

Engineering 2020 Knowledge Innovation

- Industry involvement
  - Sponsorship of projects that expose new requirements (Berkeley)
  - Advisory board
- Solution-driven innovation in project courses
  - Technology application skills
- Knowledge Innovation in Pedagogy
  - Core is not simply a warming over of existing courses
  - Research new requirements, frameworks and methods that increase bandwidth of knowledge communicated to the engineering professional
    - MOT programs often have knowledge delivered in 1,2 credit hours and are highly integrated (Minnesota, Northwestern etc.)
  - Engineering and Business Case studies

Knowledge Innovation – a high level comparison

High	
Medium	

	Program	Credits	Knowledge Delivery	Knowledge Innovation
Engineering with MOT core	CASE-MEP for professional	18 /36		
	Northwestern University Evanston – Masters of Engineering Management	18/36		
	Washington State Univ - Master of Engineering and Technology Management	18/34		
Engineering MOT	Univ of Wisconsin, Madison - Engineering Professional Development	26		
	CMU- Engineering and Technology Innovation Management	30		
	University of Minnesota – MOT	48		
	MIT-SDM	51		
	Cornell-Master of Engineering in Systems Engineering	30		

Some details

Samples of MOT Core – Typical

Northwestern

- Engineering Management (gateway course)
- Accounting for Engineers
- Financial Issues for Engineers
- Marketing Issues for Engineers
- **Quantitative Methods for Decision Making**
- Strategic Management for Engineers (capstone course)

Washington State University

- Management of Organizations
- Financial Analysis for Managers**
- Operations Research for Managers
- Project Management
- Strategic Planning of Technology and Innovations in Engineering ** *capstone course taken near the end of program of studies*
- Stat class or replacement: **STAT 430 Statistical Methods in Engineering**
- E M 702 Master's Special Problems, Directed Study and/or Examinations

Samples of MOT Core – Knowledge Innovation

University of Minnesota

- **Looking to add credentials to your resume?** An MOT packs all the punch of an MBA *and more*. You'll cover some of the same areas as you would with an MBA - but from a technology-based perspective. Besides gaining general business knowledge and technical management finesse, many of the MOT courses teach you to *forecast and analyze existing and emerging technologies for maximum competitive advantage*. The MOT will allow you to operate at the interface of engineering, technology, science, and business.
- **Macroenvironment Of Technology (example)** - Development of anticipated social, political, governmental, and economic forces scenarios affecting technological change. Use of scenarios to respond to industry threats, opportunities, and uncertainties. Corporate strategies, including building alliances for global competitiveness. (2 credits)

Samples of MOT Core – Knowledge Innovation

MIT

- SYSTEM ARCHITECTURE - SYSTEM VIEW, CIVIL ENGINEERING, ARCHITECTURES FOR THE SERVICES ENTERPRISE, INDUSTRIAL SYSTEMS ENGINEERING, STRATEGIC ALIGNMENT
- System architects respond to user needs, define and allocate functionality, decompose the system and define interfaces. This course gives students a way to approach a synthetic view of system architecture. Discussions touch upon the allocation of functionality and its projection on organizational functionality; the analysis of complexity and methods of decomposition and reintegration; as well as flexible product platforms and the trades between optimality and reusability. Industrial speakers and faculty will present examples from various fields. Heuristic and formal methods will be presented.
- **This course provides an integrative forum for SDM students.**

Samples of MOT Core – Knowledge Innovation

Cornell

- **SYSTEMS ARCHITECTURE, BEHAVIOR AND OPTIMIZATION STRATEGIC ALIGNMENT, PRODUCT AND PROCESS MANAGEMENT, MANAGEMENT& STRATEGIC PLANNING**
- This is a course in the application of the systems engineering process to the design and operation of complex systems. Topics include techniques for design, simulation, optimization, and control of *complex systems*. Case studies and system simulations in diverse areas will provide context for the application of these techniques. Pre-requisite: Applied Systems Engineering or permission from the instructor.
- Over the course of the semester, students will:
  - Articulate the value of a system relative to its intended stakeholders
  - Propose a product platform strategy for market penetration and growth
  - Apply graphical techniques for uncovering system architecture
  - Communicate architectural design principles developed from experience
  - Construct and simulate a discrete event dynamic model
  - Select and apply statistical techniques for common design and control problems
  - Quantify the risk and reliability of a system
  - Solve a non-linear resource allocation optimization using price-directed decomposition
  - Structure a multi-attribute decision-making problem using the Analytic Hierarchy Process
  - Construct and simulate a continuous time, continuous state dynamic model

Samples of MOT Core – Knowledge Innovation

Iowa State Univ

- This program in Systems Engineering will lead you to a Master's Degree in Engineering. It is designed to enable engineers, regardless of undergraduate discipline, to develop the analytical abilities needed to design, evaluate, and build complex systems involving many components and demanding specifications. The intent of this program is to extend the ability of engineers to work across disciplinary boundaries as needed. It also develops the management capabilities needed into today's working environment.

