3.0

People and Programs Analysis

3.1 College of Engineering Academic Framework

The following information on CoE people and programs was provided by the College and provided the basis for the space needs analysis.

3.1.1 Current Programs

The following departments[7] make up the College of Engineering:

Departments	Base Year (Fall 2013)		Projection (2021)	
	Undergrad	Grad	Undergrad	Grad
Biomedical Engineering (BME)	501	117	701	167
Chemical and Biological Engineering (CBE)	533	124	693	161
Civil and Environmental Engineering (CEE)	427	148	598	207
Electrical Engineering	319	455	385	485
Computer Engineering	270	N/A	355	N/A
Engineering	N/A	156	N/A	210
Engineering Mechanics (EM)	151	28	188	45
Engineering Physics	49	N/A	85	N/A
Environmental Chemistry and Technology	N/A	19	N/A	40
Freshwater and Marine Sciences	N/A	14	N/A	35
Geological Engineering (GLE)	106	16	165	40

[7]The University of Wisconsin-Madison College of Engineering, <http://www.engr.wisc.edu/academicprograms.html> (January 12, 2015).

Departments	Base Year (Fall 2013)		Projection (2021)	
	Undergrad	Grad	Undergrad	Grad
Industrial and Systems Engineering (ISyE)	237	160	285	185
Manufacturing Systems Engineering	N/A	30	N/A	35
Materials Science/Engineering	92	111	175	160
Mechanical Engineering (ME)	938	232	1,560	345
No Major	559	N/A	625	N/A
Nuclear Engineering & Engineering Physics (NEEP)	138	93	185	135
Total	**4,320**	**1,703**	**6,000**	**2,250**

3.1.2 Program Prioritization and Programs Targeted for Growth or Reduction

Based on past growth, it is expected that Mechanical Engineering, Biomedical Engineering, Chemical and Biological Engineering, and Computer Engineering programs will continue to be in high demand with the largest growth rates and student population. Growth in these areas drives specific facility requirements for the CoE including increased instructional laboratory and design spaces, infrastructure intensive research laboratories to accommodate high end equipment and instrumentation, as well as flexible research and collaborative spaces for faculty and graduate students. Additionally, these areas of focus necessitate classroom spaces that are configurable and nimble in order to address changing instructional styles and innovations in instructional delivery.

3.1.3 Accreditation

The following are factors in program accreditation:[8]

General Criterion 7. Facilities

Classrooms, offices, laboratories, and associated equipment must be adequate to support attainment of the student outcomes and to provide an atmosphere conducive to learning. Modern tools, equipment, computing resources, and laboratories appropriate to the program must be available, accessible, and systematically maintained and upgraded to enable students to attain the student outcomes and to support program needs. Students must be provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories available to the program.

The library services and the computing and information infrastructure must be adequate to support the scholarly and professional activities of the students and faculty.

[8] ABET, <http://www.abet.org/eac-criteria-2014-2015/> (February 13, 2015).

General Criterion 8. Institutional Support

Institutional support and leadership must be adequate to ensure the quality and continuity of the program.

Resources including institutional services, financial support, and staff (both administrative and technical) provided to the program must be adequate to meet program needs. The resources available to the program must be sufficient to attract, retain, and provide for the continued professional development of a qualified faculty. The resources available to the program must be sufficient to acquire, maintain, and operate infrastructures, facilities, and equipment appropriate for the program, and to provide an environment in which student outcomes can be attained.

Given the growing enrollment, facilities condition and age and the current unfavorable faculty to student ratio, the facilities are considered to be lacking in support of student outcomes consistent with requirement for accreditation.

3.1.4 Enrollment

Since 2007, the CoE has seen a 33% growth rate in its undergraduate and graduate enrollment. The anticipated growth from 4,320 undergraduate students in the base year (fall 2013) to 6,000 undergraduate students in the plan horizon (fall 2021), projects an overall growth rate of 39%.

When the Facility Master Plan project started in January 2014, the CoE projected 2014 numbers to be used as the basis of the study. From the time that the data was provided to the fall of 2014 - when actual numbers could be verified - the CoE had approximately 500 more undergraduate students than projected. Enrollment projections beyond 2021 are difficult to determine as they are influenced by industry trends, national as well as global factors, and demands and the availability of operational resources.

