

**BACCALAUREATE ENGINEERING PROGRAM  
ARRAY MANAGEMENT IN  
THE UNIVERSITY OF WISCONSIN SYSTEM**

**BACKGROUND**

Baccalaureate programs in engineering disciplines prepare graduates to apply knowledge of mathematics, science, and engineering and to use the techniques, skills, and modern engineering tools necessary for engineering practice. Students typically learn to design and conduct experiments as well as to analyze and interpret data. Successful engineers must have the ability to design a system, component, or process to meet a company's or organization's needs within economic, environmental, social, ethical, health and safety, and sustainability constraints. Engineering graduates are typically required to have the ability to identify, formulate, and solve engineering problems and to possess the education necessary to understand the impact of engineering solutions on global economic contexts.

Engineering programs generally focus on theory and conceptual design, while engineering technology programs tend to focus on application and implementation. Baccalaureate-level engineering programs typically require additional, higher-level mathematics, including calculus and calculus-based theoretical science courses. Engineering technology programs typically focus on algebra, trigonometry, applied calculus, and other courses that are more practical than theoretical in nature. Graduates from engineering programs are called engineers and often pursue entry-level work involving conceptual design or research and development. Graduates of four-year engineering technology programs are called technologists, while graduates of two-year engineering technology programs are called technicians.

The mission of the engineering schools and programs within the UW System is to develop vigorous programs of teaching, to work closely with industry and the community, and, particularly at the two doctoral institutions, to conduct and publish research.

At its December 4, 2014 meeting, the Education Committee will discuss the October 2014 report from the National Center for Higher Education Management Systems (NCHEMS), commissioned by Senior Vice President Mark Nook in March 2014, as well as the responses and evaluations received from UW institutions and Wisconsin businesses and organizations (The Regents previously received the NCHEMS report, and all documents are available for review at: [https://www.wisconsin.edu/regents/download/bor\\_supporting\\_docs/UW%20engineering%20programs%20array%20analysis%20documents.pdf](https://www.wisconsin.edu/regents/download/bor_supporting_docs/UW%20engineering%20programs%20array%20analysis%20documents.pdf)).

Interim Senior Vice President Ward will first present an overview of major issues to consider in the discussion:

- What is the current and long-term demand for baccalaureate-level programs and graduates in engineering?
- Which fields of engineering show sustainable long-term demand?

- Will expanding engineering program capacity within the UW System add to the overall engineering talent base in the State of Wisconsin?
- If the UW System decides to expand engineering-program capacity, what is the best method to expand access to students and respond to market demand?

Options include:

- (1) no new programs will be authorized.
- (2) build on the existing program array at institutions currently operating successful engineering programs; or
- (3) grant additional engineering program authorizations:
  - stand-alone programs;
  - consortial programs;
  - partnerships with existing programs; and
  - stepwise growth.

- How is employer, market, and student demand for engineering programs best analyzed?
- If engineering capacity in the UW System is expanded, what is the most cost-efficient way to achieve expansion?

Following this presentation, leaders from UW institutions that currently have engineering programs as part of their distinct mission and leaders from those institutions wishing to add engineering programs to their institutional array will be asked to briefly present their points of view to the Committee.

## **RECOMMENDATION**

For discussion only. No action is required at this time. Further discussion is expected at the February 2015 meeting of the full Board.

## **DISCUSSION**

The UW System's baccalaureate engineering programs are housed at UW-Madison, UW-Milwaukee, UW-Platteville, UW-Stout, and UW-Stevens Point. A complete listing of engineering baccalaureate degrees issued between 2008-09 and 2012-13 and organized by engineering disciplines and UW institutions is available in the attachment to this document.

According to data collected by the Office of Policy Analysis and Research (OPAR), UW-Madison has 15 baccalaureate-level engineering degrees and graduated 3,165 students from 2008-09 to 2012-13, the most recent years for which data are available. UW Milwaukee currently has seven Accreditation Board for Engineering and Technology (ABET)-accredited baccalaureate engineering programs and has graduated 935 students during the same period. UW-Platteville has eight baccalaureate ABET-accredited engineering programs and has graduated 1,735 students during the same 5-year period. UW-Stout has three engineering programs, one Engineering Technology Program and some engineering-related and has produced 725 baccalaureate engineering degrees. UW-Stevens Point has a Paper Science and Engineering Program and has graduated 39 students in the same five-year period. According to OPAR data, from 2008-09 to 2012-13, UW institutions produced a total of 6,609 engineering graduates. Degrees issued in Science, Technology, Engineering, and Mathematics (STEM), which includes engineering and engineering-related technology programs, have been a sizeable part of the UW System's output.