Samples of MOT Core – Knowledge Innovation

University of Michigan

- Practicum – engaging industry
  - http://interpro.engin.umich.edu/igppracticum.htm
  - Choice of top-notch graduate students through an interview process
  - A consulting team at competitive cost
  - The flexibility to hire a single student or a team
  - Support from experienced U-M faculty
  - Recommendations and solutions from the student(s)
  - Opportunity to preview and recruit top students

Competitive Research

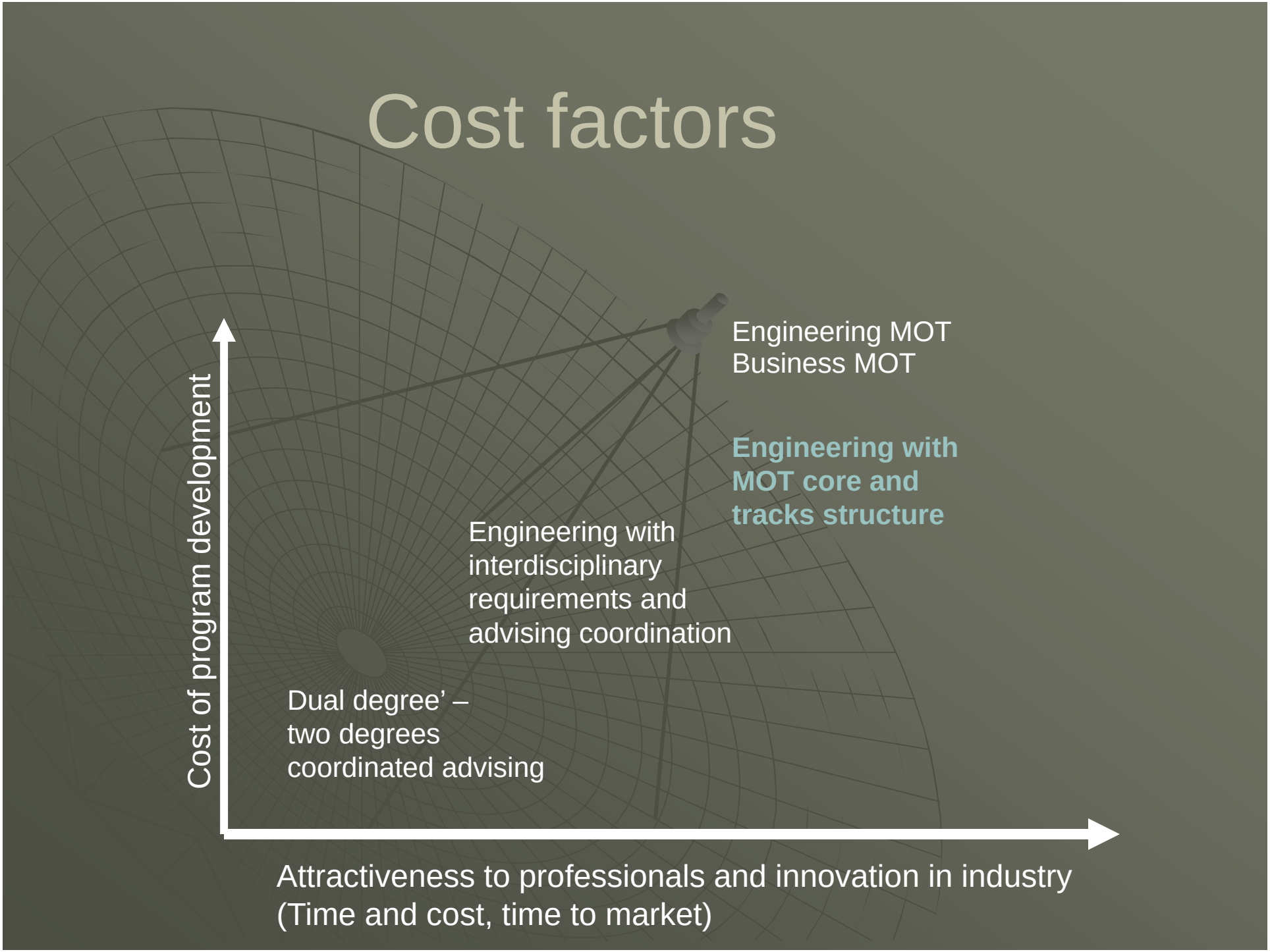
1. **Trends and opportunities**
2. **Other programs in the US**
3. **Internal capabilities, assessment and approach**

Internal capabilities and assessment

Costs,

Strengths and Weaknesses

Cost factors



OSU Strengths & Weakness

- Potential core courses identified
  - *Weakness:* In most cases, MOT content and integration appears to be poor in comparison with peers and aspirants (e.g. identified courses are geared for students with little professional background and a cumbersome pre-requisite structure)
- Potential tracks identified
  - *Weakness:* In many areas OSU researchers with valuable knowledge are buffered from practicing professionals' requirements. Professionals are demanding and often have experiential knowledge that goes beyond that of faculty.
- Experience and pre-existing infrastructure in distance delivery
  - *Weakness:* Cost of conversion and lack of incentives

OSU Strengths & Weakness

- Centers and other industry-facing groups with innovation knowledge
  - *Weakness:*
    - Lack of overall policy for resource alignment and incentives for faculty with appropriate industry innovation experience to upgrade knowledge delivered across core and track courses
    - Lack of incentive across university organizations to collaborate for the purpose of improving graduate education for professionals
- Cohorts – GM (CAR), Nationwide (CETI), others…
  - *Weakness:* No program in place to build momentum. Years to execute (First presentation of MEL in 2001). Losing momentum to competition in certain areas. (e.g. Battelle goes to George Mason in IT areas.)

