ENGINEERING MANAGEMENT

Engineering management is the art and science of planning, organizing, allocating resources, and directing and controlling engineering activities. The field of engineering management has become recognized as a professional discipline with a critical role in the modern society. Graduates develop innovative and integrated solutions to problems that arise at the convergence of engineering and business.

Graduate programs leading to the M.S. and Ph.D. degrees are offered in engineering management. The discipline involves designing, operating and continuously improving systems by integrating engineering and management knowledge. This integration starts with an awareness of customer needs and market conditions. It then seeks to optimize the use of people, equipment, money and information to achieve desired objectives. The discipline also seeks to develop students into individuals with leadership potential who can achieve high quality results in an ethical manner and with respect for the environment. The major goal of entering students is to enhance the usefulness of their previously acquired technical background. This is accomplished through coursework and research designed to expand knowledge of the management and operation of organizations in today's competitive environment. This broader understanding is further enhanced with the opportunity to acquire specialized knowledge in many areas that exist at the interface between the classical engineering and management disciplines.

The engineering management department has produced over 8,000 graduates at the B.S., M.S., and Ph.D. level since its inception in 1968. The engineering management and systems engineering department is one of only a few institutions in the world that offers B.S., M.S., and Ph.D. degrees in engineering management. The B.S. in engineering management is fully ABET accredited and the M.S. in engineering management has been certified by the American Society of Engineering Management. Graduates have been successful in working at the intersection of technology, engineering, and management to produce outstanding results.

Requirements for Completion

Students following their approved program of study will be assured of graduation upon maintenance of good academic standing. A minimum of 30 units of course work from the areas listed below must be completed with a cumulative grade point average of 3.00 (on a 4.00 scale). A maximum of nine hours of coursework for M.S. degrees may be transferred from universities outside the University of Missouri System. Such credits for transfer must have been registered as graduate courses when they were taken. All courses applied to the degree require prior written advisor approval recorded on the study plan in the student's file. It is the responsibility of each student to apply for graduation with the Missouri S&T registrar's office during his or her last semester. Assistance on this final step can be provided by the engineering management and systems engineering department.

Departmental Laboratories

The department has several "hands on" laboratories that have both a research and teaching focus. Each of our labs is directed by faculty members that work closely with students to enhance their learning experience. The description below gives a brief introduction that will help you understand the purpose of each lab.

Smart Engineering Systems Lab (SESL)

The department established the Smart Engineering Systems Lab (SESL) to develop approaches in building complex systems that can adapt in the environments in which they operate. The term "smart" in the context indicates physical systems that can interact with their environment and adapt to changes both in space and time by their ability to manipulate the environment through self-awareness and perceived models of the world based on both quantitative and qualitative information. The emerging fields of artificial neural networks, fuzzy logic, evolutionary programming, chaos, wavelets, fractals, complex systems, and virtual reality provide essential tools for designing such systems.

The focus of the SESL is in developing smart engineering architectures that integrate and/or enhance the current and future technologies necessary for developing smart engineering systems while illustrating the real life applications of these architectures. The smart engineering systems design and operations cut across a diversity of disciplines, namely manufacturing, electrical, computer, and mechanical, biomedical, civil and other related fields such as applied mathematics, cognitive sciences, biology and medicine. Current research is on developing new models and tools for building complex systems architectures that are intelligent, modular, and adaptive.

Laboratory for Investment and Financial Engineering (LIFE)

The goal of the Laboratory for Investment and Financial Engineering is to develop techniques and computational tools for increasing investment and capital return while managing and reducing financial risk. This involves research into stocks and financial derivatives (options, futures, forwards, and swaps), financial risk and uncertainty, financial forecasting, market efficiency and behavioral finance, fundamental and technical analysis, equity valuation, real options, and engineering economics. In cooperation with the Smart Engineering Systems Lab, research in the lab may also involve the use of smart and intelligent systems, such as neural networks, fuzzy logic, genetic and evolutionary algorithms, expert systems, intelligent agents, artificial life, chaos and fractals, and dynamic and complex systems. Data mining, principal component analysis and various other forms of applied statistics are also used. Members of the lab have access to financial data and various financial modeling software packages.

The Virtual and Augmented Reality Systems Engineering Lab (VASEL)

The Virtual and Augmented Reality Systems Engineering Lab (VASEL) provides advanced visualization and computational intelligence for decision making support to complement ongoing and future research work within the department, the S&T campus and across the UM system. The research conducted in this lab will address current and future challenges faced at the boundaries and interfaces of science, technology and engineering research that are essential for the next level of scientific advances to address societal needs. These challenges are found at the nexus of various domains and require experts from all backgrounds of science and engineering to facilitate research leading to the emergence of new disciplines and the generation of knowledge, particularly in the areas of complex systems design and development.

The focus of the VASEL is the research and development of techniques and platforms that are essential to understanding the complementary

and competitive teaming of humans with natural and engineered systems. This includes design and evaluation of human response to extreme events such as earthquakes and floods which informs our understanding of developing protocols to address these natural events. Research involving human response to manufactured events such as fires, shootings and even cyber-attacks similarly will lead to engineered strategies facilitated by the virtual environments used as experimental platforms.

VASEL also leverages the massive compute power of modern graphics cards to enable cutting edge artificial intelligence techniques, supporting both the visualization mission of the lab as well as independent research. Research in this area includes deep learning for disaster planning, resource allocation, and the creation of computer agents.

