IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

ATMAE Accreditation
Self-Study Report
Spring 2020

Agricultural Systems Technology
- Agriculture and Biosystems Management Option Program
- Machine Systems Option Program

Industrial Technology
- Manufacturing Option Program
- Occupational Safety Option Program

March 1, 2020

Agricultural and Biosystems Engineering Department
1340 Elings Hall
605 Bissel Road
Ames IA 50011-3270

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IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Department of Agricultural and
Biosystems Engineering
1340 Elings Hall
Ames, Iowa 50011-3270
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March 7, 2020

Dear ATMAE Accreditation Review Team,

This Self-Study Report has been prepared as Iowa State University' Agricultural and Biosystems Engineering Department response to the program standards developed by ATMAE for the accreditation of our program options within our baccalaureate programs in Agricultural Systems Technology and Industrial Technology. The report is being submitted to your review team to provide background information for your site visit to the Iowa State University campus April 19, 20, and 21, 2020, when you will review the options within the Bachelor of Science in Agricultural Systems Technology degree program and the Bachelor of Science in Industrial Technology degree program for re-accreditation. This self-study report accurately reflects the ABE degree programs of Agricultural Systems Technology and Industrial Technology as of March 1, 2020. Great effort has been set forth by all involved in the completion of this self-study and the ABE department is confident that the degrees and related options are compliant with the standards and guidelines set forth by The Association of Technology, Management, and Applied Engineering.

The preparation of this report has been a shared responsibility, involving the entire faculty and staff of the Agricultural and Biosystem Engineering Department. However, the Agricultural and Biosystems Engineering department's Technology Curriculum Committee has played a key role in this effort. This Self-Study report for Iowa State University's Agricultural and Biosystems Engineering (ABE) Department degree programs of Agricultural Systems Technology and Industrial Technology was completed by the ABE ATMAE Accreditation Committee consisting of Gretchen Mosher, Thomas Brumm, John Haughery, and Elaine Phompheng. All standards that pertain to the degree programs and options have been addressed using policies governing the department and the University. Instructors of all our Technology Systems Management courses have provided course materials and background information needed in the preparation of the report. The collaborative efforts of these engaged individuals have facilitated the many aspects of writing, editing, and producing the report. Thanks to each of them for contributing to the success of this endeavor.

Sincerely,

Steven K. Mickelson
Professor and Chuck R. and Jane F. Olsen Professor of Engineering

The On-Site Visit

ATMAE Board of Accreditation Health Travel Notice

March 12, 2020

The ATMAE Board of Accreditation (BoA) met on Wednesday, March 11, 2020 at 2 pm to determine how to conduct 2020 Accreditation and Reaccreditation reviews during the time of the national need for restricted travel due to Coronavirus Disease 2019 (COVID-19). The Board of Accreditation (BoA) approved the adoption of this document that shall serve as the temporary procedure for conducting visiting team accreditation reviews and recommendations to the BoA for this accreditation cycle under COVID-19 travel restrictions.

1. All institutions shall submit their accreditation or reaccreditation self-study as required. Self-study reports are due to the ATMAE team chair and the Director of Accreditation thirty days before the scheduled site visit.

2. All visiting team chairs and their respective team members shall conduct an initial review of compliance, partial compliance or non-compliance of accreditation standards within 30 days of receipt of the self-study document to determine what standards require additional information needed during the usual campus validation visit.

3. In the case that no or minimal information for validation is needed the assignment team chair shall contact the institution's contact person seeking the needed additional information. When the needed information is obtained, the visiting team chair shall complete the visiting team's report and accreditation recommendation WITHOUT the usual campus visit. The team chair shall submit a copy of the team's report to the contact person as usual to check the needs of corrections of facts in the report. After conducting this step, the visiting team report shall be submitted to the BoA Director and the Institution Head as usual. Please note that the timelines as established in the 2019 ATMAE Accreditation Handbook have not changed.

4. In the case where a team chair and team members are uncomfortable proceeding under step 3, the team chair shall work with the institutional program contact person to determine how to resolve the need of additional information and validation of the selfstudy. (This step is meant to give all the maximum flexibility for accreditation review during this emergency and travel restriction). Additional information remediation can include telephone and other direct communications, virtual campus visits or other processes found appropriate by the vising team chair and the campus contact person with the approval of the BoA Director.

5. The BoA expects that most, if not all accreditation reviews and visiting team recommendations will be successfully completed within 45 days of the previously arranged campus visit. (3.8 of the ATMAE Accreditation Policies and Procedures)

6. In the extreme case step 5 cannot be successfully accomplished and a timely visit to the

institution is not possible, the institution shall be granted a 1-year accreditation extension upon the approval of the BoA.

The previous six steps will be used while travel restrictions are in effect. When travel restrictions are lifted, visits will continue as scheduled. If a visiting team requests a site visit and has not submitted the final report to the institution, a modified visit may be arranged provided the visit is completed 60 days before the BoA Hearings.

General Information

The Institution

Name and Address: Iowa State University of Science and Technology
Ames, Iowa 50011

Iowa State University draws students from all 50 states and over 100 countries to Ames, Iowa. These students choose from more than 100 majors, study with world-class scholars, and hone their leadership skills in 800-plus student organizations. Iowa State University offers an environment where students can reach their potential and discover their passions.

Iowa Agricultural College and Model Farm (now Iowa State University) was officially established on March 22, 1858, by the legislature of the State of Iowa. In 1862, the Iowa legislature voted to accept the provisions of the Morrill Act, which was awarded to the agricultural college in 1864. Iowa Agricultural College (Iowa State College of Agricultural and Mechanic Arts as of 1898), as a land grant institution, focused on the ideals that higher education should be accessible to all and that the university should teach liberal and practical subjects. These ideals are integral to the land-grant university.

Even before the passage of the Smith-Lever Act of 1914, which established the Cooperative Extension Service, Iowa State was actively bringing knowledge to the people of Iowa through farmers' short courses and farm demonstrations. In addition to extension, applied research is also a part of the land-grant mission, the Agricultural and Home Economics Experiment Station was founded in 1888 as a result of the Hatch Act of 1887.

The first official class entered Ames in 1869, and the first class (24 men and 2 women) graduated in 1872. Iowa State was and is a leader in agriculture, engineering, extension, home economics, and created the nation's first state veterinary medicine school in 1879. In 1959, the college was officially renamed Iowa State University of Science and Technology. The focus on technology has led directly to many research patents and inventions including the first binary computer (the ABC), Maytag blue cheese, lead-free solder, the round hay baler (by our Agricultural and Biosystems Engineering Department), and many more. Beginning with a small number of students, Iowa State University now has approximately 34,000 students (see Figure 1) and over 100 buildings with world class programs in agriculture, technology, engineering, science, and art.

Iowa State University is widely known for its exceptional student experience which starts in the classroom and extends to a broad range of extracurricular activities. A caring community and dedicated faculty and staff give this university the friendly feel of a much smaller place. Recognized for its strengths in science and technology, Iowa State has an impressive history of discovery and innovation and is adding new chapters each year. Iowa State University is home to:

- The world’s first electronic digital computer and the encoding process essential to nearly all FAX machines

- The US Department of Energy's Ames Laboratory, where scientists developed a lead-free solder that's licensed worldwide and led in the creation of iron-arsenide superconducting materials.
- The world's largest tornado simulator for wind energy research and the world's highest resolution immersive virtual reality lab.
- The largest concentration of faculty involved in sustainable agricultural teaching and research.
- The first-in-the-nation research and demonstration farm devoted to biomass production and processing.
- The Bioeconomy Institute, a leader in developing new sources of energy, fuels, and other products from renewable resources.
- Dynamometer facility capable of testing large construction and farm machinery opened in summer 2019.
- New Student Innovation Center opened in 2020.

Iowa State University enjoys a number of national rankings.