Approaches

- Incentives for centers and other industry facing groups
  - To take a lead in creating knowledge and delivery enhancements for existing and new courses to reflect MOT content
  - Consolidate knowledge vs a course for every topic!
  - Incentive can be through revenue alignment, rather than investment
- Bridge the gap between professionals and academia
  - Identify qualified Faculty (Research and Clinical) that can leverage existing research and courses to champion knowledge development for the core/tracks
  - Identify cohorts for early pilots that will obtain detailed practice requirements and case studies
- Establish an advisory board from the customers' perspective to guide detailed requirements and execution

APPENDIX G

College of Engineering
Sources and Uses Projections for MGEL Program
Entire Program

	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020
Sources								
Base PBA	$0	$0	$1,750	$97,270	$385,550	$787,127	$1,214,550	$1,667,260
Marginal PBA	$0	$1,750	$95,520	$288,280	$401,577	$427,423	$452,710	$373,604
Cash Support from Engineering	$100,000	$0	$0	$0	$0	$0	$0	$0
Total Sources	$100,000	$1,750	$97,270	$385,550	$787,127	$1,214,550	$1,667,260	$2,040,864
Uses								
Teaching - All Colleges								
Faculty salary & benefits	$0	$207,598	$290,637	$465,019	$790,532	$814,248	$838,676	$863,836
GTA salary & benefits (1)	$0	$0	$0	$0	$0	$62,775	$64,658	$66,598
Course Development	$100,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Administration								
Staff support (0.5FTE)		$40,200	$41,607	$43,063	$44,570	$46,130	$47,745	$49,416
Marketing	$30,000	$20,000	$15,000	$10,000	$10,000	$10,000	$10,000	$10,000
Equipment/building upgrades	$0	$25,000	$20,000	$10,000	$10,000	$10,000	$10,000	$10,000
Orientation	$0	$500	$1,000	$1,500	$2,000	$2,500	$2,500	$2,500
Graduation/events	$0	$1,000	$2,000	$3,000	$4,000	$5,000	$5,000	$5,000
Total Uses	$130,000	$304,298	$380,244	$542,582	$871,103	$960,653	$988,579	$1,017,350
Sources Less Uses/Funding Gap	($30,000)	($302,548)	($282,974)	($157,033)	($83,976)	$253,897	$678,681	$1,023,514
Cumulative Funding Gap	($30,000)	($332,548)	($615,522)	($772,555)	($856,531)	($602,634)	$76,047	$1,099,561

CoE 9 month Average salaries	Au2011	Au2012	Au2013
Asst:	$86,411	$89,003	$91,673
Assoc	$101,145	$104,179	$107,305
Full	$143,456	$147,760	$152,192

No assistant professor will teach a course

Average Salary of Assoc and Full(not weighted)	$125,970	$129,749

33% for benefits		$41,989.84	$43,249.53
total		$167,959	$172,998
Assumptions:			
Average faculty teaching load/year	5		
% of faculty's time devoted to teachin	50%		
Faculty's time to teach one course	10%		
Average GTA stipend/month		$1,900	$1,957.00
Benefits/month (4.4%)		$836.00	$861.08
Instructional fee/semester		$5,668	$5,838.04
General Fees/semester		$184.00	$189.52
Learning Teach/semester		$255	$262.65
Non-resident fee/semester		$8,656	$8,915.68
Total/academic year (9 months)		$54,150.00	$55,774.50

College of Engineering
Marginal Resources and Commitments Projections
MGEL Program - All Colleges Combined
Executive Summary

	PBA Available for Program		
	Non-Engr	**Engr**	**Total**
FY 2014	$0	$1,750	$1,750
FY 2015	$39,725	$57,544	$97,270
FY 2016	$136,400	$249,149	$385,550
FY 2017	$252,967	$534,159	$787,127
FY 2018	$376,569	$837,981	$1,214,550
FY 2019	$507,608	$1,159,652	$1,667,260
FY 2020	$600,329	$1,440,535	$2,040,864

College of Engineering
Marginal Resources & Commitments Projections
MGEL Program - Non-Engineering Only

Beginning PBA	**$0**	**$0**	**$39,725**	**$136,400**	**$252,967**	**$376,569**	**$507,608**	

	Projected						
Total Marginal Resources	**FY 2014**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**
Subsidy							
Subsidy Rate Change	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Credit Hour Change	$ -	$ 13,907	$ 32,450	$ 37,085	$ 37,085	$ 37,085	$ 23,178
subtotal	$ -	$ 13,907	$ 32,450	$ 37,085	$ 37,085	$ 37,085	$ 23,178
Tuition/Fees							
Tuition Rate Change	$ -	$ 2,073	$ 7,154	$ 13,327	$ 19,924	$ 26,966	$ 32,014
Credit Hour Change	$ -	$ 59,243	$ 143,071	$ 169,232	$ 175,155	$ 181,286	$ 117,269
subtotal	$ -	$ 61,316	$ 150,224	$ 182,559	$ 195,079	$ 208,252	$ 149,284
Learning Technology Fees	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Marginal Resources	**$ -**	**$ 75,223**	**$ 182,674**	**$ 219,645**	**$ 232,165**	**$ 245,337**	**$ 172,462**