Additional Information

For additional information you can call our main department phone at 573-341-4572 or you can visit our web page at http://emse.mst.edu/.

Master of Science
Admission Standards

- B.S. in engineering or a physical science
- Undergraduate courses: Calculus Series (I, II, III), Differential Equations or Linear Algebra, Statistics, Physics (I, II) or Chemistry, Engineering Economy (can be taken as part of the M.S. program)
- GPA: Regular status: 3.0 cumulative
- Graduate Record Exam (GRE): The GRE is not required for admission but can be used for admission decisions.
- All international applicants must demonstrate sufficient command of English to successfully pursue work at the Missouri University of Science and Technology. Minimum English proficiency test score requirements are 80 for TOEFL, 6.5 for IELTS, 58 for PTE, or 115 for Duolingo.
- Statement of Purpose: All applicants must submit a statement of purpose.
- Financial Support: Students in conditional status are not eligible for financial support from the department.
- Two reference letters are required for the thesis option.

The M.S. degree program is offered on the Rolla campus and several locations including the West County Continuing Education Center in St. Louis, Fort Leonard Wood (restricted to Engineer Captain's Career Course), and by distance education throughout the United States and selected international locations. Distance course lectures are archived upon completion of the lecture and all lectures are available to students through streaming video during the semester for review. These courses can be reached from anywhere at any time. It is feasible to obtain a Missouri S&T non-thesis M.S. degree regardless of your location.

The M.S. non-thesis program requires completion of at least 10 three-credit hour courses approved by the academic advisor. The M.S. with thesis option requires 30 credit hours including the thesis. All students are required to take the following:

Core Courses

ENG MGT 5111	Management for Engineers and Scientists	
ENG MGT 5320	Project Management	
ENG MGT 5412	Operations Management Science	
ENG MGT 6211	Advanced Financial Management	

Students are then encouraged to identify an emphasis area depending on their interests and to choose available courses from the selected area. However, courses can be chosen from more than one emphasis area. Students have the option to take up to two out-of-department elective courses.

Students must submit a typed Form I to the EMSE graduate office by the beginning of the semester of their 9th credit hour. Links to forms are available at: https://grad.mst.edu/currentstudents/forms/. Thesis students cannot register for Graduate Research (ENG MGT 6099) until their Form I is on file. If students vary from Form I, they must file a Form I-A and have it approved by their advisor to update their plan of study. Non-thesis students must take three 6000-level courses. Thesis students must take two 6000-level courses (in addition to ENG MGT 6099). Students must meet all requirements for graduation as specified in the Graduate Catalog for engineering management. A graduate student already holding or completing a master's degree may obtain a second M.S. in engineering management by completing at least an additional 24 credit hours of work.

Doctor of Philosophy
Admission Standards

- B.S. in engineering, or a physical science
- Undergraduate courses: Calculus Series (I, II, III), Differential Equations or Linear Algebra, Statistics, Physics (I, II) or Chemistry, Engineering Economy (can be taken as part of the Ph.D. program)
- GPA: M.S. GPA = 3.5
- Graduate Record Exam (GRE): The GRE is not required for admission but can be used for admission decisions.
- All international applicants must demonstrate sufficient command of English to successfully pursue work at the Missouri University of Science and Technology. Minimum English proficiency test score requirements are 80 for TOEFL, 6.5 for IELTS, 58 for PTE, or 115 for Duolingo.
- Statement of Purpose: All applicants must submit a statement of purpose.
- Three reference letters.

Ph.D. applicants meeting the above requirements will be invited for an interview as a final step of the application process.

A candidate for the Ph.D. in engineering management must complete the equivalent of at least three years of full-time work beyond the bachelor's degree. The content of all Ph.D. programs is individually structured by the student in consultation with and approved by the student's advisory committee. All requirements for the degree must normally be completed within an eight-year period. At appropriate points in their program, Ph.D. students must pass both a qualifying examination and a comprehensive examination. Ph.D. students must conduct original research under the supervision of a doctoral advisor, and write and successfully defend the dissertation.

For Off-campus Students

Off-campus students will have at minimum one virtual conference per month with his/her research advisor; the Ph.D. comprehensive exam is recommended to be taken on campus; the student has the option of conducting research that is beneficial to the student's professional work; the defense of dissertation is recommended to be taken on campus.

Requirements for Dissertation

Students will conduct original research demonstrated by journal or referred proceedings, publication under the supervision of a doctoral advisor, and communicate their findings, write a dissertation on research conducted, and provide satisfactory defense of their dissertation in a final oral examination. Students are required to publish their work in approved journals and referred proceedings. A minimum of three articles is expected.

Qualifying Exam

The objective of the engineering management Ph.D. qualifying exam is to test the knowledge and understanding of the graduate student on engineering management fundamentals and the student's research capability. It is expected that the graduate student has a clear understanding of the research issues in the student's area of interest, as well as the possible impact of successful research contributions to engineering management research and literature. The qualifying exam must be taken within the first 5 semesters of enrollment. For more information, contact the department graduate staff.

Comprehensive Exam

The student's advisory committee will administer the comprehensive examination after the student has completed seventy-five percent of the coursework for the Ph.D. program and one published refereed conference proceeding or journal paper. The examination is written and oral. Upon successful completion of the written examination, an additional oral exam might be required by the advisory committee.

