



**SOUTH DAKOTA BOARD OF REGENTS
ACADEMIC AFFAIRS FORMS**

New Baccalaureate Degree Minor

UNIVERSITY:	SDSU
TITLE OF PROPOSED MINOR:	Engineering Management
DEGREE(S) IN WHICH MINOR MAY BE EARNED:	Any
EXISTING RELATED MAJORS OR MINORS:	Operations Management (B.S./M.S.), Engineering (M.Eng.)
INTENDED DATE OF IMPLEMENTATION:	2019-2020 Academic Year
PROPOSED CIP CODE:	15.1501
UNIVERSITY DEPARTMENT:	Construction & Operations Management
UNIVERSITY DIVISION:	Jerome J. Lohr College of Engineering

University Approval

To the Board of Regents and the Executive Director: I certify that I have read this proposal, that I believe it to be accurate, and that it has been evaluated and approved as provided by university policy.

President of the University

3/20/2019

Date

- 1. Do you have a major in this field?** Yes No

- 2. If you do not have a major in this field, explain how the proposed minor relates to your university mission.**

South Dakota State University (SDSU) requests authorization to offer a baccalaureate minor in Engineering Management. The minor is proposed by the Department of Construction and Operations Management. The proposed minor will provide engineering and applied sciences undergraduate students with the skills and knowledge to manage in technical/industrial settings. This new minor will appeal to students in engineering, applied science, and technology disciplines.

The Engineering Management minor supports the mission of SDSU as provided in SDCL 13-58-1: *The legislature established South Dakota State University as the Comprehensive Land-Grant University to meet the needs of the State and region by providing programs of instruction in the liberal arts and sciences and professional education in agriculture, aviation,*

education, engineering, human sciences, nursing, pharmacy, and other courses or programs as the Board of Regents may determine.

SDSU does not request new state resources.

3. What is the nature/purpose of the proposed minor?

The purpose of the proposed minor is to provide knowledge and skills in production strategy, project management, engineering systems management, and discipline-specific cost analysis for students who will be in technology focused organizations in their future careers. The minor addresses the need to manage resources of people, time, finances, and organizational assets effectively within advanced manufacturing, the built environment, and engineering services sectors of the economy.

4. How will the proposed minor benefit students? What are the majors/degree programs from which students would likely enroll in the minor?

The Engineering Management minor will benefit students by providing the opportunity to take coursework more tightly scripted to application in applied science, technology or engineering fields and the project-based nature of work commonly encountered in these settings.

Additionally, the minor will complement coursework in engineering, technology, and the applied sciences by increasing understanding of the impact time, money, and people have on their projects and system designs. This minor will help differentiate these students from others in the job market after graduation, particularly graduates who want to quickly advance their career in technical management. There are engineering management degree programs in the region, but their curriculum is related more to industrial engineering, construction engineering, or systems engineering (North Dakota State University, South Dakota School of Mines & Technology, Iowa State University, Montana State University, Missouri University of Science & Technology).

The minor will benefit and appeal to students majoring in Civil Engineering, Computer Science, Electrical Engineering, Electronics Engineering Technology, Mechanical Engineering, and Operations Management. The proposed minor will be an added benefit for students who are eligible to sit for the Fundamentals of Engineering (FE) exam.¹ Questions on engineering economy, probability and statistics, project management, and agreements and contracts are included on the exam and will better prepare these students for the exam as well as improve the likelihood of earning a passing score.

5. Describe the workforce demand for graduates in related fields, including national demand and demand within South Dakota. Provide data and examples; data sources may include but are not limited to the South Dakota Department of Labor, the US Bureau of Labor Statistics, Regental system dashboards, etc.

The SD Department of Labor has projected strong growth for professional, scientific and technical services position (12.1%), and chemical and transportation equipment manufacturing (12.8% and 11.3% respectively) for the period 2016 – 2026.² These are

¹ <https://nces.org/engineering/fe/>

² SD Dept. of Labor & Regulation (2018). *2017 Annual Workforce Report*. Available at https://dlr.sd.gov/lmic/menu_publications.aspx

sectors that typically employ technical managers. Similarly, the BLS Occupational Outlook Handbook projects engineering services organizations, which hire and promote degreed engineers, are expected to grow 16% for the same period while architectural and engineering manager employment to grow 6%.³ Competition in the job market for engineering manager positions are highly competitive with the starting salaries over \$100,000 per year.⁴

The intent is to address demand for technical managers by offering an Engineering Management minor to complement engineering, engineering technology, and applied science undergraduate programs at SDSU. The need for technical managers in manufacturing, construction, engineering services, research labs, and government is particularly pressing as these are complex, high stress jobs with long working hours making these positions hard to fill. The problem is compounded by the fact the transition from design engineer or research scientist to successful manager is not an easy one but it is the typical career advancement in organizations without a technical promotion ladder. A competent technical manager, as measured by their professional expertise in the work being performed, can have significant impact on employee job satisfaction and retention.⁵ That is, if the supervisor for a team of engineers is skilled in the techniques and processes performed by her/his reports, employees are more likely to stay with the organization and be more productive. The Engineering Management minor will prepare graduates to make the future transition to the managerial role more effective.