- Iowa State was ranked #56 among public national universities in US News & World Report's 2019 "America's Best Colleges" annual ranking and ranks first in biological/agricultural engineering graduate programs among all national universities.
- College Database named Iowa State No. 47 on its list of public colleges with the best return on investment.
- No. 1 (Iowa), top 12 percent (U.S.) best college value, Money Magazine
- No. 2 graduate and No. 3 undergraduate program, agricultural and biosystems engineering, U.S. News and World Report, 2019
- Top 25 graduate programs (public universities), aerospace; chemical; civil; computer; electrical/electronic; industrial and manufacturing systems; and materials engineering, U.S. News and World Report, 2019
- Best value in U.S., Graduate College (No. 5) and criminal justice program (No. 9), Value Colleges, 2017
- No. 1 (Midwest) and No. 3 (U.S.) fashion merchandising program, fashion schools
- No. 8 (U.S.) landscape architecture programs, No. 18 (U.S.) interior design, No. 23 (U.S.) architecture, Design Intelligence
- No. 30 (public universities) student engagement, Wall Street Journal/ Times Higher Education
- No. 2 Best Colleges for Software Engineering and No. 2 Best Colleges for Marketing Degree Programs, Schools.com, 2018
- No. 1 Best 4-Year Colleges in Iowa, Schools.com, 2018
- College of Agriculture and Life Sciences ranks in the top 4 percent worldwide for agricultural programs, QS World University Rankings
- Ames, Iowa, is No. 2 on Livability's 2018 Best College Towns list.

<u>Number of Students Enrolled</u>

A total of 33,391 students enrolled at Iowa State in the fall of 2019. The student body consisted of 28,294 undergraduates, 4,498 graduate students, and 599 professional (veterinary medicine) students. This includes 3,189 international students from 115 countries and 4,870 US minority students. More than 270,000 alumni live in all 50 states and 152 countries. Figure 1 shows fall enrollment from 1868 to 2018.

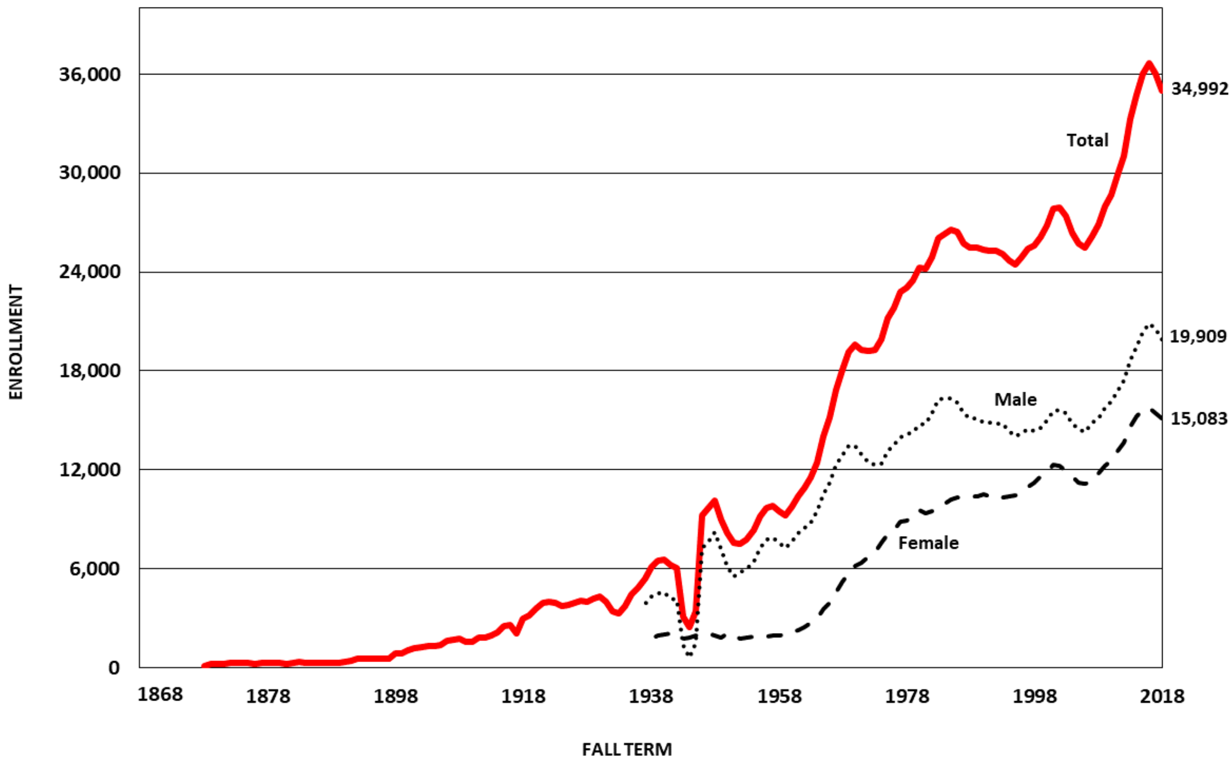

Figure 1. Enrollment at Iowa State University, 1868-2018.

Total Full-Time Equivalent Faculty

Approximately 9,600 faculty and staff are employed at Iowa State. In the fall of 2018, Iowa State employed 1,805 faculty (FTE). Table 1 lists the number of FTE faculty (tenure, tenure-eligible and non-tenure) for 2015 to 2019 by college.

Table 1. FTE faculty (tenured, tenure-eligible and non-tenure eligible), 2015-2019, by college.

College	Number of Faculty (full-time equivalent)				
	2015	2016	2017	2018	2019
Agriculture & Life Sciences	311	310	319	315	298
Business	109	115	130	135	129
Design	95	94	89	94	94
Engineering	262	262	271	270	266
Human Sciences	184	181	184	179	186
Liberal Arts and Sciences	636	634	632	617	614
Veterinary Medicine	179	171	161	151	149
Library	16	14	13	11	8

Operating Budget

Table 2 lists the operating budget for Iowa State University for fiscal year 2019.

Table 2. Iowa State University operating budget for FY2019 (in thousands).

Total	$1,461,886	
Federal appropriations	$ 12,972	(0.9%)
Tuition and fees	$ 520,006	(35.6%)
Contracts and grants	$ 284,080	(19.4%)
State appropriations	$ 237,884	(16.3%)
Auxiliary enterprises	$ 234,846	(16.1%)
Other income	$ 125,959	(8.6%)
Independent operations	$ 46,139	(3.1%)

Institutional Accreditation

Iowa State University is accredited by the Higher Learning Commission (HLC), a commission of the North Central Association of Colleges and Schools. Assessment of academic programs ensures that Iowa State University is providing excellence in all academic areas. Following guidelines established by the Board of Regents for Iowa, all academic programs are assessed through a formal Program Review process on a regular basis. In addition to review of the programs, Iowa State University continually reviews and assesses the educational programs through student outcomes assessment.

The cycle of accreditation is typically every ten years, during which institutions involve their constituencies in a reflective process of self-study and evaluation.

Iowa State University was reaccredited by HLC in 2016 and is currently beginning the university wide self-study for an HLC reaccreditation visit November of 2025. In addition to accreditation by HLC, Iowa State University also holds accreditation from specialized accrediting agencies together with recognition and licensure from boards such as ATMAE and ABET. A list of each academic program's specialized accreditation review bodies and their most recent accreditation dates appear in Table 3 below.

Table 3. Iowa State University accreditation, institutional and specialized (updated September 27, 2019 by the ISU Office of Institutional Research, https://www.provost.iastate.edu/academic-programs/accreditation).

IOWA STATE UNIVERSITY

Accreditation

Institutional and Specialized

INSTITUTION ACCREDITATION	DATE OF LAST COMPREHENSIVE REVIEW ACCREDITATION LETTER
Accredited by the Higher Learning Commission, www.hlcommission.org, (800) 621-7440	February, 2016