Dissertation

The dissertation, embodying the results of an original investigation, must be written upon a subject mutually agreed upon between the student and the advisor.

Research Areas

Research areas include, but are not limited to: Operations Research, Applied Optimization and Optimal Control, Simulation-Based Optimization, Markov Decision Processes, Airline Revenue Management, Computational Intelligence, Machine Learning, Deep Learning, Complex Systems, Bioinformatics, Infrastructure System Modeling, Autonomous Systems, Systems Engineering and Systems Architecting, Cyber-Physical Systems, Lean Management, Systems Thinking, Product Design and Development, Human Systems Integration, Human Factors, Ergonomics, Human Health and Safety Engineering, Engineering Psychology, Statistics and Design of Industrial Experiments, Energy Systems, Organizational Behavior, Decision Science, Risk Analysis, Risk Communication, Data Visualization, Policy Analysis, Behavioral Interventions, Program Evaluation, Stakeholder Engagement, Investments, Financial Derivatives, Financial Engineering, Financial Risk Management, Stock Price and Volatility Forecasting, Cryptocurrencies, and Decentralized Finance.

Graduate Certificate Programs

This program is designed to appeal to working professionals. Certificate courses taken for graduate credit can be counted in the M.S. degree once accepted into the M.S. degree. If the four-course sequence is completed with a grade of "B" or better in each of the courses taken, they can apply to the M.S. program in engineering management with all admission requirements waived. The certificate program may be followed by six additional 3 credit hour courses to complete the M.S. degree. The certificate program is open to all persons holding a B.S., M.S., or Ph.D. degree in engineering or a physical science and who have a minimum of 12-months of professional employment experience or are currently accepted into a graduate degree program at Missouri S&T.

Admission Standards

- B.S. in engineering or a physical science
- Undergraduate courses: Calculus Series (I, II, III), Differential Equations or Linear Algebra, Statistics, Physics or Chemistry, Engineering Economy
- GPA: Regular status: 2.75 cumulative
- All international applicants must demonstrate sufficient command of English to successfully pursue work at the Missouri University of Science and Technology. Minimum English proficiency test score requirements are 80 for TOEFL, 6.5 for IELTS, 58 for PTE, or 115 for Duolingo.

Once admitted to the program, the student must take the four designated courses as given below. In order to receive a graduate certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses.

Engineering Management

The engineering management certificate program aims to provide individuals with a core body of engineering management knowledge that includes key technical management concepts, processes, and methods for individuals preparing to transition from individual technical contributors to managers of complex technological projects.

The certificate program coverage includes planning, organizing, allocating resources, and directing and controlling technical projects and people in technical jobs. Students will be responsible for prerequisite knowledge as determined by course instructors.

ENG MGT 5111	Management for Engineers and Scientists
ENG MGT 5320	Project Management
ENG MGT 5412	Operations Management Science
ENG MGT 6211	Advanced Financial Management

Financial Engineering

The financial engineering certificate program aims to equip students with a set of tools that will help them meet the standards of the Global Association of Risk Professionals (GARP) and the Professional Risk Managers' International Association (PRMIA) certifications. While being separate organizations, both GARP and PRMIA have become the standards in financial engineering and financial risk management, due to their similar knowledge of requirements for certification.

Certificate topics will help prepare students to take the GARP Financial Risk Managers (FRM) exam and/or the PRMIA Professional Risk Managers (PRM) exam. Both exams are set around topics in financial theory, financial markets and financial instruments, market risk measures, quantitative analysis, mathematical foundations of risk management, financial derivatives for risk reduction, risk management best practices, operational risk, market risk, credit risk, case studies, ethics, and governance. The certificate courses will provide a strong foundation in these areas.

Students will be responsible for prerequisite knowledge as determined by course instructors and are expected to have taken ENG MGT 5210 Economic Decision Analysis, ENG MGT 5202 Financial Decision Analysis, SYS ENG 6103 Systems Life Cycle Costing, or an equivalent introduction to finance and/or engineering economics course, as a

prerequisite to the certificate program. To complete the certificate, students must complete any four of the five certificate courses.

ENG MGT 6212	Investment
ENG MGT 6213	Financial Engineering
SYS ENG 5212	Introduction to Neural Networks and Applications
ENG MGT 5212	Intelligent Investing
ENG MGT 6211	Advanced Financial Management

Foundations of Supply Chain Integration Systems

The Foundations of Supply Chain Integration Systems certificate is open to all persons holding a BS in engineering or a quantitative business degree or who are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Foundations of Supply Chain Integration Systems Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in Engineering Management or the M.S. degree program in Systems Engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the Foundations of Supply Chain Integration Systems Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

Curriculum:

ENG MGT 5313	Packaging Management	3
ENG MGT 5515	Integrated Product And Process Design	3
ENG MGT 5614	Supply Chain Management Systems	3
SYS ENG 6104	Systems Architecting	3

Human Systems Integration (HSI)

This certificate will prepare students to have a significant impact on complex tasks involving humans. In our increased threat environment, the consequences of HSI failures will become even more critical. We can no longer afford to have a token human factors specialist added to teams addressing complex military issues. A more effective comprehensive approach is to broadly educate military personnel and defense contractors and others in HSI. An increased understanding of human performance will allow for improved performance across the areas of interest which will be gained from this certificate and will result in improved survivability in response to disasters and catastrophes.