Total Marginal Commitments

Student Services Allocation	$ -	$ 17,444	$ 42,157	$ 50,363	$ 52,844	$ 55,417	$ 38,350
Central Tax (24% of Fees & Subsidy)	$ -	$ 18,054	$ 43,842	$ 52,715	$ 55,719	$ 58,881	$ 41,391
Total Marginal Commitments	**$ -**	**$ 35,498**	**$ 85,999**	**$ 103,078**	**$ 108,563**	**$ 114,298**	**$ 79,741**

Net Marginal Resources	**$ -**	**$ 39,725**	**$ 96,675**	**$ 116,567**	**$ 123,601**	**$ 131,039**	**$ 92,721**

Ending PBA	**$0**	**$39,725**	**$136,400**	**$252,967**	**$376,569**	**$507,608**	**$600,329**
Dollar Change	**$0**	**$ 39,725**	**$ 96,675**	**$ 116,567**	**$ 123,601**	**$ 131,039**	**$ 92,721**
Percentage Change	**na**	**na**	**243%**	**85%**	**49%**	**35%**	**18%**

Assumptions:

APPENDIX H

Leadership and Team Effectiveness

Course Description

Faculty Leader(s): **Tony Rucci**
Rucci_3@fisher.osu.edu
614-292-9688

Larry Inks
inks_3@fisher.osu.edu
614-292-4591

Course Description and Learning Objectives

This course will have a 'practical applications' bias. While technical and professional knowledge and skills are a necessary foundation for success in one's chosen *occupation*, it is increasingly apparent that understanding the behavior of people in organizations, as well as one's own leadership effectiveness are the pivotal factors to success over one's *career* lifetime.

The course will use a combination of articles, cases, textbooks and videos. It will emphasize practical application of effective leadership skills through a combination of survey feedback, class exercises, discussion and participation, and assignments designed to promote goal-setting around individual student leadership practices and effectiveness.

The objectives of this course are to create a learning experience that allows each student:

1. To understand and appreciate both the academic literature as well as the practical application of good organizational management and leadership practices.

2. To critically evaluate the unique nature of people's behavior *in organizations*, and to understand how to channel and manage organizational behavior in order to achieve goals and to achieve superior organizational performance.

3. To critically evaluate their own team and leadership effectiveness skills.

4. To learn from the personal experiences of their classmates and enjoy the learning experience

Course Outline

I. Leadership's role in the value creation chain (4 hours)
- Classic economic value theory
- The 'intangibles' model of value creation
- The role of leaders in creating and sustaining employee commitment
- What the best leaders do best

II. The pivotal role of vision and strategy (4 hours)
- Vision, core purpose and core values
- What is strategy?
- Gaining strategic alignment
- Implementing strategy

III. Creating and leading effective teams (4 hours)
- Lessons learned from high performance teams
- What makes an effective team member
- What makes an effective team leader

IV. Organizational behavior and talent management practices (2 four-hour sessions) (8 hours)
- Organizational culture
- Organization development
- Managing change
- Talent management practices
    - Recruiting and selection
    - Performance management
    - Motivation and engagement
    - Compensation and rewards
    - Leadership development

V. The question of character in leadership (4 hours)
- Does character matter?
- Managerial courage and ethics
- 'Authentic' leadership
- Establishing a leadership legacy

Books and Readings Required for the Course
Larson, C. and F. LaFasto, *Teamwork: What Must Go Right* (Newbury Park, CA: Sage Publications, 1989).

Case Packet: Available from UniPrint (behind Engineering building). Contains all additional articles and cases for the modules above.

Course Requirements and Grading
Grades will be based on the following criteria:

Individual case assignment	50%	(100 pts.)
Final paper:	50%	(100 pts.)
	100%	(200 pts.)

Financial and Managerial Accounting for Engineers

Course Description

Course Description and Learning Objectives

This three credit course provides an overview of the basic topics in financial and managerial accounting. The primary focus will be on helping students understand the meaning of the numbers in financial statements, their relationship to one another, and learning how they are used in planning, decision-making and control towards achieving the objectives of an organization. All of the financial statements found in corporate annual reports will be covered in detail, including the balance sheet, income statement, statement of retained earnings and statement of cash flows. The managerial portion will cover fundamental concepts, including activity-based management, along with concepts useful for managerial decision making, such as Cost-Volume-Pricing and differential analysis. The focus will next shift to planning (budgeting) and performance evaluation of business segments as they strive to execute the firm's strategy. Finally, we will discuss measurement and incentives (compensation) of managers, and special topics such as transfer pricing and capital budgeting.