In 2014, three engineering technology baccalaureate-completion programs in collaboration with select Wisconsin Technical College System institutions, were implemented jointly at UW-Oshkosh and UW-Green Bay.

Students may also enroll in pre-engineering programs at many UW institutions, including the UW Colleges, or can take advantage of certificates, collaborative degrees with other universities and colleges, as well as articulation agreements in engineering and engineering technology fields among institutions within and outside the state. Several institutions deliver all or part of their engineering programs at technical and UW colleges or via various forms of distance education at different sites. Some of the courses leading to an engineering degree are also available online.

### **Engineering Program Quality**

Quality in engineering programs is assessed by the Accreditation Board for Engineering and Technology (ABET) which, according to its website "accredits over 3,400 applied science, computing, engineering, and engineering technology programs at nearly 700 colleges and universities in 28 countries worldwide. Approximately 85,000 students graduate from ABET-accredited programs each year." Accreditation by ABET is regarded as evidence that an engineering program has met certain standards necessary to produce graduates who are ready to enter their professions and meet workforce requirements. Students who graduate from accredited programs have access to enhanced opportunities in employment; licensure, registration and certification; graduate education, and global mobility.

## 2013 Notices of Intent to Plan Baccalaureate Engineering Programs

In the fall of 2013, the Office of Academic and Student Affairs received several Notices of Intent from UW comprehensive institutions for new baccalaureate engineering degrees. The proposing institutions sent their proposals to UW System Administration and to the Provosts of the institutions for initial comments and review. In chronological order, below are the dates on which each university submitted its proposals.

September 13, 2013	UW-Eau Claire	B.S. in Materials Science and Engineering
October 15, 2013	UW-River Falls	B.S. in Environmental Engineering B.S. in Agricultural Engineering
December 12, 2013	UW-Stevens Point	B.S. in Chemical Engineering B. S. in Environmental Engineering
December 20, 2013	UW-Stout	B.S. in Chemical Engineering B.S. in Electrical Engineering B.S. in Mechanical Engineering
October 31, 2014	Northwest Wisconsin Engineering Consortium Proposal (UW-River Falls, UW-Stout, and UW-Eau Claire; for the same degrees as mentioned above).	

The proposal for a Northwest Wisconsin Engineering Consortium was submitted by UW-River Falls, UW-Stout and UW-Eau Claire to President Cross and Interim Senior Vice President Ward as part of UW-Stout's, UW-River Falls' and UW-Eau Claire's response to the NCHEMS study. Engineering fields for which the Consortium seeks pre-authorization to plan are Electrical Engineering, Chemical Engineering, Mechanical Engineering, Materials Science and Engineering, Environmental Engineering and Agricultural Engineering.

Under the proposal, the Consortium will operate as a collaborative quasi-college of engineering for the partner universities. Students will be admitted to their home institution and, through a common core of shared courses, freely move between the academic programs offered by the Consortium partners. The proposal also includes an Hanover Research demand study for a B.S. in Biosystems Engineering at UW-River Falls, dated August, 2013; a Hanover Research demand study for a B.S. in Environmental Engineering Technology at UW-River Falls dated July 2013; and a Hanover Research demand study for a B.S. in Mechanical Engineering at UW-River Falls, dated December 2012. In addition, the Consortium partners' response includes a 2013 study by the Education Advisory Board, entitled *Market Demand for Baccalaureate Programs in Mechanical, Electrical, and Chemical Engineering*.

A B.S. in Biomedical Engineering at UW-Milwaukee was pre-authorized by the Office of Academic, Faculty and Global Programs, on March 27, 2014. UW-Milwaukee also notified UW

System Administration that it will soon submit Notices of Intent for a B.S. in Software Engineering and for Ph.D. programs in several engineering disciplines.

### **The 2014 Study of Engineering Programs Supply and Demand**

For the report commissioned by UW System Administration, NCHEMS was asked to determine “the extent and nature of shortages of engineers needed in the Wisconsin workforce, if any.” Based on the results of this initial information, NCHEMS was asked to “provide recommendations as to cost-effective approaches to responding to any identified shortages.”

The NCHEMS report provides information about the supply and demand for engineers in various specialty areas, both statewide and in different regions within the state. In addition, it presents data that provide a deeper understanding of the current and future market need for engineering graduates in Wisconsin

The report specifically identifies five engineering fields in which there is a need in the state of Wisconsin: chemical, civil, electrical, industrial, and mechanical (p. 18). The report also points out that Wisconsin is a net exporter of engineers; that expected retirements were not expected to create acute shortages of engineers (p. 4); and that wages for engineers in Wisconsin are lower than their counterparts in bordering states and nationally (pp. 6-13).