SPECIALIZED ACCREDITATION OF ACADEMIC PROGRAMS

Accounting: The Association to Advance Collegiate Schools of Business	January, 2015
Administration Preparation Program (School Administration): Department of Education, State of Iowa	October, 2014
Art and Design: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Aerospace Engineering: Engineering Accreditation Commission of ABET	August, 2019
Agriculture Engineering: Engineering Accreditation Commission of ABET	August, 2019
Agricultural Systems Technology Program, Agricultural and Biosystems Management Option, ATMAE	December, 2015
Agricultural Systems Technology Program, Machine Systems Option, ATMAE	December, 2015
Apparel, Merchandising, and Design: National Association of Schools of Art & Design Commission on Accreditation	May, 2013
Architecture: National Architectural Accrediting Board	August, 2013
Athletic Training Education Program: Commission on Accreditation of Athletic Training Education	August, 2011
Biological/Pre-Medical Illustration: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Biological Systems Engineering: Engineering Accreditation Commission of ABET	August, 2019
Business: The Association to Advance Collegiate Schools of Business	January, 2015
Chemical Engineering: Engineering Accreditation Commission of ABET	August, 2019
Child Development Laboratory School: National Association for the Education of Young Children	April, 2017
Civil Engineering: Engineering Accreditation Commission of ABET	August, 2019
Community and Regional Planning: Planning Accreditation Board	May, 2017
Computer Engineering: Engineering Accreditation Commission of ABET	August, 2019
Computer Science: Computing Accreditation Commission of ABET	August, 2016
Construction Engineering: Engineering Accreditation Commission of ABET	August, 2019
Counseling Psychology (Doctoral Program): American Psychological Association	April, 2019
Counseling Psychology (Internship Program): American Psychological Association	May, 2016
Dietetics (Didactic Program): Accreditation Council for Education in Nutrition and Dietetics	August, 2017
Dietetics (Internship Program): Accreditation Council for Education in Nutrition and Dietetics	August, 2017
Electrical Engineering: Engineering Accreditation Commission of ABET	August, 2019
Family Counseling and Planning: Certified Financial Planning Board of Standards	July, 2015
Family Financial Planning: Certified Financial Planning Board	September, 2017
Forestry: Society of American Foresters	December, 2012
Graphic Design: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Horticulture: National Association of Landscape Professionals	June, 2019
Hospitality Management: Accreditation Commission for Programs in Hospitality Administration	August, 2015
Industrial Design: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Industrial Engineering: Engineering Accreditation Commission of ABET	August, 2019
Industrial Technology Program, Agricultural and Biosystems Management Option, ATMAE	December, 2015
Industrial Technology Program, Occupational Safety Option, ATMAE	December, 2015
Integrated Studio Arts: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Integrated Visual Arts: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Intensive English and Orientation Program: Commission on English Language Program Accreditation	August, 2019
Interior Design: Council for Interior Design Accreditation	May, 2016
Interior Design: National Association of Schools of Art and Design Commission on Accreditation	May, 2013
Journalism and Mass Communication: Accrediting Council on Education in Journalism & Mass Communications	May, 2016
Landscape Architecture: Landscape Architectural Accreditation Board	May, 2017
Lloyd Veterinary Medical Hospital: American Animal Hospital Association	September, 2017
Materials Engineering: Engineering Accreditation Commission of ABET	August, 2019
Mechanical Engineering: Engineering Accreditation Commission of ABET	August, 2019
Music: National Association of Schools of Music	December, 2015
Practitioner Preparation Program (Teacher Preparation): Department of Education, State of Iowa	October, 2014
Public Relations: Public Relations Society of America	May, 2017
Software Engineering: Engineering Accreditation Commission of ABET	August, 2019
Veterinary Diagnostic Laboratory: American Association of Veterinary Laboratory Diagnosticians	October, 2017
Veterinary Medicine: American Veterinary Medical Association, Council on Education	April, 2018

Office of Institutional Research (Source: Office of the Senior Vice President and Provost)
Last Updated: 9/27/2019

History of Accreditation by ATMAE

The first four-year degree in Agricultural Manual Training (the predecessor of Industrial Technology) was awarded in 1919. In 1924 this curriculum became Industrial Arts. In 1940 Industrial Arts was transferred from the Engineering Division to the Agriculture Division changing the name of the curriculum to Industrial Education. In 1968, the Industrial Education curriculum was transferred to the newly formed College of Education, became a department in 1974 and then renamed to the Department of Industrial Education and Technology in 1982.

In 1992, the curriculum received its initial accreditation under NAIT (now ATMAE). The undergraduate curriculum was renamed to Industrial Technology in 1994. The two program options of Manufacturing and Occupational Safety were re-accredited in 2008 and 2015.

In 2004, the Industrial Education and Technology (IET) department merged with the Agricultural and Biosystems Engineering (ABE) department. The two technology curricula (Industrial Technology and Agricultural Systems Technology) were now administered by one department and one college but kept as separate degree programs. Our industrial impact has broadened with the merger of the ISU IET into ABE. We are now the focus for technology education on the ISU campus. During the 2008 reaccreditation of the Industrial Technology program we also applied for accreditation of the Agricultural Systems Technology (AST) program. Upon successful accreditation of both programs, our AST program options became the first such program to be accredited. The two AST program options, Agricultural and Biosystems Management and Machine Systems, were re-accredited by ATMAE in 2015.

Administration of Institution

Organization charts for the University and the College of Agriculture and Life Sciences can be found online at:

Iowa State University: http://www.president.iastate.edu/sites/default/files/org/univorg.pdf

College of Agriculture and Life Sciences:
https://www.cals.iastate.edu/files/page/files/cals_organizational_chart-fall_2019.pdf

Major Academic Units within the Institution

Iowa State's academic offerings are administered through eight colleges that offer 105 bachelor's degree programs, 112 master's degree programs, and 82 doctoral degree programs. Iowa State offers one professional degree program, veterinary medicine. The colleges (listed below) also provide opportunities for students to learn and grow through internships, learning communities, international study, and association with outstanding faculty members.

- Agriculture and Life Sciences
- Business
- Design
- Engineering

- Human Sciences
- Liberal Arts and Sciences
- Veterinarian Medicine
- Graduate College

Institution Mission and Goals

Iowa State's mission, vision and goals are stated in the 2017-2022 Strategic Plan (https://strategicplan.iastate.edu/). A summary of these are:

- Mission: Create, share, and apply knowledge to make Iowa and the world a better place.
- Vision: Iowa State University will lead the world in advancing the land-grant ideals of putting science, technology, and human creativity to work.
- Goal #1: Ensure access to the ISU Experience – including an exceptional education offering practical, global, and leadership experiences that shape the well-rounded citizens and informed critical thinkers needed in the 21st century.
- Goal #2: Enhance the university's research profile by conducting high impact research that addresses the grand challenges of the 21st century.
- Goal #3: Improve the quality of life for all Iowans through services and programs dedicated to economic development and the promotion of healthy communities, people, and environments.
- Goal #4: Continue to enhance and cultivate the ISU Experience where faculty, staff, students, and visitors are safe and feel welcomed, supported, included, and valued by the university and each other.

Relationship of Institution to Superior Governing Body

Iowa's 33rd General Assembly created the State Board of Education in 1909 to oversee, coordinate and govern the state's three public institutions of higher learning, including the State University of Iowa in Iowa City, the Iowa State College of Agriculture and Mechanic Arts in Ames, and the Iowa State Teachers College in Cedar Falls. The State Board of Education also has overseen the Iowa School for the Deaf since 1917, and the Iowa Braille and Sight Saving School since 1911.

The State Board of Education was renamed the Iowa Board of Regents in 1955. The three institutions followed with name changes of their own, beginning with the Iowa State College of Agriculture and Mechanic Arts changing to Iowa State University of Science and Technology in 1959. The Iowa State Teachers College became the State College of Iowa in 1961 and the University of Northern Iowa in 1967. In 1964, the State University of Iowa shortened its common use name to the University of Iowa.

The Board of Regents is statutorily authorized by Iowa Code Chapter 262, which states that the Board is responsible to "have and exercise all the powers necessary and convenient for the effective administration of its office and of the institutions under its control..."

The broad responsibilities of the Board of Regents, State of Iowa, include:

- Creating strategic plans for the Board and approving mission statements and strategic plans for the institutions, as well as monitoring progress toward strategic goals.
- Creating and monitoring implementation of broad policies.
- Reviewing and approving academic programs.
- Approving budgets, tuition and fees, bonding, investment policies, and other business and finance matters.
- Managing and controlling property and capital projects.
- Hiring and evaluating performance of the university presidents and special school superintendents.
- Maintaining oversight on matters related to personnel and employment relations; administering the Regent Merit System and coordinating Regent collective bargaining activities.
- Serving as trustees of the University of Iowa Hospitals and Clinics.
- Monitoring and coordinating legislative matters and interactions with other state agencies.
- Conducting studies and investigations, either alone or in association with the institutions and/or other agencies, and reporting findings and recommendations.

In accordance with its strategic plan, the Board of Regents, as a governing body, has established financial and operational policies for its institutions to help ensure quality, competent performance, and progress toward goals.

Frequent public meetings and numerous governance reports to the Board, prepared by Board staff and the institutions, enable the Board to monitor and enhance its institutions. All meetings, minutes, and materials of the Board of Regents are open to the public, except for those specifically exempted by Iowa Code Chapters 21 and 22 on open meetings and open records.

Public information covers a broad range of topics, including the Regent institutions' and the Board Office's budgets; enrollment; graduation and retention rates; faculty activities; academic program accreditation; capital projects; distance education programs; economic development and technology transfer; and much more.