The following data represents the College of Engineering enrollment for the base year, current year, and future projections:

	Base Year (Fall 2013)	Current (Fall 2014)	Future Projections (Fall 2021)
HC Total	6,023	6,700	8,250
Undergraduate	4,320	5,000	6,000
Graduate	1,703	1,700	2,250

3.1.5 Employees

Fall 2013: ..... 181 T/TT
Fall 2021: ..... 300 T/TT
Staff:..... 2015 levels are 1,950 individuals comprising 1,280 full-time equivalent positions. Projections for 2021 are roughly 2,100 individuals comprising 1,400 full time positions. These numbers do not include student hourly employees, which currently number around 880.

The projection for 300 T/TT faculty in the fall of 2021 is based on the preferred ratio of 20:1 for number of undergraduate students relative to T/TT faculty. The ratio of undergraduate students to faculty is tied to the quality of instruction and assistance provided to students and is an important reference for national comparisons. Research-based engineering universities have predominantly lower ratios than non-research institutions. The appropriate split of time between research and teaching activities are reflected in ratios of approximately 20:1 for universities amongst the top twenty in the USA, while engineering institutions above the 30:1 ratio are not typically ranked in the top 30 in the country.

Last year, the ratio for the CoE was 24:1. Based on increased enrollment this fall, the ratio is approximately 27:1, and at peak growth, this ratio would approach 34:1. The CoE does not believe that a 27:1 ratio represents a sustainable future for a research university as the balance of time and commitment to quality education will be at the expense of research activity. To achieve CoE strategic objectives related to both the quality of the undergraduate education and commitment to research, and to remain competitive with peer intuitions, the CoE has identified an "ideal" ratio of 20:1. This would mean an increase of approximately 120 faculty between today and the plan horizon when the College hits the 6,000 undergraduate student number. The CoE recognizes that they will need to move incrementally toward achieving the ideal ratio. For this reason, the studies that were explored as part of the CoE Facilities Master Plan reference the variables related to number of undergraduates, number of faculty and ratio of undergraduates to T/TT faculty. Refer to *Figure 3A*

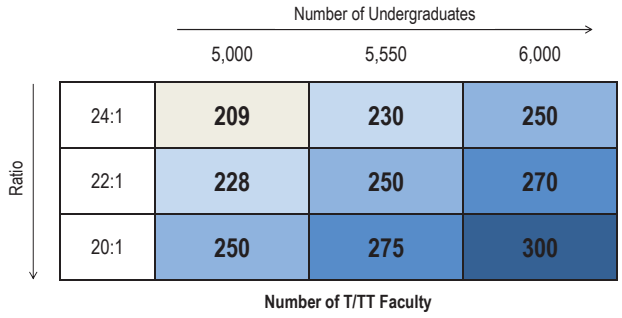

Figure 3A: **Undergraduate to T/TT Faculty Ratios**

The following table illustrates faculty growth projections as provided by the CoE. The overall number of 295 for 2021 was rounded up to 300 to meet the 20:1 ratio for undergraduate to T/TT faculty based on 6,000 students:

	Existing 2013			2013 Peer Faculty			Projected 2021		
Department	Faculty Adjunct	Faculty	T/TT Faculty	Faculty Adjunct	Faculty	T/TT Faculty	Faculty Adjunct	Faculty	T/TT Faculty
Admin/Other									
Biomedical Engineering *	2	16	15	2	27	25	5	42	35
Chemical & Biological Engineering	1	20	18	1	23	23	3	38	30
Civil and Environmental Engineering	19	23	25	19	27	25	22	40	35
Electrical and Computer Engineering	4	42	38	4	42	38	8	50	45
Engineering Physics	2	17	20	2	20	20	5	35	30
Engineering Professional Development	16	38	6	16	40	6	20	50	10
Industrial and Systems Engineering	2	17	17	2	17	17	5	30	25
Materials Science and Engineering	3	14	13	3	15	15	7	30	25
Mechanical Engineering	1	36	29	1	55	47	5	75	60
Grainger Institute for Engineering	0	0	0	0	0	0	0	0	0
	50	**223**	**181**	**50**	**266**	**216**	**80**	**390**	**295**

Note: All numbers in headcount
Faculty Adjunct less than .60 FTE
T/TT = Tenure/Tenure Track
Two "Associate Professor" included in "Faculty" but have < .60 FTE

Note: Faculty in the Grainger Institute are included in departmental headcounts

Figure 3B: **Faculty Staffing Projections**

3.1.6 Community/Industry Partners

The College of Engineering works closely with its industrial partners, from small entrepreneurial start-ups to Fortune 500 corporations, providing a wide range of resources in research and education. These collaborations spark innovative research ideas and offer faculty, staff, and students at all levels valuable opportunities to use technical engineering knowledge to solve complex, multidisciplinary challenges.