Course Outline

1. Introduction to Financial and Managerial Accounting
   Business activities
   The role of accounting in business
   Financial Statements
   Accrual accounting concepts
   Financial Statement (Ratio) analysis
   Product costs
   Activity-based costing

2. Product costs
   Activity-based costing

3. Cost Behavior and Cost-Volume-Profit Analysis
   Fixed/Variable/Mixed costs
   Break-even analysis
   Operating leverage and margin of safety
   Relevant costs for decision-making

4. Developing annual profit plans
   Standard costing/ Variance analysis

5. Performance evaluation of businesses
   Return on investment
   Residual income
   Economic value added (EVA)
   Transfer pricing
   Discounted cash flow analysis
   Capital budgeting techniques (including NPV, IRR, Payback)

Textbook

Survey of Accounting by Carl Warren, 6th edition, Southwestern Publishing, 2013

Examinations

You are required to bring one or more #2 pencils and a non-programmable calculator to all exams. Examinations for this quarter are scheduled as follows:

EXAMINATIONS	DATE/TIME	POINTS	CHAPTERS
First Examination	**TBD**	**80**	**TBD**
Second Examination	**TBD**	**120**	**TBD**
Third Examination	**TBD**	**80**	**TBD**
Fourth Examination	**TBD**	**120**	**TBD**

The first and second exams will cover Financial Accounting. The third and final exams will cover Managerial Accounting. All the exams will be "closed book"! Each exam will consist of computational (long) problems, short problems and multiple choice questions.

Faculty Member Responsible

Prakash Mulchandani, Senior Lecturer, Department of Accounting and Management Information Systems

Technology Strategy & Innovation Management
Michael J. Leiblein

Course Description and Learning Objectives

Technology Strategy & Innovation Management provides students with a strategic perspective on management in complex, knowledge-intensive, and dynamic environments. These settings pose a different set of challenges to the identification and pursuit of competitive advantage than described in your previous courses. Although tradeoffs between different resource allocation policies and forms of organization remain critical, the emphasis is now on whether and when to shift from old to new sources of advantage. Importantly, these distinctions often require new tools and frameworks to consider: (a) how to evaluate highly uncertain investment proposals, (b) whether and how to capture value from intangible, knowledge-based assets, and (c) how to design organizations that assemble and organize resources to exploit existing advantages and explore new opportunities. In sum, the course considers temporal tradeoffs in addition to the functional and product-market tradeoffs emphasized in other courses.

The course is organized around three broad questions: First, how do organizations generate value? Second, what factors influence the portion of this value that is captured by the innovating organization? Finally, how can managers assemble and organize knowledge resources to deliver value in dynamic settings? In considering these questions we will develop and apply a series of conceptual models that illustrate interactions between competitive strategy and patterns of technological, market, and competitive change. These models provide a means to consider which firms will benefit from technology or market change, why many existing firms fail to incorporate new technology in a timely manner and the types of technologies and markets in which a given firm should invest.

The pedagogical approach taken in *Technology Strategy & Innovation Management* involves a mixture of readings, lectures, and case analyses. The readings are primarily drawn from research in strategic management, organizational economics, and organization theory. The lectures are designed to elaborate on and extend key points in the readings. The case studies provide an opportunity to integrate and apply these tools in a variety of technology intensive contexts. The course is organized into three modules:

Course Outline

The course is organized into three modules:

1. **Creating Value: Patterns of Change in Technologies & Markets.** The first module examines how changes in the structure of technological and consumer markets create opportunities for new value creation. The main idea is that change in consumer preferences, technological solutions, and regulatory constraints create imbalances that are amenable to innovative organizational solutions. These imbalances often initially occur in particular geographic regions suggesting opportunities to explore how changes in one setting affect competition in other settings. The primary objectives of this module are to consider methods for evaluate investment proposals in uncertain and dynamic settings.
    - **a.** The Evolution of Technologies and Markets
    - **b.** The Concept of Innovative Disruption
    - **c.** Competition between incumbents and entrants
    - **d.** Project portfolios and technology platforms
    - **e.** Real options and investment under uncertainty

2. **Capturing Value: Understanding Competition.** The second module explores the factors which determine the portion of value created for society that is captured by an individual firm. The main ideas are to demonstrate distinctions between the concepts of value creation and value capture, to illustrate that economic value is almost always created through the coordinated action of a group of firms, and to introduce the distinct mechanisms that may be used to capture value from an innovation. Consistent with the observation that the strength and type of institutional (legal) protection varies across product- and geographic markets, the benefits and costs associated with the use of specific value capture mechanisms systematically vary with context. The primary objective of this module is to evaluate the use of mechanisms such as patents, complementary assets, standard setting organizations, and lead time to capture value from value creating innovations.
    - **a.** The Challenge of Managing IP
    - **b.** Patents and Secrecy

c. Lead time

d. Complementary Assets

e. The Influence of Standards (Network Externalities)

3. **Delivering Value: Organizational Competence.** The third module examines the resource allocation policies and organizational mechanisms firms use to generate and deliver particular types of innovations. The module emphasizes differences in the types of technological problems managers choose to solve and the types of incentives, collaboration, and coordination mechanisms used to organize solutions to these problems. It also elaborates on situations where conflicting managerial styles across levels and geographic portions of the organization complicate its ability to generate innovative value. The primary purpose is to explore how managers assemble and organize resources to deliver various (e.g., incremental vs. radical; autonomous vs. systemic, sustaining vs. disruptive) forms of innovative value.