Much of this information is available on the Board's web site, http://www.iowaregents.edu, which also features the Board's strategic plan, meeting schedule, minutes, and Regent and Board Office contact information.

Administrative Unit

Department of Agricultural and Biosystems Engineering
605 Bissel Road / 1340 Elings Hall
Ames, Iowa 50011

Since 1905, the Department of Agricultural Engineering, now the Department of Agricultural and Biosystems Engineering (ABE), has been a leader in providing engineering solutions to agricultural problems in the United States and the world. The department's original mission was to mechanize agriculture. That mission has evolved to encompass a global view of the entire food production system–the sustainable management of natural resources in the production, processing, storage, handling, and use of food fiber and other biological products.

Current research efforts include agricultural water quality and management, engineering for economically and environmentally sound animal production systems, grain handling and food processing, agricultural machine design and automated controls, precision farming systems, agricultural safety, seed conditioning and processing, manufacturing systems, quality management, and soil tillage and management systems. Using research findings, ABE Extension builds partnerships and provides research-based learning opportunities to improve quality of life in Iowa. We focus on activities that assist Iowa agriculture and industry.

Our academic programs are an important part of who we are. The faculty and students in the Agricultural and Biosystems Engineering Department at Iowa State University are committed to learning and student success. The professional success of our graduates is evidence of this commitment.

The first four-year degree in Agricultural Manual Training (the predecessor of Industrial Technology) was awarded in 1919. In 1924 this curriculum became Industrial Arts. In 1940 Industrial Arts was transferred from the Engineering Division to the Agriculture Division changing the name of the curriculum to Industrial Education. In 1968 the Industrial Education curriculum was transferred to the newly formed College of Education and then became a department in 1974 and then renamed to the Department of Industrial Education and Technology in 1982. In 1992, the curriculum received its initial accreditation under NAIT (now ATMAE). The undergraduate curriculum was renamed to Industrial Technology in 1994.

In 2004, the Industrial Education and Technology Department merged with the Agricultural and Biosystems Engineering department. The two technology curricula (Industrial Technology and Agricultural Systems Technology) were now administered by one department and one college but kept as separate degree programs. Our industrial impact has broadened with the merger of the ISU Department of Industrial Education and Technology into ABE. We are now the focus for technology education on the ISU campus. During the 2008 reaccreditation of the Industrial Technology program we also applied for accreditation of the Agricultural Systems Technology program. Upon successful accreditation of both programs, our Agricultural Systems Technology became the first such program to be accredited.

In 2016, the department was ranked number one among departments in agricultural and/or biological engineering in both graduate and undergraduate programs by U.S. New and World Report. In 2019, the department was again ranked number one in graduate programs. The department has consistently ranked in the top three programs in the last ten years.

The Agricultural and Biosystems Engineering department continues to lead the way in many endeavors that support the profession, serve stakeholders, and contribute to the university. The department is now in its second century of service with expectations of continued leadership. This department remains committed to the land grant philosophy of serving the people of Iowa, our nation, and the world through learning, discovery, and engagement, especially as human needs become more global in nature and population growth requires increased food supplies and security.

Dean and Department Chair

Dean: Daniel J. Robison, Ph.D.
Endowed Dean's Chair, College of Agriculture and Life Sciences
Director, Iowa Agriculture and Home Economics Experiment Station
138 Curtiss Hall, 513 Farm House Lane
Ames, Iowa 50011-1054
Phone: 515-294-3830
Email: robisond@iastate.edu

Chair: Steven K. Mickelson, Ph.D.
Charles R. & Jane F. Olsen Professor
Chair of Agricultural and Biosystems Engineering
1340B Elings Hall, 605 Bissel Road
Ames, Iowa 50011-1098
Phone: 515-294-1435
Email: estaben@iastate.edu

Names of other Departments in Administrative Unit

These departments are administered either singly or jointly by the College of Agriculture and Life Sciences:

- Agricultural and Biosystems Engineering (joint with the College of Engineering)
- Agricultural Education and Studies
- Agronomy
- Animal Science
- Ecology, Evolution and Organismal Biology (joint with the College of Liberal Arts and Sciences)
- Economics (joint with the College of Liberal Arts and Sciences)
- Entomology
- Food Science and Human Nutrition (joint with the College of Human Sciences)
- Genetics, Development and Cell Biology (joint with the College of Liberal Arts and Sciences)
- Horticulture
- Natural Resource Ecology and Management
- Plant Pathology and Microbiology
- Roy J. Carver Department of Biochemistry, Biophysics and Molecular Biology (joint with the College of Liberal Arts and Sciences)
- Sociology (joint with the College of Liberal Arts and Sciences)
- Statistics (joint with the College of Liberal Arts and Sciences)

These departments are administered either singly or jointly by the College of Engineering:

- Aerospace Engineering
- Agricultural and Biosystems Engineering (joint with the College of Agriculture and Life Sciences)
- Chemical and Biological Engineering
- Civil, Construction, and Environmental Engineering
- Electrical and Computer Engineering
- Industrial and Manufacturing Systems Engineering
- Materials Science and Engineering
- Mechanical Engineering

Names and Titles of others with Program Administration and/or Coordination Responsibility

Chair, ABE Technology Curriculum Committee:

Dr. Gretchen A. Mosher
Associate Professor
3331 Elings Hall, 604 Bissell Road
Ames, IA 50011-1098
Phone: 515-294-6416
Email: gamosher@iastate.edu

Titles of Degrees, Programs and Concentrations for which Accreditation is being requested

We are seeking ATMAE accreditation for a total of four (4) degrees/options.

1. Bachelor of Science with a major in Agricultural Systems Technology, Agricultural and Biosystems Management option (AST-ABM).
2. Bachelor of Science with a major in Agricultural Systems Technology, Machine Systems option (AST-MS).
3. Bachelor of Science with a major in Industrial Technology, Manufacturing option (ITEC-M)
4. Bachelor of Science with a major in Industrial Technology, Occupational Safety option (ITEC-OS).

Operating Budget for administrative unit in which the Degree, Program and Concentrations for which Accreditation is being requested reside

Institutional funds for the four option (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs support full-time faculty, part-time faculty, staff, facilities, equipment, computer hardware/software, operations, and maintenance. The budget for the department is provided by a combination of resources from the College of Agriculture and Life Sciences, College of Engineering, the Agricultural and Home Economics Experiment Station, and University and Cooperative Extension. The total state budget for the department for FY19 was $6.2M. The total departmental teaching budget from the College of Agriculture and Life Sciences and College of

Engineering was $4.1M. To put these numbers in perspective, the FY19 allocation was over $4,600 per student. The budgets for FY2015 to FY2019 are listed in Table 4.

Table 4. ABE department total and teaching budgets by fiscal year.

Year	Total Budget	Teaching Budget
FY 2015	6.2M	3.8M
FY 2016	6.4M	4M
FY 2017	6.4M	4M
FY 2018	6.4M	4M
FY 2019	6.2M	4.1M

Compliance with Standards

Standard 1 - Preparation of Self-Study and campus visit. The Self-Study Report shall follow the guidelines of the Accreditation Handbook version in place at the time of the accreditation application. The report shall be completed by a representative portion of the institutions administrative staff and teaching faculty directly related to the program(s) to be reviewed. Students should be involved in the accreditation preparation process. Representative student transcripts for each program and/or option shall be included in the self-study and made available for the visiting team. Representative examples of student's management and/or technical graded work shall be available for each course in the Self-study and/or campus documentation room. Examples of textbooks and instructional materials for each management and/or technical course shall be provided for the visiting team.

Standard 2 - Program Definition: A program is a set of courses leading to a degree. A program may have more than one option, specialization or concentration, but specific course requirements for each option shall be clearly specified, and as appropriate all program/options shall meet ATMAE standards. In situations where an option is not appropriate for ATMAE accreditation based upon the approved definition of technology, management, and applied engineering, the request for accreditation should clearly state which option, concentration, or specialization is seeking accreditation and which ones are excluded. The case for exclusion should be made with the application for accreditation. If an option, concentration or specialization is excluded and the program becomes accredited, the program must identify specifically which concentrations, options and specializations are and are not accredited in all their publications and promotional materials that mention accreditation. Only institutions legally authorized under applicable state law to provide degree programs beyond the secondary level and that are recognized by the appropriate regional and/or national accrediting agency are considered for accreditation. Evidence must exist that the programs are understood and accepted by the university/college community, and the business/industry community.