6. Provide estimated enrollments and completions in the table below and explain the methodology used in developing the estimates.

	Fiscal Years*			
	1 st	2 nd	3 rd	4 th
<i>Estimates</i>	FY 20	FY 21	FY 22	FY 23
Students enrolled in the minor (fall)	15	19	25	33
Completions by graduates	3	10	15	23

*Do not include current fiscal year.

The estimates are based on enrollment in selected programs in the College of Engineering (Civil Engineering, Computer Science, Electrical Engineering, Electronics Engineering Technology, Mechanical Engineering, Operations Management) the target population for the minor. Enrollment was 1018 students in fall 2018. Using a conservative estimate, the University anticipates 1% of students from this target population will declare in the first year with an estimated 50% annual growth as the minor is promoted by faculty and professional advisors. It is expected the number of declared minors to level out at 30 students based on current enrollment trends in the college.

³ Bureau of Labor Statistics, U.S. Department of Labor. (2018). *Occupational Outlook Handbook*, Architectural and Engineering Managers. Available at <https://www.bls.gov/ooh/management/architectural-and-engineering-managers.htm>.

⁴ Connely, C. (2018). The 35 highest-paying jobs in America. Available at: <https://www.cnbc.com/2018/08/16/the-25-highest-paying-jobs-in-america.html>

⁵ Artz, B., Goodall, A., & Oswald, A.J. (2016). If your boss could do your job, you're more likely to be happy at work. *Harvard Business Review* Digital Articles. Available at: <https://hbr.org/2016/12/if-your-boss-could-do-your-job-youre-more-likely-to-be-happy-at-work>

7. What is the rationale for the curriculum? Demonstrate/provide evidence that the curriculum is consistent with current national standards.

The proposed minor is framed by a detailed curriculum review of 17 engineering management and similarly named minors at universities across the nation. A summary of three of the most suitable analogs to the proposed minor can be found in Appendix B. Common courses in these programs include: engineering economy, technology/engineering/systems management, project management, accounting/finance, cost estimating & management analysis, probability and statistics.

For the purposes of the Engineering Management minor at SDSU, the intent is to focus on four key content areas to assure students have the breadth of knowledge and skills to be promoted to into a leadership position and be a successful manager. These content areas are also tied to ABET student outcome criteria of solving complex problems, communicating effectively, and analyzing and interpreting data, reflected in the learning outcomes for the minor. See Appendix A for student outcomes mapped to the proposed curriculum.

The key content areas are engineering economy, project management, systems engineering and management, and probability and statistics. 1) Engineering economics (aka engineering administration) provides the manager with practical tools for making economic decisions such as break-even analysis, cost, risk & uncertainty, capital projects, and life-cycle analysis. 2) Project management requires a wide-ranging portfolio of interpersonal and technical skills. Assuring a project is on time, on budget and to specifications require the project manager is adept in cost estimating, budgeting, scheduling, planning, and communications. 3) Systems engineering and management brings functional aspects of engineering management (projects, product feature development, quality & performance) together with the broader strategic processes of optimization, systems design and modeling, and conceptual frameworks. 4) Underlying the required and elective courses in the minor are primarily applications used to make critical managerial decisions.

8. Complete the tables below. Explain any exceptions to Board policy requested.

A. Distribution of Credit Hours

Engineering Management Minor	Credit Hours	Percent
Requirements in minor	12	67%
Electives in minor	6	33%
Total	18	100%

B. Required Courses in the Minor

Prefix	Number	Course Title	Credit Hours	New (yes, no)
STAT OR STAT	281 381	Introduction to Statistics Introduction to Probability and Statistics	3	No
GE	385	Introduction to Systems Engineering and Management	3	Yes
GE	469	Project Management	3	No

Prefix	Number	Course Title	Credit Hours	New (yes, no)
OM OR CEE	460 482	Manufacturing Cost Analysis ⁶ Engineering Administration	3	No
Subtotal			12	

GE 385 Introduction to Systems Engineering and Management (3 cr.) introduces systems engineering, which is related to engineering design processes. Systems engineering is an emerging field that cuts across engineering, applied science, and technology management disciplines. GE 385 will be required for the Engineering Management Minor; however, other students may also take this course as an elective.