The human systems integration certificate program consists of four of five courses. Students will be responsible for prerequisite knowledge as determined by course instructors. With the prior approval of the department, appropriate courses may be substituted for a certificate course if that course is not available.

ENG MGT 5330	Advanced Human Factors	3
ENG MGT 6310	Human Systems Integration	3
IS&T 5885	Human-Computer Interaction and User Experience	3
Select one of the following:		
ENG MGT 5316	Safety Engineering Management	3
IS&T 5887	Human-Computer Interaction Evaluation	3

Lean Six Sigma

This certificate program offers an opportunity for professionals to expand their knowledge in Lean Six Sigma through a flexible graduate education program. The certificate provides a solid foundation of Lean Six Sigma methods and practices that can be immediately applied to process improvement projects in the work place. The certificate consists of four courses designed to prepare professionals for variation and waste reduction projects and provide a sound statistical background.

The Lean Six Sigma certificate program consists of four of the five courses below, which are delivered as part of our regular master's degree programs in engineering management. Students will be responsible for prerequisite knowledge determined by course instructors.

ENG MGT 5710	Six Sigma
ENG MGT 6710	Design for Six Sigma
ENG MGT 6611	Lean Systems
Select one of the following:	
STAT 5643	Probability And Statistics
STAT 5353	Statistical Data Analysis

Military Construction Management

(Certificate restricted to the Engineer Captain's Career Course at Fort Leonard Wood.)

ENG MGT 5110	Managerial Decision Making
ENG MGT 5111	Management for Engineers and Scientists
CIV ENG 5445	Construction Methods
CIV ENG 5360	Water Resources And Wastewater Engineering
or CIV ENG 6443	Contract Formulation And Project Delivery Systems

Modeling and Simulation for Decision Systems

The Modeling and Simulation for Decision Systems Certificate is open to all persons holding a BS in engineering or a quantitative business degree or who are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Modeling and Simulation for Decision Systems Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in Engineering Management or the M.S. degree program in Systems Engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the Modeling and Simulation for Decision Systems Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

Curriculum:

ENG MGT 5110	Managerial Decision Making	3
ENG MGT 6310	Human Systems Integration	3

ENG MGT 6411	Advanced Topics in Simulation Modeling	3
ENG MGT 6415	Optimization under Uncertainty	3
or SYS ENG 6110	Optimization under Uncertainty	

Project Engineering & Construction Management

Although available to all interested students, the project engineering and construction management graduate certificate program was created to specifically meet the needs of visiting faculty/graduate students from Algeria as part of the collaborative program "Development of Engineering Management Curriculum and Distance-Learning Methodologies in Algeria: An Educational Partnership," sponsored by the United States Department of State, Bureau of Educational and Cultural Affairs, and the North African Partnerships Program.

The objective of this collaborative program is to provide educational and technical assistance to Algeria in order for that country to develop new graduate programs in engineering management and construction engineering and modern teaching methodologies, including Internet and distance learning. The cooperative framework provides participants with engineering management skills and expertise to prepare them to be leaders at their home institutions.

Choose two:

CIV ENG 5445	Construction Methods	
CIV ENG 5449	Engineering and Construction Contract Specifications	
CIV ENG 6442	Construction Administration, Planning and Control	
CIV ENG 6445	Advanced Construction Engineering	

Choose two:

ENG MGT 5111	Management for Engineers and Scientists	
ENG MGT 5210	Economic Decision Analysis	
ENG MGT 5320	Project Management	
ENG MGT 6323	Global Project Management	

Project Management

The project management certificate program aims to equip students with a set of tools that will allow them to achieve Project Management Institute (PMI) standards in the project management area, to successfully manage projects and human resources, and to analyze, evaluate, and improve systems.

The certificate program will consist of three required courses and the student's choice of one of two finance related courses :

ENG MGT 5320	Project Management	
ENG MGT 6322	Case Studies in Project Management	
ENG MGT 6323	Global Project Management	
ENG MGT 5210	Economic Decision Analysis	
or SYS ENG 6103	Systems Life Cycle Costing	

Safety Engineering

Safe engineering systems protect the health of workers and the public, preserve the environment, and improve the profitability of industrial facilities. The graduate certificate in safety engineering is a program of study that focuses on methods to reduce risks, prevent accidents, and/or mitigate the consequences to acceptable levels. Risk reduction is accomplished by identifying hazards with unacceptable consequences and then reducing the probability of occurrence (accident reduction) and/or reducing the consequences to acceptable levels (mitigation). The program of study consists of four courses: two required core courses and two courses selected from a specialization track.