For the purposes of examining regional demand, the NCHEMS report divided the state into several demarcated regions with possible market need. The report makes the following main recommendations to the UW System (p. 20):

- No new engineering programs should be created in Regions 1 (Western WI/Minneapolis), Region 2 (Northern WI), Region 3 (Wausau) and Region 4 (Western WI from north of La Crosse to Platteville) because there is no demand to justify the investment;
- The UW System should give priority to expanding existing capacity at UW-Madison (located in Region 6) and UW-Milwaukee (located in Region 7) rather than creating new capacity at other institutions;
- UW System Administration should conduct a targeted study to determine if a chemical engineering program should be added to UW-Milwaukee or whether priority should be given to expanding capacity for civil, electrical, industrial, and mechanical programs; and
- The UW System should create a collaborative engineering program in Region 5 at UW-Green Bay and/or UW-Oshkosh, with the involvement of UW-Madison and/or UW-Milwaukee.

A revised version of the NCHEMS report was received at UW System Administration on October 20, 2014. It was shared electronically by Interim Senior Vice President David J. Ward with the President's Cabinet, Chancellors, Provosts, CBOs, and others on October 21<sup>st</sup>, requesting feedback and observations by October 31, 2014. In a letter dated October 31, 2014, President Cross invited businesses and organizations, as well as state agencies, to provide input on engineering workforce needs of the state for the next decade and how the UW System could address these needs.

### **History of Engineering Array Studies conducted by UW System Administration**

A review of the history of market demand studies for engineering program within the UW System shows that the array management of engineering program has been reviewed periodically over time. Current efforts to examine this question will take into account the NCHEMS report and the newly gathered information from UW System institutions and responses from businesses and business organizations.

In 1974, UW System Administration issued a "Report of the System Task Force on Engineering/Technology." In 1988, the Steering Task Force for Strategic Planning in Engineering and Technology within the UW System released a report, entitled "Better Living through Technology: Wisconsin at Risk." The central conclusion of the 1974 comprehensive report was that "there appears to be little need for development of schools/colleges or engineering/technology within Wisconsin" (p. 1)

The 1988 "Better Living Through Technology" report, by a steering committee that included industry representatives and faculty leaders, was charged with developing a recommendation for improving the coordination of engineering and technology programs in order to make the UW System more responsive to state and national needs, become more cost-effective, and improve the quality of existing programs. Expansion priorities were tied to access, research and interactions with industry and economic leaders in the state.

In 2007, an Engineering Education Task Force with representation of all UW institutions offering bachelor's degrees in engineering, was charged by then-Senior Vice President for Academic Affairs Rebecca Martin to study the current and projected supply and demand of engineering graduates in Wisconsin. The Task Force was asked to formulate recommendations on steps that need to be taken by the UW System to ensure that the state's emerging public higher education needs in engineering over the next decade were effectively and efficiently met. The Task Force completed its report in November 2007. The report was presented to the Board of Regents Education Committee for discussion at its April 2008 meeting.

The report concluded that overall enrollments in UW System engineering programs have remained steady during the previous decade. Further, the report noted that a margin of additional capacity was present in almost all of the UW System engineering programs, and that this capacity margin "serves as an important balancing factor that can be used to address

the cyclical nature of demand for engineers and enrollment in engineering programs, and appears to be adequate to meet current engineering needs.”

The Task Force’s conclusion was that overall there was no evidence based on the data examined of a significant unmet need for engineers in the state. The report’s key recommendations were to:

- Periodically assess potential regional and state-wide demand for engineering graduates;
- Utilize existing resources to the extent possible to meet potential unmet regional and state need. The Task Force recommended that such unmet need be initially served, where possible, through collaboration between UW institutions with existing engineering programs and UW institutions in the region(s) of need;
- Develop strategies for accommodating part-time and place-bound students in existing engineering programs;
- Develop strategies for attracting more students in general, and women and students of color in particular;
- Work with K-12 and pre-college programs to nurture interest and ensure academic readiness for engineering study; and
- Periodically assess capacity and demand while maintaining quality through adequate investment of resources and pursuit of Accreditation Board for Engineering and Technology (ABET) accreditation.

Regional needs assessments from Wisconsin business organizations have also been shared with UW System leadership periodically. In 2011, the UW System Office of Market Research published the results of a focus group research project, entitled “Engineering and Technology Needs in the Chippewa Valley Area.” The 2014 *BE BOLD 2: Growing Wisconsin’s Talent Pool* study issued by Competitive Wisconsin, Inc., cites engineering as one of the top talent needs for businesses in Wisconsin.