Standard 1

Standard 1 - Preparation of Self-Study. The Self-Study Report shall follow the guidelines of the Accreditation Handbook version in place at the time of the accreditation application. The report shall be completed by a representative portion of the institutions administrative staff and teaching faculty directly related to the program(s) to be reviewed. Students should be involved in the accreditation preparation process. Representative student transcripts for each program and/or option shall be included in the self-study and made available for the visiting team. Representative examples of student's management and/or technical graded work shall be available for each course in the Self-study and/or campus documentation room. Examples of textbooks and instructional materials for each management and/or technical course shall be provided for the visiting team.

Definition of Terms

Program: A defined course of study leading to a degree program which is denoted by a unique name on the official transcript.
Option: An official subset of a program which may be denoted by a unique name on the official transcript. (Program options are sometimes referred to as concentrations or specializations, this document will use the term option to represent program options, concentrations or specializations)
Program Title: The official approved title of the degree program being considered for accreditation.
Program Mission: A general statement which identifies the broad purpose of a program.
Program Outcomes: A list of general behaviors in the form of knowledge and skills program graduates have attained as a result of the program or option.
Outcome Measures: A series of activities, including both direct and indirect measures, undertaken during or after students have completed a program to determine the overall effectiveness of the degree program or option. Evidence from outcome measures shall be collected, analyzed, and reported for each program learning outcome.
Direct Measure: A key assessment measure identified by the institution that aligns with a Program Learning Outcome where the students' knowledge and skills can be directly evaluated by a professional including activities such as projects, essays, presentations, and tests. Direct outcome measures are typically course-based assessments but may also occur external to a course such as an external certification test.
Indirect Measure: A key assessment measure identified by the institution that aligns with a Program Learning Outcome where the students' knowledge and skills are indirectly assessed or collected through perception-based measures such as satisfaction surveys, focus groups, or employer surveys.
Student Learning Competencies: Course-based student learning outcomes statements that specify the observable and measurable knowledge, skills, attitudes, and/or abilities students will attain through the completion of a course. Course learning outcomes should be aligned and mapped to program learning outcomes using an appropriate matrix and state in course syllabi.

SUMMARY RESPONSE

The Self-Study report for Iowa State University's Agricultural and Biosystems Engineering (ABE) Department degree programs of Agricultural Systems Technology and Industrial Technology was completed by the ABE Technology Curriculum Committee consisting of faculty members Gretchen Mosher (chair), John Haughery (vice-chair), Stuart Birrell, Tom Brumm, David Eisenmann, and Steve Freeman. Ex-officio members include Ashtyn Beek (AST Adviser), Tamara Kerns (ITEC Adviser), Elaine Phompheng (ABE Student Services Specialist), Erin Bowers (Feed Technology), Levi Eden (AST Club), Joe Meier (ITEC Club). All standards that pertain to the degree programs and options have been addressed using policies governing the department and the university.

Preparations for accreditation began in 2016 for a 2020 accreditation visit. This self-study report accurately reflects the ABE degree programs of Agricultural Systems Technology and Industrial Technology as of March 1, 2020. Great effort has been set forth by all involved in the completion of this self-study and the ABE department is confident that the degrees and related options are compliant with the standards and guidelines set forth by The Association of Technology, Management, and Applied Engineering.

DETAILED RESPONSE

For the convenience of the ATMAE visiting team members, we have compiled a listing of the 19 standards for accreditation in the Outcomes Assessment Accreditation Model followed by a summary response that addresses and documents the compliance for each standard.

Standard 1 – Preparation of Self-Study: See above.

Standard 2 – Program Definition: The four programs/options are (1) Bachelor of Science with a major in Agricultural Systems Technology, Agricultural and Biosystems Management option (AST-ABM), (2) Bachelor of Science with a major in Agricultural Systems Technology, Machine Systems option (AST-MS), (3) Bachelor of Science with a major in Industrial Technology, Manufacturing option (ITEC-M) and (4) Bachelor of Science with a major in Industrial Technology, Occupational Safety option (ITEC-OS).

Standard 3 – Program Title, Mission, and Program Outcomes: The Agricultural and Biosystems Engineering (ABE) department has four baccalaureate degree options in technology, divided into two majors –Industrial Technology and Agricultural Systems Technology – each of which has two options. All options prepare individuals for positions involving the management of complex agricultural and/or industrial systems. For each degree option, 14 program learning outcomes have been established and validated through external advisory committees and graduate surveys. These in turn have informed the measurable program learning outcomes described later in this document.

Standard 4 – Program Goals: The four options share two long-range goals. The first is to continue to refine the continuous improvement processes with a specific emphasis on documenting improvements, how often courses are offered, and enhancing the ability for students to access and complete coursework in a timely manner. The second goal is to continue to recruit qualified undergraduates, with an emphasis on increasing the gender and racial diversity of the programs. Additionally, each program option has between two and four goals (a combination of long and short-term), related to issues such as course offerings, capstone projects, and international experiences.

Standard 5 – Program Learning Outcomes Identification & Validation: For each of the four options, the Agricultural and Biosystems Engineering department identified and validated fourteen measurable program learning outcomes with faculty, the External Advisory Council, and graduates. Eleven of the learning outcomes are common to all four options; each option has three unique learning outcomes. These outcomes have been validated and confirmed by program stakeholders.

Standard 6 – Program Structure & Course Sequencing: Each of the four options meets ATMAE's minimum foundation semester hour requirements, and none exceed ATMAE's maximum foundation semester hour requirements specified in each area. Over 55% of the courses used to deliver the four option programs include lab experiences, and all option programs require students to spend at least 20% of their time in lab. Course sequencing is developed by the Technology Curriculum Committee in consultation with relevant course instructors. Changes in course scope and sequence always considers the application of prerequisite content in upper division courses, so that student are continually learning to use core concepts ranging from mathematics to communication in technology-relevant situations.

Standard 7 – Student Admission & Retention Standards: Iowa State University admissions programs are "major blind" –that is, the same criteria for admission are used for all undergraduate degree programs at the institution. Similarly, academic probation guidelines are the same across the institution. Thus, the admission and retention standards compare favorably (i.e., are identical) with institutional standards. An examination of average GPA at graduation shows that two of the four programs are essentially identical to the college average, while two others are approximately 0.2 quality points lower. In the two latter programs, a large fraction of students is transfer students (ISU students switching majors) who sometimes earn a low GPA in another major prior to transferring.

Standard 8 – Transfer Course Work: ISU has standard guidelines for allowing transfer credit for courses in math, English, and other core areas. Essentially, if the institution at which the courses were taken is accredited, and if the offering department has established equivalency, credit is given. For more program specific coursework, the four options follow a departmental policy for validating transfer credits. In this way, all four option programs ensure that transfer coursework meets rigor and content standards.

Standard 9 – Student Enrollment: Student enrollments in each option program have been in the following ranges during the past five years: AST-ABM –31 to 39; AST-MS –113 to 177; ITEC-M –222 to 261; ITEC-OS –18 to 32. The recent trend has been toward stable enrollments, with some program options seeing slight increases or decreases. Although the university and department intentions are not to offer courses with an enrollment below 15 undergraduates, student numbers in all required classes have been sufficient to allow classes to be offered without disruption.

Standard 10 – Administrative Support & Faculty Qualifications: There is a high-level of institutional support for all four option programs. Financial support is in excess of $4000 per student per year when base budget and differential tuition fees are considered. Additional evidence of the value of the program to top administration comes in the form of the key roles that the CALS and COE Deans played in securing funding for the $74M facility in which the programs are now housed (70% of the undergrad ABE population are in the four option programs relevant to this self-study). Support is also evidenced by the human resources which the ABE department commits toward the program, for example in the form of the six-faculty-member curriculum committee oversees all four option programs, populated by highly qualified and successful faculty members dedicated to student learning and curricular excellence. Tenure track faculty with industrially-relevant research and extension programs and lecturers with strong industrial backgrounds provide the core departmental teaching programs, assisted in some cases by adjunct faculty members who are currently employed in relevant industries.

Standard 11 – Facilities, Equipment & Technical Support: In the Sukup and Elings Hall buildings, each program option makes use of several rooms in the complex during the four-year sequence of courses. Modern classroom spaces offer a range of class sizes are used for lecture delivery, while well-equipped and safe lab spaces are available for labs. Staff and faculty work together to maintain and manage the teaching laboratories.