a. Allocating Resources

b. Managing Innovation by Creating a Market for Ideas

c. Process and Product Innovation

d. Benefits & Challenges to Outsourcing & Open Innovation

e. Collaborative Strategies

COURSE REQUIREMENT AND GRADING

Required Materials:

- Readings marked "DOWNLOAD" are available at no charge through the OSU library system. To download these articles, navigate to http://library.osu.edu/, click the "research database" quicklink and search for the "Business Source Complete" tool. If you are accessing the site from an off campus location you will need to provide your "name.number" OSU email username and password. Once you've found the Business Source Complete database you may search and download PDF files.
- Cases and Readings marked "PACKET" may be purchased through Xanedu. Xanedu will post a link to the Carmen Learning Management System page with further instructions.
- Popular Textbooks in Technology Strategy: There is no required textbook, but the following are useful references:
  1. Afuah, Allan. 1998. Innovation Management: Strategies, Implementation, and Profits. Oxford University Press. New York, NY. .
  2. Burgelman, R., Christensen, C., Wheelwright, S. 2004. Strategic Management of Technology and Innovation. Irwin-McGraw Hill.
  3. Leiblein, M.J. and A. Ziedonis. 2011. Technology Strategy & Innovation Management, Edward Elgar Publishing.
  4. McGahan, A. 2004. How Industries Evolve: Principles for Achieving and Sustaining Superior Performance, Harvard Business School Press.
  5. Schilling, M. 2005. Strategic Management of Technological Innovation, Boston: McGraw Hill.
  6. Tushman, M. & P. Anderson. 1997. Managing Strategic Innovation & Change, Oxford, New York, NY.

Instructional Procedure:

This course will be taught in discussion format using a mixture of readings, lectures, and cases. The assigned readings provide background conceptual material for each session. The cases contain information on the objective of the activity, the people involved, and a series of events and administrative difficulties that confront the responsible executive. The intent of case analysis is to provide you with the opportunity to make complex decisions with limited information and to sort through data that is available to a decision-maker, some of which may be superfluous. In preparing cases, the following guidelines may be helpful: (1) recognize that the data in a

case are invariably incomplete, (2) do not overlook the data that are available, (3) if an essential piece of data is missing, make reasonable and explicit assumptions, and (4) believe the facts and data in a case, but be suspicious of stated opinions. You are not required to obtain data from other sources to analyze cases in this class.

Evaluation:
Course grade will reflect performance in terms of **(1) class contribution (25%), (2)** a sequence of **group two page papers (20%), (3) a group project (25%), and (4) a final exam (30%).**

ABOUT YOUR INSTRUCTOR

Michael Leiblein is an associate professor in the competitive strategy area at the Fisher College of Business. Michael teaches the Technology Strategy, Advanced Strategic Analysis, and Innovation Field Study elective courses in the MBA Program, has previously taught Fisher's MBA business and corporate strategy core courses, and currently teaches a variety of PhD and Executive Education electives at Fisher and throughout Europe. In 2000 and 2002 the Ohio State University evening MBA students named him outstanding core course instructor.

Michael's academic research focuses on the relationship between organizational form and firm performance. His work has been published in leading academic journals and has received international media coverage in outlets such as *The Financial Times* (London) and *USA Today*. Michael's dissertation research and academic papers have been recognized with several international academic awards. He is currently the primary investigator on a grant from the *General Electric National Center for the Middle Market* to explore effective innovation practices and the primary investigator on a grant from the *National Science Foundation* that extends his work on the causes and innovative consequences of organizational decisions in the global semiconductor industry.

Michael serves as member of several prestigious editorial boards including the *Strategic Management Journal* (since 2004), the leading academic journal in the field of strategic management, and the *Academy of Management Review* (since 2005). He also serves as an advisory panel member for the *National Science Foundation* (since 2011). He has previously served as an editorial board member (2002 through 2007) and as an associate editor (2008 through 2011) at the *Journal of Management,* as a member of the executive committee for the Business Policy & Strategy division of the *Academy of Management* and as a representative and officer of the Competitive Strategy division of the *Strategic Management Society*. At Ohio State, he serves as the academic director for the *Fisher College Innovation Initiative* and as a co-director for the *Food Innovation Center*, one of President Gee's two inaugural trans-disciplinary centers devoted to improving global health, life quality and economics by way of innovations in the food industries. He is the author and sponsor of the *Fisher College Innovation Index* and has consulted in the United States, Europe, and Asia for a variety of organizations and associations.

Michael received his Ph.D. from Purdue University and his M.B.A. and a B.S. in Electrical Engineering from Rensselaer Polytechnic Institute. Prior to his doctoral studies, he worked as a consultant for Andersen Consulting (Accenture) and as an engineer for Johnson Controls. In his free time, Michael enjoys attending collegiate sporting events, opera, and hiking through New England and the American Southwest.