In 2014, the CoE announced creation of the Grainger Institute for Engineering. Funded with $25 million from The Grainger Foundation of Lake Forest, Illinois, the Institute will serve as an incubator for trans-disciplinary research conducted at the University of Wisconsin-Madison College of Engineering. This research will enable the College to lead discoveries in targeted technological areas important to society and to our nation's economy. Currently, researchers in the Institute are focusing on advanced manufacturing and materials discovery and sustainability—areas that build on existing strengths within the College of Engineering and at UW-Madison. These research areas are critical at a national level: U.S. President Barack Obama aims to reinvigorate U.S. manufacturing through an initiative called the National Network for Manufacturing Innovation. Research leadership in advanced manufacturing will help to strengthen the global competitiveness of existing U.S. manufacturers, spur new ventures, and boost local and state economies. Advanced materials are key to the success of this initiative. The national Materials Genome

Initiative aims to boost U.S. manufacturing competitiveness and make the process of discovering and developing advanced materials faster, less expensive, and more predictable.[9]

In addition, extending the reach of the CoE with community/industry partners is critical to achieving several of the key goals identified in the College of Engineering *Strategic Plan 2015-2020*[10] that are related to entrepreneurship, technology transfer, and educational outreach.

Specific goals and action items identified in the *Strategic Plan* to achieve these goals that hinge specifically on increased, successful relationships with community/industry partners include the following:

Entrepreneurship

Goal: "Champion student, faculty, and staff innovation and its transition to the marketplace".
Action Items:

- Identify and implement ways to not only sustain but further grow the successful innovation experiences, such as innovation days and innovation competitions hosted by CoE and elsewhere across campus.
- Develop a clinical-practice-centered, team-based program (including but not limited to participation in innovation competitions) that provides education in the core competencies associated with new product innovation, development, production, and introduction into the marketplace. The program, which will lead to a certificate, leverages mentorship by a network of experienced entrepreneurs and is open to undergraduate students, graduate students, and working professionals.
- Develop sabbatical and leave policies that encourage efforts to create startups: allow for greater movement between faculty position and starting a company.
- With a panel of local entrepreneurs and students and faculty, identify and implement ideas to generate enhanced visibility of their successes and celebrate their efforts and culture. Establish mentoring partnerships, enhance the discovery to product flow, and recognize accomplishments.

Technology Transfer

Goal: "Accelerate translation of faculty/student/staff research to technologies".
Action Items:

- Conduct benchmarking research and identify best practices to reduce barriers and increase opportunities for entrepreneurial technology transfer through consultation with entrepreneurial individuals.

[9]Grainger Institute for Engineering, <https://graingerinstitute.engr.wisc.edu> (February 10, 2015).

[10]College of Engineering, University of Wisconsin-Madison, *Strategic Plan (Internal) 2015-2020*, Version 5 (internal) - Final Version, January 24, 2015..

  - Convene a panel of faculty and local alumni entrepreneurs (undergraduates and graduate students) and interview them for what works well and what are barriers related to tech transfer opportunities.
  - Convene a panel of faculty who regularly file patents but have not yet pursued a startup effort. Document the reasons why they have not pursued such activities.
- Partner with the campus Office of Corporate Relations to expand relationships with corporations.
- Work with CoE External Relations/Communications to create stories for publication in paper and electronic formats.
- Work with Madison Region Economic Partnership to set up a board of local entrepreneurs who will mentor any faculty/student/staff interested in startups.
- Educate faculty, staff and students with regard to intellectual property rights and the processes to develop products and make them aware of campus resources. Develop College personnel guidelines that reward entrepreneurism.

Educational Outreach

Goal: "Increase understanding by non-traditional and K-12 students of engineering and technology applications in society".

Action Items:

- Assess new options, identify potential audiences, and implement feasible new approaches for providing CoE courses to non-traditional students.
- Identify, assess, and select new opportunities to increase the distance delivery of engineering courses to off-campus students.
- Investigate, evaluate, and implement competency-based curricular approaches and evaluation methods for engineering outreach education.
- Expand relationships with other UW-System schools, Wisconsin Technical College system and local school districts to extend the reach of College of Engineering outreach activities.
- Coordinate with the School of Education to expand engineering-related resources available to K-12 teachers – ed component of CAREER awards, encourage faculty to pursue outreach that are extramurally funded.