Standard 12 - Program/Option Operation: AST students (both options) and ITEC students (both options) are each advised by a single professional advisor. Student ratings of advising demonstrate the high quality of advisor. Scheduling of instruction is done with input from faculty and students to maximize availability and minimize course conflicts. Nearly all Technology Systems Management (TSM) courses are offered every fall and spring semesters. Quality of instruction is assessed for each class taught by the department, and feedback is used to improve instructions and as part of faculty evaluations. Student evaluation of instruction ratings indicate high instructor effectiveness and a high achievement of learning outcomes. Students have access to a wide variety of up-to-date resource materials, ranging from reference books in a world-class library, to well-equipped manufacturing labs, to computer labs with workstation-level dual-screen computers. Courses are mapped to competencies, and direct and indirect measures of competency achievement are made.

Standard 13 – Graduate Satisfaction with Program/Option: Evaluations of graduate satisfaction with the programs are made every semester. Students are satisfied with their ability to meet general and option specific competencies. Students also report that they are satisfied with the quality of the classes, the facilities, the department’s academic culture and the support they receive.

Standard 14 – Employment of Graduates: The average placement rates for all four programs over the past five years for which data is available ranges from 82% to 100%, and average starting salaries for the graduates range from $47,000 to $65,000 per year. These are strong rates of placement and strong starting salaries. We believe that our strong placement and salary results are indicative of the overall program quality, ability to attract strong students, and high regard with which key external constituencies view our programs.

Standard 15 – Job Advancement of Graduates: A survey of program graduates two to five years after graduation shows that all graduates have advanced (taken positions of increased responsibility) at least once in their careers so far. On average, option graduates have advanced twice or more. These data show that all program options are providing students with the knowledge and skills to contribute materially to their employers and to advance through the ranks on the basis of their contributions.

Standard 16 – Employer Satisfaction with Job Performance: Employer satisfaction with the job performance of graduates shall be tracked on a regular basis (two to five years) including employer attitudes related to the importance of the specific program learning outcomes for the program. Summary data shall be available showing employer satisfaction with the job performance of graduates.

Standard 17 – Advisory Committee Approval of Overall Program: The department has an active External Advisory Council that serves the role of industrial advisory committee. This 18-member strong group is composed of persons who have distinguished themselves in the multiple fields associated with our department –including all four option programs covered by this accreditation self-study. The department clearly link specific members of the EAC to option programs and in so doing are able to get more meaningful feedback from them.

Standard 18 – Outcome Measures Used to Improve Program: Since the last accreditation visit, multiple outcome measures have motivated over two-dozen program changes, ranging from minor adjustments to major revisions. The Technology Curriculum Committee is the driver for these changes, and considers data gathered from exit interviews and surveys, employer evaluations of interns, and advice from the external advisory board, faculty, and students.

Standard 19 – Program Responsibility to Provide Information to Public: The Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data are posted and made accessible to the public on the ABE website (http://www.abe.iastate.edu/abe-department/), on the Accreditation (https://www.abe.iastate.edu/accreditation/) page which includes links to complete information for the Agricultural Systems Technology and Industrial Technology (https://www.abe.iastate.edu/accreditation/agricultural-systems-technology-and-industrial-technology/) programs.

Standard 2

Standard 2 - Program Definition: A program is a set of courses leading to a degree. A program may have more than one option, specialization or concentration, but specific course requirements for each option shall be clearly specified, and as appropriate all program/options shall meet ATMAE standards. In situations where an option is not appropriate for ATMAE accreditation based upon the approved definition of technology, management, and applied engineering, the request for accreditation should clearly state which option, concentration, or specialization is seeking accreditation and which ones are excluded. The case for exclusion should be made with the application for accreditation. If an option, concentration or specialization is excluded and the program becomes accredited, the program must identify specifically which concentrations, options and specializations are and are not accredited in all their publications and promotional materials that mention accreditation. Only institutions legally authorized under applicable state law to provide degree programs beyond the secondary level and that are recognized by the appropriate regional and/or national accrediting agency are considered for accreditation. Evidence must exist that the programs are understood and accepted by the university/college community, and the business/industry community.

SUMMARY RESPONSE

1. Bachelor of Science with a major in Agricultural Systems Technology, Agricultural and Biosystems Management option (AST-ABM).
2. Bachelor of Science with a major in Agricultural Systems Technology, Machine Systems option (AST-MS).
3. Bachelor of Science with a major in Industrial Technology, Manufacturing option (ITEC-M)
4. Bachelor of Science with a major in Industrial Technology, Occupational Safety option (ITEC-OS).

DETAILED RESPONSE

Listed below are the requirements for each of the four degree/program/options.

1. Program Title: Agricultural Systems Technology degree – Agricultural and Biosystems Management option (AST-ABM)

Mission: The mission of the Bachelor of Science academic program in AST-ABM is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

General Outcomes: At two to five years after graduation, graduates of the AST-ABM program, through professional practice, should:
1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural technology.

2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to be a successful leader of multi-disciplinary teams.
6. Have demonstrated the ability to efficiently manage multiple simultaneous projects.
7. Have demonstrated the ability to work collaboratively.
8. Have demonstrated the ability to implement multi-disciplinary systems-based solutions.
9. Have demonstrated the ability to apply innovative solutions to problems through the use of new methods or technologies.
10. Have demonstrated the ability to contribute to the business success of their employer.
11. Have demonstrated the ability to build community.

Program Learning Outcomes: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:
a) an ability to apply knowledge of mathematics, science, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to formulate or design a system, process or program to meet desired needs;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify and solve applied science problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of solutions in a global and societal context;
i) recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice;
l) an ability to develop, implement, and evaluate best management practices for human and natural resource systems for producing, processing and marketing bio-based products worldwide;
m) an ability to integrate and apply agricultural and biosystems engineering technologies in the bio-based industries; and;
n) an understanding of the complex systems that sustain our water, air, soils, and food.

2. Program Title: Agricultural Systems Technology degree – Machine Systems option (AST-MS)

Mission: The mission of the Bachelor of Science academic program in AST-MS is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

General Outcomes: At two to five years after graduation, graduates of the AST-ABM program, through professional practice, should:

1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural technology.
2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to be a successful leader of multi-disciplinary teams.
6. Have demonstrated the ability to efficiently manage multiple simultaneous projects.
7. Have demonstrated the ability to work collaboratively.
8. Have demonstrated the ability to implement multi-disciplinary systems-based solutions.
9. Have demonstrated the ability to apply innovative solutions to problems through the use of new methods or technologies.
10. Have demonstrated the ability to contribute to the business success of their employer.
11. Have demonstrated the ability to build community.

Program Learning Outcomes: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:

a) an ability to apply knowledge of mathematics, science, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to formulate or design a system, process or program to meet desired needs;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify and solve applied science problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of solutions in a global and societal context;
i) recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice;
l) an ability to specify, manage, and test machine systems in the context of complete agricultural, biological production or processing systems;
m) an understanding of the technology and application of machine systems including power and information flows, function and interaction with biological materials;

n) an ability to perform energy and cost analyses of complete machine systems to ensure the success and sustainability of an enterprise.

3. <u>Program Title</u>: Industrial Technology degree – Manufacturing option (ITEC-M)

<u>Mission</u>: The mission of the Bachelor of Science academic program in ITEC-M is to prepare women and men for careers that integrate and apply industrial technology to lead and manage human, manufacturing, and safety systems.

<u>General Outcomes</u>: At two to five years after graduation, graduates of the AST-ABM program, through professional practice, should:
1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural technology.
2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to be a successful leader of multi-disciplinary teams.
6. Have demonstrated the ability to efficiently manage multiple simultaneous projects.
7. Have demonstrated the ability to work collaboratively.
8. Have demonstrated the ability to implement multi-disciplinary systems-based solutions.
9. Have demonstrated the ability to apply innovative solutions to problems through the use of new methods or technologies.
10. Have demonstrated the ability to contribute to the business success of their employer.
11. Have demonstrated the ability to build community.

<u>Program Learning Outcomes</u>: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:
a) an ability to apply knowledge of mathematics, science, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to formulate or design a system, process or program to meet desired needs;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify and solve applied science problems;
f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of solutions in a global and societal context;
i) recognition of the need for, and an ability to engage in life-long learning;

j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice;
l) an ability to develop, implement, and evaluate manufacturing processes and facilities;
m) an ability to apply computer aided design and manufacturing, control systems, and automation systems to industrial settings; and
n) an ability to implement and analyze the use of manufacturing technologies to enhance production, quality, and profitability of manufacturing systems.