Requires two core courses and two courses selected from a track

Core Courses:

ENG MGT 4312/ CHEM ENG 5130	Risk Assessment and Reduction	3
ENG MGT 5316	Safety Engineering Management	3

Available Specialization Tracks:

Track 1: Chemical/Metallurgical Process Safety

Required:

CHEM ENG 6241		3

Choose one course from the following:

CHEM ENG 5190/ ELEC ENG 5350	Plantwide Process Control	3
IS&T 5885	Human-Computer Interaction and User Experience	3
MET ENG 5630	Environmental Aspects Of Metals Manufacturing	3

Track 2: Safety Engineering Management

ENG MGT 5713	Management And Methods In Reliability	3
SYS ENG 6110	Optimization under Uncertainty	3

Track 3: Process Control Systems

Choose two courses from the following:

ELEC ENG 5870	Mechatronics	3
ELEC ENG 5350/ CHEM ENG 5190	Plantwide Process Control	3
ELEC ENG 5340	Advanced PLC	3
CHEM ENG 6241		3
COMP ENG 5420	Introduction to Network Security	3

Track 4: Nuclear Process Safety

Choose two courses from the following:

IS&T 5885	Human-Computer Interaction and User Experience	3
NUC ENG 4207	Nuclear Fuel Cycle	3
NUC ENG 4229	Nuclear Power Plant Systems	3
NUC ENG 4347	Radiological Engineering	3
NUC ENG 4281	Probabilistic Risk Assessment	3
NUC ENG 6223	Nuclear Reactor Safety	3

Track 5: Nuclear Material Safety

Required:

NUC ENG 4312	Nuclear Radiation Measurements and Spectroscopy	3

Choose one course from the following:

NUC ENG 4207	Nuclear Fuel Cycle	3
NUC ENG 4347	Radiological Engineering	3
NUC ENG 4363	Applied Health Physics	3
NUC ENG 6331	Radiation Shielding	3

Track 6: Radiological Health & Safety

Required:

NUC ENG 4363	Applied Health Physics	3

Choose one course from the following:

NUC ENG 4207	Nuclear Fuel Cycle	3
NUC ENG 4312	Nuclear Radiation Measurements and Spectroscopy	3
NUC ENG 4347	Radiological Engineering	3
NUC ENG 6331	Radiation Shielding	3

Track 7: Human Factors

Required:

ENG MGT 4330	Human Factors	3

Choose one course from the following:

BIO SCI 4383	Toxicology	3
PSYCH 4700	Industrial Psychology	3
PSYCH 4730	Environmental Psychology	3

Track 8: Reliability

Choose two courses from the following:

ENG MGT 5713	Management And Methods In Reliability	3
STAT 5353	Statistical Data Analysis	3
STAT 6570	Theory Of Reliability	3

Systems of Human Capital Management

The Systems of Human Capital Management Certificate is open to all persons holding a BS in engineering or a quantitative business degree or who are currently accepted into a graduate degree program at Missouri S&T. Once admitted to the program, the student must take the four designated courses (provided in the curriculum section). In order to receive a Graduate Certificate, the student must have an average cumulative grade point of 3.0 or better in the certificate courses. Once admitted to the program, a student will be given three years to complete the program.

Students admitted to the Systems of Human Capital Management Certificate Program will have non-degree graduate status, however, they will earn graduate credit for the course they complete. If the student completes the four-course sequence with a grade of B or better in each of the courses taken, they, upon application, will be admitted to the M.S. degree program in Engineering Management or the M.S. degree program in Systems Engineering. The certificate credits taken by the students admitted to the M.S. degree program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to begin the courses in the SYSTEMS OF HUMAN CAPITAL MANAGEMENT Certificate Program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

Curriculum:

ENG MGT 5110	Managerial Decision Making	3
ENG MGT 5111	Management for Engineers and Scientists	3
ENG MGT 6113	Advanced Personnel Management	3
ENG MGT 6413	Advanced Engineering Management Science	3

Venkat Allada, Professor
PHD University of Cincinnati
Sustainable produce development, product platform design, mass customization, product innovation, lean manufacturing, intelligent manufacturing systems, process planning supply chain management, systems engineering process and design.

Casey Canfield, Assistant Professor
PHD Carnegie Mellon University
Human Systems Integration, Human Factors, Automation, Energy Systems, Smart Cities, Organizational Behavior, Decision Science, Risk Analysis, Risk Communication, Data Visualization, Policy Analysis, Behavioral Interventions, Program Evaluation, Implementation Science, Stakeholder Engagement.

Steven M. Corns, Associate Professor
PHD Iowa State University
Associate Chair of Graduate Studies. Computational intelligence, Complex Systems, Bioinformatics, Infrastructure Systems Modeling, Autonomous Systems.

Cihan H Dagli, Professor
PHD University of Birmingham, UK
Systems Architecting and Engineering, Cyber Physical Systems, Machine Learning, Deep Learning, Computational Intelligence. INCOSE Fellow, IISE, IFPR Fellow.

David Enke, Curators' Distinguished Teaching Professor
PHD University of Missouri-Rolla
Investments, Derivatives, Options and Futures, Financial Forecasting, Trading Strategies, Hedge Funds, Endowment Investing, Financial Risk Management, Engineering Economy, Computational Finance, Computational Intelligence, Neural Networks.

Abhijit Gosavi, Professor
PHD University of South Florida
Lean manufacturing, supply chain management, revenue management, simulation-optimization.

Sheryl Hodges, Associate Teaching Professor[1]
DEng Louisiana Tech University
Program/Project Management, Financial Management, Organizational Management, Engineering/Construction.

Robert Marley, Robert B. Koplar Professor
PHD Wichita State University
Human System Integration, Ergonomics.

Gabriel Nicolosi, Assistant Professor
PHD The Pennsylvania State University
Operations Research, Applied Optimization and Optimal Control, Differential Games and Machine Learning.

Stephen A Raper, Associate Professor
PHD University of Missouri-Rolla
Associate Chair of Undergraduate Studies in Engineering Management. Packaging engineering, operations, productivity, total quality management, packaging systems design, environmental aspects of packaging, and statistical process control.