Engineering Ethics and Professionalism

Syllabus

Instructor: Prof. Kevin Passino, Dept. of Electrical and Computer Engineering

Course Description and Learning Objectives:

To learn professionalism, ethical decision-making strategies, codes of ethics, moral frameworks, engineering as social experimentation, assessment of safety and risk, risk-benefit analysis, safe-exit and fail-safe systems, employer and employee rights and responsibilities, confidentiality and conflict of interest, whistle-blowing, research integrity, consulting engineers, expert witnesses and advisors, environment and sustainable development, globalization of engineering, appropriate technology, cautious optimization outlook and moral leadership in engineering. Many engineering ethics case studies are studied in detail.

Text book: Martin M.W., Schinzinger R., *Ethics in Engineering*, 4th Ed., McGraw-Hill, NY, 2005

Reading List: See the reading list of topics relevant to the area of professionalism and engineering ethics. Other books on this list may be of interest for later reading also.

Web Resources: See the following web sites for more materials on engineering ethics and professionalism:

1. The Online Ethics Center for Engineering and Science: http://onlineethics.org/
2. National Institute for Engineering Ethics: http://www.niee.org/
3. Center for the Study of Ethics in the Professions at IIT: http://ethics.iit.edu/
4. Association for Practical and Professional Ethics at IU: http://www.indiana.edu/~appe/
5. IEEE document of professional aspects of employment, click here.
6. IEEE document on education/professionalism, click here.
7. UN Universal Declaration of Human Rights, click here.
8. IEEE Society on Social Implications of Technology
9. Texas A&M Univ. engineering ethics: http://ethics.tamu.edu/
10. NSPE Board of Ethical Review: http://www.niee.org/pdd.cfm?pt=NIEE&doc=EthicsCases

Course Requirements and Grading:

Homework Projects: 5 homework projects, with 15% of grade for each = 75%

Final Project: 25% of final grade

Policy on Working Together: You may talk to anyone about the solutions to the homework problems, but you must turn in what is ENTIRELY your own written/typed solutions to those. For the final project you will work on a team and what you turn in must be written/typed ENTIRELY only by the team members.

Final Project: It is highly recommended that you form your design team and start on the project as soon as possible. It is your responsibility to find team members, and each team must have between 2 and 4 members (no more, no less)

Course Outline

1. Introduction

- Electrical and computer engineering as professions
- Overview of course objectives

2. Ethical Dilemmas, Choices, and Codes of Ethics

- Ethical decision-making strategies
- Critique codes of ethics

3. Moral Frameworks for Engineering Ethics

- Moral frameworks, connections to engineering
- Personal commitments and professional life
- Case study: OSU College of Engineering student organization, "Engineers for Community Service," (ECOS)

4. Engineering as Social Experimentation

- Engineering as social experimentation
- Involving the public in the design process
- Case studies for engineering as social experimentation

5. Safety and Risk

- Assessment of safety and risk
- Design considerations, uncertainty
- Risk-benefit analysis, safe-exit and fail safe systems

6.-8. Case Studies for the Design Process

- Case studies in impact of safety/risk on design

9. Engineer's Responsibilities and Rights

- Employee/employer rights and responsibilities
- Confidentiality and conflict of interest
- Whistle-blowing

10. Case Studies for the Workplace

- Case studies on professional behavior/policies on the job

11. Honesty

- Research integrity
- Consulting engineers
- Expert witnesses and advisors

12. Environmental Ethics

- Engineering, ecology, economics
- Sustainable development
- Ethical frameworks

13. Global Issues

- Multinational corporations, globalization of engineering
- Technology transfer, appropriate technology
- Computer ethics, weapons development

14. Cautious Optimism and Moral Leadership

- Cautious optimism as a technology development attitude
- Moral leadership in engineering

Appendix I: Faculty

A. CORE COURSES

1) College of Engineering

a) Dr. Kevin M. Passino, Professor, Electrical & Computer Engineering, passino.1@osu.edu

2) Fisher College of Business

a) Dr. Michael J. Leiblein, Associate Professor, Competitive Strategy, leiblein_1@fisher.osu.edu
b) Mr. Prakash Mulchandani, Senior Lecturer, Accounting, mulchandani_3@fisher.osu.edu
c) Dr. Jeff Ford, Professor, Management & Human Resources, Ford_1@fisher.osu.edu

3) John Glenn School of Public Affairs

a) Dr. Trevor L. Brown, Associate Professor, brown.2296@osu.edu
b) Dr. Stephanie Moulton, Assistant Professor, moulton.23@osu.edu
c) Dr. Paul Craig Boardman, Assistant Professor, boardman.10@osu.edu
d) Dr. Beth Anne Schuelke-Leech, Assistant Professor, schuelke-leech.1@osu.edu
e) Dr. Amanda Girth, Assistant Professor, girth.1@osu.edu

B. TECHNICAL TRACKS (All faculty from College of Engineering)

1) Material Joining

a) Dr. Avraham Benatar, Associate Professor, Materials Science Engineering, benatar.1@osu.edu
b) Dr. Dave Farson, Associate Professor, Materials Science Engineering, farson.4@osu.edu
c) Dr. John Lippold, Professor, Materials Science Engineering, lippold.1@osu.edu
d) Dr. David Phillips, Associate Professor-Clinical, Materials Science Engineering, phillips.176@osu.edu
e) Dr. Stanislav Rokhlin, Professor, Materials Science Engineering, rokhlin.2@osu.edu

f) Dr. Wei Zhang, Associate Professor, Materials Science Engineering, zhang.3978@osu.edu