4. <u>Program Title</u>: Industrial Technology degree – Occupational Safety option (ITEC-OS)

<u>Mission</u>: The mission of the Bachelor of Science academic program in ITEC-OS is to prepare women and men for careers that integrate and apply industrial technology to lead and manage human, manufacturing, and safety systems.

<u>General Outcomes</u>: At two to five years after graduation, graduates of the AST-ABM program, through professional practice, should:
1. Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural technology.
2. Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3. Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.
4. Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5. Have demonstrated the ability to be a successful leader of multi-disciplinary teams.
6. Have demonstrated the ability to efficiently manage multiple simultaneous projects.
7. Have demonstrated the ability to work collaboratively.
8. Have demonstrated the ability to implement multi-disciplinary systems-based solutions.
9. Have demonstrated the ability to apply innovative solutions to problems through the use of new methods or technologies.
10. Have demonstrated the ability to contribute to the business success of their employer.
11. Have demonstrated the ability to build community.

<u>Program Learning Outcomes</u>: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:
a) an ability to apply knowledge of mathematics, science, and applied sciences;
b) an ability to design and conduct experiments, as well as to analyze and interpret data;
c) an ability to formulate or design a system, process or program to meet desired needs;
d) an ability to function on multi-disciplinary teams;
e) an ability to identify and solve applied science problems;

f) an understanding of professional and ethical responsibility;
g) an ability to communicate effectively;
h) the broad education necessary to understand the impact of solutions in a global and societal context;
i) recognition of the need for, and an ability to engage in life-long learning;
j) a knowledge of contemporary issues;
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice;
l) an ability to develop, implement, and evaluate occupational safety and health programs for businesses and organizations;
m) an ability to identify and analyze hazards and loss producing conditions in work environments;
n) an ability to eliminate or control occupational hazards using appropriate technologies, administrative interventions, and training for behavior modification.

Standard 3

Standard 3 - Program Title, Mission, and Program Outcomes: Each program/option shall have appropriate titles consistent with the approved ATMAE definition of Technology, Management, and Applied Engineering.

- **3.1** The program/option title, definition and mission shall be compatible with the ATMAE definition of Technology, Management, and Applied Engineering. The program/option shall lead to a degree at the associate, bachelor, or master's level.
- **3.2** General program outcomes shall be established for each program/option that provides a framework for the development of specific measurable program learning outcomes.

SUMMARY RESPONSE

The Agricultural and Biosystems Engineering (ABE) department has four baccalaureate degree options in technology, divided into two majors – Industrial Technology and Agricultural Systems Technology – each of which has two options. All options prepare individuals for positions involving the management of complex agricultural and/or industrial systems. For each degree option, 14 program learning outcomes have been established and validated through external advisory committees and graduate surveys. These in turn have informed the measurable program learning outcomes described later in this document.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department has four degree options that lead to a bachelor of science degree: (1) Agricultural Systems Technology (AST) degree - Agriculture and Biosystems Management (ABM) option; (2) Agricultural Systems Technology (AST) degree - Machine System (MS) option; (3) Industrial Technology (ITEC) degree - Manufacturing (M) option; and (4) Industrial Technology (ITEC) degree - Occupational Safety (OS) option.

Each program/option has a specific mission and a set of general outcomes. General outcomes are what we expect graduates to have done or be capable of doing two to five years after graduation.

Current AST/ITEC General Program Outcomes: At two to five years after undergraduate graduation, through professional practice, graduates should:

1) Have demonstrated competence in methods of analysis involving use of mathematics, fundamental physical and biological sciences, technology, and computation needed for the professional practice in the field of agricultural technology.
2) Have developed skills necessary to contribute to the design process; including the abilities to think creatively, to formulate problem statements, to communicate effectively, to synthesize information, and to evaluate and implement problem solutions.
3) Be capable of addressing issues of ethics, safety, professionalism, cultural diversity, globalization, environmental impact, and social and economic impact in professional practice.

4) Have demonstrated continuous professional and technical growth, with practical experience, so as to be licensed in their field or achieve that level of expertise, as applicable.
5) Have demonstrated the ability to be a successful leader of multi-disciplinary teams.
6) Have demonstrated the ability to efficiently manage multiple simultaneous projects.
7) Have demonstrated the ability to work collaboratively.
8) Have demonstrated the ability to implement multi-disciplinary systems-based solutions.
9) Have demonstrated the ability to apply innovative solutions to problems through the use of new methods or technologies.
10) Have demonstrated the ability to contribute to the business success of their employer.
11) Have demonstrated the ability to build community.

Program learning outcomes for each of the degree options are addressed in Standard 5. They are listed below for reference.

Program Title: Agricultural Systems Technology degree - Agriculture and Biosystems Management option (AST-ABM)

- Mission: The mission of the AST-ABM program at Iowa State University is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

- Program Learning Outcomes: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:
  a) an ability to apply knowledge of mathematics, science, and applied sciences;
  b) an ability to design and conduct experiments, as well as to analyze and interpret data;
  c) an ability to formulate or design a system, process or program to meet desired needs;
  d) an ability to function on multi-disciplinary teams;
  e) an ability to identify and solve applied science problems;
  f) an understanding of professional and ethical responsibility;
  g) an ability to communicate effectively;
  h) the broad education necessary to understand the impact of solutions in a global and societal context;
  i) recognition of the need for, and an ability to engage in life-long learning;
  j) a knowledge of contemporary issues;
  k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice;
  l) an ability to develop, implement, and evaluate best management practices for human and natural resource systems for producing, processing and marketing bio-based products worldwide;
  m) an ability to integrate and apply agricultural and biosystems engineering technologies in the bio-based industries; and;
  n) an understanding of the complex systems that sustain our water, air, soils, and food.

Program Title: Agricultural Systems Technology degree - Machine System option (AST-MS)

- Mission: The mission of the AST-MS program at Iowa State University is to prepare women and men for careers that integrate and apply agricultural and biosystems engineering technology to manage human and natural resource systems for producing, processing, and marketing food and other biological products worldwide.

- Program Learning Outcomes: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:
  a) an ability to apply knowledge of mathematics, science, and applied sciences;
  b) an ability to design and conduct experiments, as well as to analyze and interpret data;
  c) an ability to formulate or design a system, process or program to meet desired needs;
  d) an ability to function on multi-disciplinary teams;
  e) an ability to identify and solve applied science problems;
  f) an understanding of professional and ethical responsibility;
  g) an ability to communicate effectively;
  h) the broad education necessary to understand the impact of solutions in a global and societal context;
  i) recognition of the need for, and an ability to engage in life-long learning;
  j) a knowledge of contemporary issues;
  k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice;
  l) an ability to specify, manage, and test machine systems in the context of complete agricultural, biological production or processing systems;
  m) an understanding of the technology and application of machine systems including power and information flows, function and interaction with biological materials;
  n) an ability to perform energy and cost analyses of complete machine systems to ensure the success and sustainability of an enterprise.

Program Title: Industrial Technology degree - Manufacturing option (ITEC-M)

- Mission: The mission of the ITEC-M program at Iowa State University is to prepare women and men for careers that integrate and apply industrial technology to lead and manage human, manufacturing, and safety systems.

- Program Learning Outcomes: Outcomes are statements of measurable knowledge, skills and abilities. At the times of graduation, student should have:
  a) an ability to apply knowledge of mathematics, science, and applied sciences;
  b) an ability to design and conduct experiments, as well as to analyze and interpret data;
  c) an ability to formulate or design a system, process or program to meet desired needs;
  d) an ability to function on multi-disciplinary teams;
  e) an ability to identify and solve applied science problems;
  f) an understanding of professional and ethical responsibility;
  g) an ability to communicate effectively;
  h) the broad education necessary to understand the impact of solutions in a global and societal context;

Standard 4

Standard 4 - Program Goals: Each program and program options shall have current short and long-range goals and plans for achieving these goals.

SUMMARY RESPONSE

The four options share two long-range goals. The first is to continue to refine the continuous improvement processes with a specific emphasis on documenting improvements, how often courses are offered, and enhancing the ability for students to access and complete coursework in a timely manner. The second goal is to continue to recruit qualified undergraduates, with an emphasis on increasing the gender and racial diversity of the programs. Additionally, each program option has five to six goals (a combination of long- and short-term) related to issues such as course offerings, capstone projects, and international experiences.