Joan Barker Schuman, Teaching Professor
PHD University of Southern Mississippi
Project Management and Engineering Economics.

David G Spurlock, Teaching Professor
PHD University of Illinois Urbana
General Management.

Javier Valentin-Sivico, Assistant Teaching Professor
PHD Missouri University of Science and Technology
Engineering Economics, Operations Management.

ENG MGT 5000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

ENG MGT 5001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

ENG MGT 5070 Teaching Engineering (LEC 3.0)
Introduction to teaching objectives and techniques. Topics include: using course objectives to design a course; communication using traditional and cutting-edge media; textbook selection; assessment of student learning; grading; student learning styles; cooperative/active learning; and student discipline. Prerequisite: Graduate standing. (Co-listed with Env Eng 5070, Comp Eng 5070, Elec Eng 5070, Civ Eng 5070).

ENG MGT 5099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

ENG MGT 5110 Managerial Decision Making (LEC 3.0)
Individual and group decision making processes and principles for engineers and technical managers with emphasis on the limitations of human rationality and the roles of social influence and organizational contexts; principles and skills of negotiation. Prerequisite: Senior or graduate standing.

ENG MGT 5111 Management for Engineers and Scientists (LEC 3.0)
The transition of the engineer or scientist to manager; study of management roles and theory, organizational systems and behavior, managing and motivating technical personnel, leadership, communication, processes, and customer focus. Prerequisite: Graduate standing.

ENG MGT 5210 Economic Decision Analysis (LEC 3.0)
Comprehensive treatment of engineering economy including effects of taxation and inflation; sensitivity analysis; decisions with risk and uncertainty; decision trees and expected value, normally includes solutions on personal computer and student problem report. Prerequisite: Graduate students without previous course in engineering economy because of partial overlap.

ENG MGT 5212 Intelligent Investing (LEC 3.0)
An overview of the essential elements of intelligent investing. Coverage includes stocks, bonds, exchange traded funds, mutual funds, stock screening, fundamental and technical analysis, valuation, market and industry analysis, macroeconomic indicators, investing strategies, and portfolio construction. Prerequisites: Senior or Graduate Standing.

ENG MGT 5312 Advanced Risk Assessment and Reduction (LEC 3.0)
Safe, secure manufacturing facilities protect the health of employees and the public, preserve the environment, and increase profitability. Methods for systematically identifying hazards and estimating risk improve the safety performance and security of manufacturing facilities. Prerequisite: Senior or Graduate Standing.

ENG MGT 5313 Packaging Management (LEC 3.0)
Provides a comprehensive background in the field of packaging and its place in productive systems. Emphasizes the design or economics of the system. Analyzes the management of the packaging function and interrelationship with other functions of an enterprise.

ENG MGT 5316 Safety Engineering Management (LEC 3.0)
This course is an introduction to the principles of safety engineering applied to industrial situations. Job safety analysis, reduction of accident rates, protective equipment, safety rules and regulations, environmental hazards, health hazards, and ergonomic hazards are covered. Prerequisite: Senior or graduate standing.

ENG MGT 5320 Project Management (LEC 3.0)
Organization structure and staffing; motivation, authority and influence; conflict management; project planning; network systems; pricing, estimating, and cost control; proposal preparation; project information systems; international project management. Prerequisite: Graduate Standing. (Co-listed Sys Eng 5105).

ENG MGT 5330 Advanced Human Factors (LEC 3.0)
An in-depth review of the foundations of human factors, focusing on the interaction of people with various forms of technology in a variety of environments. Topics include research and evaluation methods, displays (e.g., visual, auditory), attention and information processing, decision making, motor skills, anthropometry, and biomechanics. (Co-listed with PSYCH 5710).

ENG MGT 5410 Industrial System Simulation (LEC 3.0)
Simulation modeling of manufacturing and service operations through the use of computer software for operational analysis and decision making. Prerequisite: Stat 3115 or Stat 3117.

ENG MGT 5411 Engineering Design Optimization (LEC 3.0)
This course is an introduction to the theory and practice of optimal design as an element of the engineering design process. The use of optimization as a tool in the various stages of product realization and management of engineering and manufacturing activities is stressed. The course stresses the application of nonlinear programming methods. Prerequisite: Math 3304 or 3329.

ENG MGT 5412 Operations Management Science (LEC 3.0)
Application of management science with an emphasis on supporting managerial decision-making. Design and operations of systems are modeled and analyzed using quantitative and qualitative techniques implemented using modern technology. Specific approaches include mathematical modeling and optimization, probabilistic/statistical analysis, and simulation. Prerequisites: Graduate standing.

ENG MGT 5414 Introduction To Operations Research (LEC 3.0)
Mathematical methods for modeling and analyzing industrial systems, topics including linear programming, transportation models, and network models. Prerequisite: Stat 3115 or Stat 3117. Senior or graduate standing.

ENG MGT 5510 Industrial Marketing Systems Analysis (LEC 3.0)
An analysis of the factors of engineered products, customers, communication, promotion, personal selling, persuasion and management within a dynamic industrial sales environment. Prerequisites: Senior or graduate standing.

ENG MGT 5511 Technical Entrepreneurship (LEC 3.0)
Student teams develop a complete business plan for a company to develop, manufacture and distribute real technical/product service. Lectures & business fundamentals, patents, market/ technical forecasting, legal and tax aspects, venture capital, etc., by instructor and successful technical entrepreneurs. Prerequisite: Senior or graduate standing.