## **RELATED REGENT POLICIES**

ACIS 1.0

RPD 4-12: Academic Program Planning, Review, and Approval in the University of Wisconsin System.

**University of Wisconsin System**  
**Bachelor's Degrees Conferred in Engineering Disciplines**  
**2008-09 through 2012-13**

<b>UW Institution</b>	<b>Discipline</b>	<b>2008-09</b>	<b>2009-10</b>	<b>2010-11</b>	<b>2011-12</b>	<b>2012-13</b>
<b>UW-Madison</b>	Agricultural Engineering	24	17	20	19	44
	Biomedical/Medical Engineering	50	49	52	59	45
	Chemical Engineering	55	44	67	79	87
	Civil Engineering	85	84	121	109	119
	Computer Engineering	33	16	31	27	26
	Electrical, Electronics and Communications Engineering	75	58	65	56	60
	Engineering Mechanics	38	29	29	35	23
	Engineering Physics	3	5	3	3	3
	Engineering, Other				3	1
	Geological/Geophysical Engineering		3	3	2	4
	Industrial Engineering	48	72	52	69	81
	Materials Engineering	16	19	11	19	20
	Mechanical Engineering	142	169	181	152	152
	Naval Architecture and Marine Engineering	5	5	5		
	Nuclear Engineering	17	17	19	15	26
	<b>Total</b>		<b>591</b>	<b>587</b>	<b>659</b>	<b>647</b>
<b>UW-Milwaukee</b>	Civil Engineering	45	39	51	52	64
	Computer Engineering		7	4	10	15
	Electrical, Electronics and Communications Engineering	33	35	41	45	40
	Industrial Engineering					16
	Manufacturing Engineering	12	13	5	16	
	Materials Engineering	4	9	1	4	12
	Mechanical Engineering	55	66	61	77	103
	<b>Total</b>		<b>149</b>	<b>169</b>	<b>163</b>	<b>204</b>
<b>UW-Platteville</b>	Civil Engineering	80	72	54	81	64
	Computer Engineering	15	15	21	15	19
	Electrical, Electronics and Communications Engineering	28	28	27	33	42
	Engineering Physics	14	9	10	10	8
	Environmental/Environmental Health Engineering	8	10	11	16	13
	Industrial Engineering	9	21	19	8	13
	Industrial Production Technologies/Technicians	95	78	101	92	114
	Mechanical Engineering	63	67	103	115	134
	<b>Total</b>		<b>312</b>	<b>300</b>	<b>346</b>	<b>370</b>



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<b>UW-Stevens Point</b>	Paper Science and Engineering		8	6	9	16
<b>UW-Stout</b>	Computer Engineering				2	8
	Engineering Technology, General	71	62	66	59	71
	Engineering-Related Fields	41	23	38	41	48
	Manufacturing Engineering	26	37	36	39	42
	Polymer/Plastics Engineering				9	6
	<b>Total</b>	<b>138</b>	<b>122</b>	<b>140</b>	<b>150</b>	<b>175</b>
<b>Total UW System by Engineering Discipline</b>						
	Agricultural Engineering	24	17	20	19	44
	Biomedical/Medical Engineering	50	49	52	59	45
	Chemical Engineering	55	44	67	79	87
	Civil Engineering	210	195	226	242	247
	Computer Engineering	48	38	56	54	68
	Electrical, Electronics and Communications Engineering	136	121	133	134	142
	Engineering Mechanics	38	29	29	35	23
	Engineering Physics	17	14	13	13	11
	Engineering Technology, General	71	62	66	59	71
	Engineering, Other				3	1
	Engineering-Related Fields	41	23	38	41	48
	Environmental/Environmental Health Engineering	8	10	11	16	13
	Geological/Geophysical Engineering		3	3	2	4
	Industrial Engineering	57	93	71	77	110
	Industrial Production Technologies/Technicians	95	78	101	92	114
	Manufacturing Engineering	38	50	41	55	42
	Materials Engineering	20	28	12	23	32
	Mechanical Engineering	260	302	345	344	389
	Naval Architecture and Marine Engineering	5	5	5		
	Nuclear Engineering	17	17	19	15	26
	Paper Science and Engineering		8	6	9	16
	Polymer/Plastics Engineering				9	6
	<b>Total</b>	<b>1,190</b>	<b>1,186</b>	<b>1,314</b>	<b>1,380</b>	<b>1,539</b>

Office of Policy Analysis and Research  
UW System Administration  
10/17/2014  
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