2) Automobile Systems Engineering

a) Dr. Giorgio Rizzoni, Professor, Mechanical & Aerospace Engineering, rizzoni.1@osu.edu
b) Dr. Yann Guezennec, Professor, Mechanical & Aerospace Engineering, guezennec.1@osu.edu
c) Dr. Rajendra Singh, Professor, Mechanical & Aerospace Engineering, singh.3@osu.edu
d) Dr. Jin Wang, Assistant Professor, Electrical & Computer Engineering,

3) Enterprise Services and Architectures (ESA)

a) Dr. Rajiv Ramnath, Associate Professor-Clinical, Computer Science & Engineering
b) Dr. Jayashree Ramanathan, Associate Professor-Clinical, Computer Science & Engineering

THE OHIO STATE UNIVERSITY

College of Engineering
Master Global Engineering Leadership
Student Advising Sheet

Students must submit a completed course plan during orientation after meeting with their advisor.

Student Name: _____
First Middle Initial Last

OSU ID# _____ OSU Email Address: _____

Phone: _____ Advisor: _____

Core Courses

Course Number	Course Name	Credit Hrs	Term/Year
ENGR 6210	Accounting/Finance	3	
ENGR 7200	Ethics	1	
ENGR 6230	Innovation & Technology	3	
PUBAFRS 5750H	Business-Govt Relationship	3	
ISE 6801	Project Management	3	
Choose one course from the following:			
PUBAFRS 6050	Mgmt in Public Agencies	4	
ENGR 6210	Leadership & Team Effectiveness	3	
	Total Hours Must be minimum of 16 cr hrs		

First Semester Enrolled: ☐ Autumn ☐ Spring ☐ Summer
Year: _____

Projected Graduation: ☐ Autumn ☐ Spring ☐ Summer
Year: _____

Technical Track - Indicate chosen track with an "X"

☐ Automotive Systems Engineering ☐ Materials Joining ☐ Enterprise Systems and Architectures

Choice of courses for each track listed on reverse side.

Course Number	Course Name	Credit Hrs	Term/Year
	Total Hours Must be minimum of 11 cr hrs		

Total Degree Credit Hours: Must be a minimum of 31 _____

Capstone Project

Course Number	Course Name	Credit Hrs	Term/Year
ENGR 7192	Individual Studies		
ENGR 7192	Individual Studies		
	Total Hours Must be 5 cr hrs		

Date: _____

Student Signature: _____

Advisor Signature: _____

Courses for Materials Joining Technical Track

Department	Course #	Course Name	Credit Hrs
WELDENG	7001	Physical Principles in Welding Processes I	3
WELDENG	7101	Welding Metallurgy I	3
WELDENG	7201	Engineering Analysis for Design and Simulation	4
WELDENG	7406	Welding of Plastics and Composites	3

Courses for Automotive Systems Engineering Track
Select two focus areas that includes two courses each

Department	Course #	Course Name	Credit Hrs
Focus area 1			
MECHENG	7383	Electrochemical Energy Conversion and Storage Systems for Automotive Applications	3
MECHENG	7384	Energy Modeling, Simulation, Optimization and Control of Advanced Vehicles	3
Focus area 2			
MECHENG	7236	Powertrain Dynamics	3
ECE	5554	Powertrain Control Systems	3
Focus area 3			
MECHENG	7260	Automotive Noise and Vibration Control I	3
MECHENG	7262	Automotive Noise and Vibration Control II	3

Courses for Enterprise Services and Architectures

Department	Course #	Course Name	Credit Hrs
CSE	5231	Enterprise Software Engineering	2
CSE	5234	Applied Enterprise Distributed Computing for Engineers and Scientists	3
CSE	5241	Introduction to Databases	2
CSE	5235	Enterprise Services and Architectures	3

THE OHIO STATE UNIVERSITY

Graduate School

250 University Hall
230 North Oval Mall
Columbus, OH 43210-1366

Phone 614-292-6031
Fax 614-292-3656
gradsch.osu.edu

April 30, 2015

Dr. Ed McCaul, PhD
Secretary, Committee on Academy Affairs
College of Engineering

Master of Global Engineering Leadership

Ed,

The Graduate School Curriculum Committee (GSCC) met on April 7th and, among its agenda items, considered the proposal to add a radar specialization to the Master of Global Engineering Leadership program. The addition of new specializations to this degree was part of the original proposal to create the MGEL degree. The proposal was straightforward and the committee had only minor comments. The GSCC approved the proposal for the specialization.

- For non-specialists, it was not intuitively obvious how the Medical Imaging course fits into the Radar specialization. It might be useful for perspective students to provide a rationale for inclusion of the course.

- It was assumed there are no prerequisites for the 5000 level courses listed in the specialization. If there are, they should be listed.

Please let me know if you will change the proposal to include the above clarifications. I will next forward the proposal to Graduate Council and then the Council on Academic Affairs for final review.

Don't hesitate to contact me with questions or clarifications.

Best,

Scott Herness

Scott Herness
Associate Dean
The Graduate School