ENG MGT 5512 Legal Environment (LEC 3.0)
Study of the effect of the legal environment on the decisions which the engineering manager must make. The course investigates the social forces that produced this environment and the responsibilities incumbent upon the engineer. Prerequisites: Senior or graduate standing.

ENG MGT 5513 Energy and Sustainability Management Engineering (LEC 3.0)
This course explores strategic processes and partnership required for the management of sustainable energy infrastructures and innovation in energy systems. Topics relate to renewable energy, energy efficiencies, energy conversion, energy technology, and economic efficiency of energy sources. Prerequisite: Senior or Graduate Standing.

ENG MGT 5514 Patent Law (LEC 3.0)
A presentation of the relationship between patent law and technology for students involved with developing and protecting new technology or pursuing a career in patent law. Course includes an intense study of patentability and preparation and prosecution of patent applications. Prerequisite: Senior or graduate standing.

ENG MGT 5515 Integrated Product And Process Design (LEC 3.0)
Emphasize design policies of concurrent engineering and teamwork, and documenting of design process knowledge. Integration of product realization activities covering important aspects of a product life cycle such as "customer" needs analysis, concept generation, concept selection, product modeling, process development, and end of product life options. Prerequisites: Junior or above standing. (Co-listed with MECH ENG 5757).

ENG MGT 5610 Advanced Facilities Planning & Design (LAB 1.0 and LEC 2.0)
An integrated approach to the planning and design of facilities; examination of advanced techniques and tools for facility location, space allocation, facility layout materials handling system design, work place design; e.g. mathematical programming and simulation modeling. Prerequisites: Graduate standing.

ENG MGT 5613 Value Analysis (LEC 3.0)
An organized effort at analyzing the function of goods or services for the purpose of achieving the basic functions at the lowest overall cost, consistent with achieving the essential characteristics. Covers the basic philosophy, function analysis, FAST diagramming, creativity techniques, evaluation of alternatives, criteria analysis, and value stream mapping. Prerequisite: Senior or graduate standing.

ENG MGT 5614 Supply Chain Management Systems (LEC 3.0)
This course focuses on the development of logistics management skills related to global supply chains. Particular attention will be given to supply chain systems management as part of the firm's strategic positioning, cultural interactions and transportation sourcing decisions. Prerequisite: Stat 3115 or Stat 3117.

ENG MGT 5615 Production Planning And Scheduling (LEC 3.0)
Introduction to basic techniques of scheduling, manufacturing planning and control, just-in-time systems, capacity management, master production scheduling, single machine processing, constructive Algorithms for flow-shops, scheduling heuristics, intelligent scheduling systems are the topics covered. Prerequisite: Eng Mgt 3310.

ENG MGT 5710 Six Sigma (LEC 3.0)
This course is an introduction to the principles of implementing the Six Sigma philosophy and methodology. Topics include tools and methods including process flow diagrams, cause and effect diagrams, failure mode and effects analysis, gage R&R, capability studies, design of experiments and strategy for organizing six sigma techniques in industry. Prerequisite: Graduate standing.

ENG MGT 5711 Total Quality Management (LEC 3.0)
Examination of various quality assurance concepts and their integration into a comprehensive quality management system: statistical techniques, FMEA's, design reviews, reliability, vendor qualification, quality audits, customer relations, information systems, organizational relationships, motivation. Prerequisite: Senior or graduate standing.

ENG MGT 6000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

ENG MGT 6001 Special Topics (LEC 0.0-6.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

ENG MGT 6010 Seminar (IND 0.0-6.0)
Discussion of current topics.

ENG MGT 6040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

ENG MGT 6050 Continuous Registration (IND 1.0)
Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

ENG MGT 6099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

ENG MGT 6101 Advanced Research Methodology in Engineering Management (LEC 3.0)
An advanced study of research methodology techniques and theories in conducting research activities. The research problems, hypotheses, literature search, data requirements and analyses, interpretation and presentation of results are examined. Prerequisite: Graduate standing. (Co-listed with Sys Eng 6101).

ENG MGT 6110 Case Studies In General Management (LEC 3.0)
A quantitative study of engineering management problems related to the functioning of the industrial enterprise through case studies. Prerequisite: Graduate standing.

ENG MGT 6112 Leadership for Engineers (LEC 3.0)
Provides engineers with a background in leadership concepts and principles; enables students to develop practical skills in leading and managing through multiple personal assessment. Topics include leadership styles, managing commitments, conflict resolution, change management, emotional intelligence, team dynamics and business ethics. Prerequisite: Eng Mgt 5110.

ENG MGT 6113 Advanced Personnel Management (LEC 3.0)
Current practices of procurement and maintenance of technical personnel in research, development, and design organizations. Adaptation of such personnel to the technological enterprise, current practices in personnel administration, labor management relationships.

ENG MGT 6211 Advanced Financial Management (LEC 3.0)
Principles of financial organization and management in the technological enterprise; demands for funds; internal and external supply of funds; budgetary control; reserve and dividends policy. Emphasizes systems approach and problems of engineering design and automation as they influence financial decisions. Prerequisite: Graduate standing.