C. Elective Courses in the Minor: List courses available as electives in the program. Indicate any proposed new courses added specifically for the minor.

Select 6 credits from the following:

Prefix	Number	Course Title	Credit Hours	New (yes, no)
BLAW OR CM	350 473	Legal Environment of Business Construction Law and Accounting ⁷	3	No
MNET	367-367L	Production Strategy and Lab ⁸	3	No
OM	425	Production and Operations Management ⁹	3	No
OM	462	Quality Management ¹⁰	3	No

D. List any prerequisites for the courses above.

The following courses include prerequisite requirements:

Course Title	Prerequisite
STAT 281 Introduction to Statistics	One MATH course (102, 103, 104, 115, 120, 121, or 123) or appropriate placement based on standardized testing
STAT 381 Introduction to Probability and Statistics	MATH 123 + MATH 125
MNET 367-367L Production Strategy and Lab	MNET 150 or MNET 231 or (MATH 102 + ET 210 + ET 232) or instructor consent
OM 425 Production & Operations Management	STAT 281 or STAT 381
OM 460 Cost Analysis	STAT 281 or STAT 381
OM 462 Quality Management	STAT 281 or STAT 381

⁶ Minor course modification will revise OM 460 Manufacturing Cost Analysis to remove MNET 367-367L Production Strategy & Lab as prerequisite effective fall 2019.

⁷ Minor course modification will revise CM 473 Construction Law and Accounting (3 cr.) course title to Construction Law and Contracts and remove course prerequisites effective fall 2019.

⁸ Minor course modification to add 'instructor consent' for students who have adequate preparation, i.e. usually will be engineering majors.

⁹ Minor course modification will revise OM 425 Production and Operations Management to remove MNET 367-367L Production Strategy & Lab as prerequisite effective fall 2019.

¹⁰ Minor course modification will revise OM 462 Quality Management to remove MNET 367-367L Production Strategy & Lab as prerequisite effective fall 2019.

- E. Minors typically consist of 18 credit hours, including prerequisite courses. Proposals to establish new minors as well as proposals to modify existing minors must recognize and address this limit.¹ If the minor includes more than 18 credit hours (including prerequisites), provide justification below.**

The Engineering Management minor includes courses that are required for engineering, engineering technology, and applied science majors at SDSU. The proposed minor may be completed in 18 credits. As part of the required coursework students would complete either STAT 281 or STAT 381. The course prerequisite for both courses will be fulfilled by a math course that meets SGR #5 requirements. ABET accredited programs will require students to complete one of the statistics courses as part of their program requirements.

Students will select 6 credits from a list of electives. Three of the four elective courses either require no prerequisite or are fulfilled by either STAT 281 or STAT 381 in the core requirements of the minor. If a student selects MNET 367-367L Production Strategy and Lab as one of the electives, the minor may require a total of 21 credit hours. MNET 367-367L will require the course prerequisite of MNET 150 or MNET 231 or (MATH 102, ET 210, ET 232). In addition, students may register for MNET 367-367L with instructor consent.

- 9. What are the learning outcomes expected for all students who complete the minor? How will students achieve these outcomes?**

Upon completion of the Engineering Management minor, the successful student will possess an ability to:

1. Analyze and interpret technical data.
2. Identify, formulate, and solve broadly defined problems by applying math and/or technical knowledge relevant to the discipline
3. Demonstrate mastery in communication (written & oral) with a wide range of audiences.
4. Demonstrate mastery in systems integration using analysis, design/development, and implementation tools.

- 10. What instructional approaches and technologies will instructors use to teach courses in the minor? This refers to the instructional technologies and approaches used to teach courses and NOT the technology applications and approaches expected of students.**

Instructional methods will include lecture, discussion, team-based projects, and experiential learning such as simulation and modeling.

- 11. Delivery Location¹¹**

- A. Complete the following charts to indicate if the university seeks authorization to deliver the entire program on campus, at any off campus location (e.g., UC Sioux Falls, Capital University Center, Black Hills State University-Rapid City, etc.) or deliver the entire program through distance technology (e.g., as an online program)?**

¹¹ The accreditation requirements of the Higher Learning Commission (HLC) require Board approval for a university to offer programs off-campus and through distance delivery.