ENG MGT 6212 Investment (LEC 3.0)
An introduction to the theory and practice of investment, including financial markets and instruments, security trading, mutual funds, investment banking, interest rates, risk premiums, the capital asset pricing model, arbitrage pricing theory, market efficiency, bonds and the fixed income market, equity valuation, fundamental and technical analysis. Prerequisite: Eng Mgt 1210 or 5210. (Co-listed with Sys Eng 6612).

ENG MGT 6213 Financial Engineering (LEC 3.0)
An introduction to financial engineering, with an emphasis on financial derivatives, including the future markets, the pricing of forwards and futures, forward rate agreements, interest and exchange rate futures, swaps, the options markets, option strategies, the binomial and Black-Scholes models for option valuation, the option Greeks, and volatility smiles. Prerequisites: Eng Mgt 1210 or 5210. (Co-listed with Sys Eng 6613).

ENG MGT 6215 Financial Risk Management (LEC 3.0)
Techniques and methods for managing financial risk, including portfolio theory, Monte Carlo methods, ARIMA, time series forecasting, Value-at-Risk, stress testing, extreme value theory, GARCH and volatility estimation, random variables and probability distributions, real options, decision trees, utility theory, statistical decision techniques, and game theory. Prerequisite: Eng Mgt 1210 or 5210. (Co-listed with Sys Eng 6615).

ENG MGT 6310 Human Systems Integration (LEC 3.0)
This course considers Human Systems Integration (HSI) in a variety of applications including systems acquisition and training, HSI tools, techniques, and procedures. Prerequisite: Eng Mgt 4330 or Psych 4710.

ENG MGT 6322 Case Studies in Project Management (LEC 3.0)
Includes the main components of the Project Management Institute (PMI) Body of Knowledge; case studies in project management including project implementation, organizational structures, project estimating, project scheduling, project risk management, and conflict management. Prerequisite: Eng Mgt 5320 or equivalent.

ENG MGT 6323 Global Project Management (LEC 3.0)
In depth and advanced topics in project management including project management methodologies, strategic planning for excellence, project portfolio management, integrated processes, culture, and behavioral excellence; normally includes a hands-on group project. Prerequisite: Eng Mgt 5320 or equivalent.

ENG MGT 6410 Markov Decision Processes (LEC 3.0)
Introduction to Markov Decision Processes and Dynamic Programming. Application to Inventory Control and other optimization and control topics. Prerequisite: Graduate standing in background of probability or statistics. (Co-listed with Comp Eng 6310, Mech Eng 6447, Aero Eng 6447, Sys Eng 6217 and Comp Sci 6202).

ENG MGT 6412 Mathematical Programming (LEC 3.0)
Linear optimization and its engineering applications; problem modeling, search-based optimization, the simplex method for solving linear problems, multi-objective optimization, discrete dynamic programming. Applications of optimization in the fields such as transportation, project management, manufacturing and facility location will be discussed. Prerequisites: One of the following: Stat 3113, Stat 3115, or Stat 3117; Math 3108. (Co-listed with Math 6665 and Sys Eng 6412).

ENG MGT 6413 Advanced Engineering Management Science (LEC 3.0)
Solving of managerial problems utilizing management science techniques. Problems are analyzed, modeled and solved using such techniques as linear, goal, dynamic, programming, simulation, statistical analysis or other non-linear methods. Solutions will involve the use of personal or mainframe computers. A study of the current literature in management science will also be conducted. Prerequisite: Eng Mgt 5414 or graduate standing.

ENG MGT 6415 Optimization under Uncertainty (LEC 3.0)
Optimization in the presence of model uncertainty or system stochasticity is discussed. The course covers fundamentals of stochastic programming, robust optimization, and dynamic programming. Prerequisites: Graduate standing. (Co-listed with Sys Eng 6110).

ENG MGT 6510 Technological Innovation Management (LEC 3.0)
Technological innovation is new technology creating new products and services. This course studies the issues of managing technological innovation under four topics: 1) Innovation; 2) New Ventures; 3) Corporate Research & 4) R&D Infrastructure. Prerequisite: Graduate standing.

ENG MGT 6511 Advanced Marketing Management (LEC 3.0)
Study of marketing decision areas in the technically based firm, including product selection and development, marketing research, market development, distribution, advertising, and promotion. Pricing policies including legal aspects and problems in selecting, training and controlling field sales force. Examination of interaction within consumer and industrial marketing environments. Prerequisites: Eng Mgt 5111, Econ 1200.

ENG MGT 6610 Advanced Production Management (LEC 3.0)
Examination of responsibilities of production manager in the technological enterprise for providing finished goods to meet the quality, price, quantity and specification needs of the market place. Study of functions of production manager. Quantitative approach to decision making in production management. Prerequisites: Senior or graduate standing and advanced mathematical modelling competence.

ENG MGT 6611 Lean Systems (LEC 3.0)
Lean Systems embodies a total enterprise philosophy built on removing waste. Concepts such as flow, just-in-time, lead times, inventory turns, standardized work, pull system, value streams, quick changeover, workplace organization, and visual controls are discussed to improve system performance. Prerequisite: Graduate standing.

ENG MGT 6710 Design for Six Sigma (LEC 3.0)
Principles of Design for Six Sigma for product development.Topics include tools and methods including quality function deployment, concept generation, concept selection, product modeling, process development, DFX strategies, failure mode and effects analysis, design of experiments, TRIZ, and robust design. Prerequisite: Eng Mgt 5710.