	Yes/No	Intended Start Date
On campus	Yes	2019-2020 Academic Year

	Yes/No	If Yes, list location(s)	Intended Start Date
Off campus	No		

	Yes/No	If Yes, identify delivery methods ¹²	Intended Start Date
Distance Delivery (online/other distance delivery methods)	Yes	015 Internet Asynchronous 030 Blended Hybrid	2019-2020 Academic Year

B. Complete the following chart to indicate if the university seeks authorization to deliver more than 50% but less than 100% of the certificate through distance learning (e.g., as an online program)?¹³

	Yes/No	If Yes, identify delivery methods	Intended Start Date
Distance Delivery (online/other distance delivery methods)	No		

12. Does the University request any exceptions to any Board policy for this minor? Explain any requests for exceptions to Board Policy. If not requesting any exceptions, enter "None."

AAC Guideline 2.8 limits minors to eighteen credit hours unless valid reasons exist to exceed the limit. As noted in question 8.E students may complete this minor in 18 credits, however based on their choice of electives it may require 21 credits. Students may select MNET 367-367L (3 cr.) as one of the courses that will fulfill six credits of electives. Students are able to complete MNET 367-367L after completing MNET 150, MNET 231 or (MATH 102 + ET 210 + ET 232) or by instructor consent. Three of the four elective courses either require no prerequisite or are fulfilled by either STAT 281 or STAT 381 in the core requirements of the minor.

Engineering majors who declare this minor will specifically benefit on the Fundamentals of Engineering (FE) exam, which ultimately leads to professional engineer licensure, as statistics, project management, and engineering economy (cost analysis) are topics on the exam.

13. Cost, Budget, and Resources: Explain the amount and source(s) of any one-time and continuing investments in personnel, professional development, release time, time redirected from other assignments, instructional technology & software, other operations and maintenance, facilities, etc., needed to implement the proposed minor. Address off-campus or distance delivery separately.

No additional resources are needed. The one new course, GE 385 Introduction to Systems Engineering and Management, will be delivered using schedule management to assure faculty resources are available.

¹² Delivery methods are defined in [AAC Guideline 5.5](#).

¹³ This question responds to HLC definitions for distance delivery.

14. New Course Approval: New courses required to implement the new minor may receive approval in conjunction with program approval or receive approval separately. Please check the appropriate statement (*place an "X" in the appropriate box*).

YES,

the university is seeking approval of new courses related to the proposed program in conjunction with program approval. All New Course Request forms are included as Appendix C and match those described in section 7.

NO,

the university is not seeking approval of all new courses related to the proposed program in conjunction with program approval; the institution will submit new course approval requests separately or at a later date in accordance with Academic Affairs Guidelines.

Appendix A
Engineering Management Minor - Student Learning Outcomes

Individual Student Learning Outcomes	Required Courses				Elective Courses				
	STAT 281 or STAT 381	GE 385	GE 469	OM 460 or CEE 482	BLAW 350	CM 473	MNET 367-367L	OM 425	OM 462
Students will analyze and interpret technical data.	X	X					X	X	X
Students will identify, formulate, and solve broadly defined problems by applying math and/or technical knowledge relevant to the discipline.		X		X					X
Students will demonstrate mastery in communication (written & oral) with a wide range of audiences.			X		X	X			
Students will demonstrate mastery in the integration of systems using analysis, design/development, and implementation tools.		X					X		

Appendix B
Example Curriculums

Montana State University – Engineering Management minor

<i>Required Courses</i>	Credits
Engineering Economic Analysis	3
Engineering Management & Ethics	3
Production Inventory Cost Analysis	3
Project Management for Engineers	3
<i>Required Pre-Requisites (not counted in total credits for the minor)</i>	
Applied Engineering Data Analysis or Engineering Probability & Statistics I	3
Calculus for Technology II or Calculus II	3
<i>Technical Problem Solving Elective (choose from 4 courses)</i>	3
<i>Managerial Problem Solving Electives (choose from 12 courses)</i>	6
Total	21

Rochester Institute of Technology – Engineering Management minor

<i>Required Courses</i>	
Cost Management in Technical Organizations	3
Engineering Economy	3
Engineering Management	3
<i>Required Prerequisites</i>	
Linear Systems & Differential Equations	3
Probability & Statistics II or Applied Statistics	3
<i>Electives (choose from 7 courses)</i>	6
Total	21

University of Colorado at Boulder – Engineering Management minor

<i>Required Courses</i>	
Introduction to Engineering Management	3
Engineering Economics	3
Project Management Systems or Pre-construction Estimating & Scheduling or Software Development Methods & Tools or Introduction to Construction	3
<i>Electives (choose from 8 courses)</i>	9
Total	18

Appendix C
New Course Requests

GE 385 Introduction to System Engineering and Management

Credits: 3

Introduction to the discipline of systems engineering and its intersection with engineering management. Course will cover the process of new systems development comprising concept, design, and build. Risk management, human factors, project management, integration of hardware and software, and system validation.

Prerequisites: None; Co-requisites: None; Registration Restrictions: None