DETAILED RESPONSE

The goals for the four option (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs are presented below in separate sections. The Technology Curriculum Committee does not have a substantial concern with any of the four option programs. However, part of our continuous improvement process is to strive to improve even the things we are currently doing well. The first section shares two long range goals common to all four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs. The following sections describes the short range and long range goals that have been identified but are currently unrealized for each of the four option programs. The goals below are presented within that context.

Common to All Four Options

The first long-range goal common to all degree program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) is to refine the Technology Curriculum Committee's continuous improvement process (CIP). *Achievement Plan:* Adopt a more streamlined process for the documentation of continuous improvements made in the curriculum programs. The goal is to increase the transparency of the documentation of curricular changes and assessment of student outcomes. The Technology Curriculum Committee believes there are opportunities to adapt structures used in other departmental curricula to strengthen and enhance all four options.

The other long-range goal common to all four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs is to increase diversity – particularly regarding gender and race. *Achievement Plan:* The ABE Equity, Diversity, and Inclusion Committee (EDIC), which works on departmental diversity issues broadly, will lead efforts in the recruitment and retention of qualified undergraduates who are underrepresented (e.g., gender, race). The EDIC will work to build on previous initiatives, including faculty and staff professional development and the adviser-led ABE Students of Color Network. Future programming is expected to leverage other university-wide programs such as Science Bound to recruit and retain a diverse, qualified pool of undergraduate students.

AST-ABM Short-Range Goals

- Continue to assess and determine whether course offering schedules meet student enrollment needs. *Achievement Plan:* Associate Chair and TCC will work with instructors and scheduling advisor to plan for increase in student numbers.
- Recruit students from AST-ABM into the feed technology minor, and further incorporate courses from the feed technology minor into the degree program. *Achievement Plan:* Address pre-requisite concerns related to the animal science course in animal nutrition (AN S 319). Work with TCC and College of Agriculture and Life Sciences Curriculum Committee to support development of non-major animal nutrition course and options for students to complete required pre-requisites to allow AST-ABM students to satisfy the feed technology minor.

AST-ABM Long-Range Goals

- Strengthen industry engagement by using specialized AST-ABM option style capstone projects. *Achievement Plan:* Capstone instructors and others work with ABM-focused faculty to identify opportunities for capstone projects, internships, and industry guest speakers in courses.
- Increase the number of students in the Agricultural Biosystems Management option. *Achievement Plan*: ABE will participate in agricultural recruiting events (i.e., FFA Convention) and will work with college staff to highlight aspects of ABM option in AST.
- Complete the transition to the Feed Mill and Grain Science Complex through ABM course and laboratory learning activities. *Achievement Plan:* Work with ABM faculty to utilize Feed and Grain Science Complex for course and laboratory learning activities upon completion (expected 2021).

AST-MS Short-Range Goals

- Recruit students from AST-MS into the feed technology minor, and further incorporate courses from the feed technology minor into the degree program. *Achievement Plan:* Address pre-requisite concerns related to the animal science course in animal nutrition (AN S 319). Work with TCC and College of Agriculture and Life Sciences Curriculum Committee to support development of non-major animal nutrition course and options for students to complete required pre-requisites to allow AST-MS students to satisfy the feed technology minor.
- Address the conflicts between hands-on laboratories and number of major and non-major students. *Achievement Plan:* Associate Chair and TCC will work with instructors and scheduling advisor to plan for increasing student numbers.

AST-MS Long-Range Goals

- Increase number of faculty and improve the student/faculty ratio in Machine Systems option. *Achievement Plan:* Work with entire faculty and deans with the ABE Chair as lead to increase the teaching FTEs related to this option.

- Increase opportunities for international experiences for students in Machine Systems option. *Achievement Plan:* Work with the ABE International Programs Committee to develop study abroad experiences directly related to AST-MS students and then work with advisers to promote the programs to attract more students.

ITEC-M Short-Range Goals

- Review scope and sequence of ITEC-M degree plan. *Achievement Plan:* TCC to review option-level courses to determine most appropriate scope and sequencing of coursework.
- Resolve complications related to large class size for courses such as TSM 115 and 340. *Achievement Plan:* Associate Chair and TCC will work with instructors and scheduling advisor to plan for increasing student numbers.
- Revisit faculty ownership of courses. *Achievement Plan:* TCC to work with ABE Chair and ABE faculty to determine best option to ensure every course has a faculty champion.

ITEC-M Long-Range Goals

- Increase number of faculty and improve the student/faculty ratio in manufacturing option. *Achievement Plan:* Work with entire faculty and deans and the lead is the ABE Chair to increase the teaching FTEs related to this option.
- Increase opportunities for international experiences for students in manufacturing option. *Achievement Plan:* Work with the ABE International Programs Committee to develop study abroad experiences directly related to ITEC-M students and then work with advisers to promote the programs to attract more students.
- Explore opportunities for including additional additive manufacturing content in the Manufacturing option. *Achievement Plan:* The TCC will carefully consider how the department might incorporate more additive manufacturing into existing courses or the need for a new course in this content area.

ITEC-OS Short-Range Goals

- Evaluate offering and credit load of TSM 471 (Safety Laboratory) to determine alignment with expectations. *Achievement Plan:* Work with course instructor and TCC to assess expectations as compared with credit awarded.
- Increase industry involvement from safety professionals in student club activities. *Achievement Plan:* The faculty advisor to the ASSP to work with the Des Moines (Hawkeye) professional chapter to offer opportunities to be more involved with the club.
- Increase the opportunity for students in the industrial technology occupational safety option to complete OSHA 10-hour general industry training. *Achievement Plan:* The instructor of TSM 370 (Occupational Safety) will explore options to provide OSHA cards as part of the class.

ITEC-OS Long-Range Goals

- Increase number of students in Occupational Safety option program. *Achievement Plan:* Faculty in the Safety Focus Group will work with the ASSP chapter and college staff to highlight aspects of Occupational Safety in recruitment and retention of students. Safety

Standard 5

Standard 5 - Program Learning Outcomes Identification & Validation: Measurable program learning outcomes shall be identified, assessed and validated for each program/option. These outcomes must align with the program goals established for the program/option and validation shall be accomplished through a combination of external experts, an industrial advisory committee and, after the program is in operation, follow up studies of direct and indirect measures for each outcome.

SUMMARY RESPONSE

For each of the four options, the Agricultural and Biosystems Engineering department identified and validated fourteen measurable program learning outcomes with faculty, the External Advisory Council, and graduates. Eleven of the learning outcomes are common to all four options; each program option has three unique learning outcomes. These outcomes have been validated and confirmed by program stakeholders.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department has developed learning outcomes for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) at the time of graduation. There a set of eleven common learning outcomes (a-k) for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) and three option specific learning outcomes (l-n).

The common and option specific learning outcomes were validated by the External Advisory Council, the Agricultural and Biosystems Engineering faculty and program option alumni (two to five years after graduation) in 2007, 2014 and 2019. An outcomes validation survey was administered to both groups. Table 5.1 lists the number of respondents in each group for the 2019 survey, which included graduates (alumni) from 2015 through 2018. There was a low number of ITEC-OS alumni responses, despite repeated reminders to complete the survey; thus, the data from this group was not included in presented results.

Table 5.1. Number of respondents and response rate to 2019 outcomes validation survey.

Group	Number of respondents	Response rate
External Advisory Council	15	94%
ABE Faculty	29	83%
AST-ABM alumni	9	19%
AST-MS alumni	20	18%
ITEC-M alumni	19	11%
ITEC-OS alumni	2	11%

Respondents used a five-point Likert scale to rate the importance of each of the common learning outcomes and option specific outcomes for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) in the context of professional practice.

Results from these validation processes for the common learning outcomes are presented in Tables 5.2 (AST-ABM and AST-MS) and 5.3 (ITEC-M and ITEC-OS).

Table 5.2. Validation[1] of common learning outcomes in 2019 for AST program option (AST-ABM and AST-MS) by the External Advisory Council, ABE faculty and program alumni.

Common Learning Outcomes	AST-ABM Options			AST-MS Options		
	External Advisory Council	ABE Faculty	Alumni	External Advisory Council	ABE Faculty	Alumni
(a) ability to apply knowledge of mathematics, science, technology and applied sciences;	3.0	4.8	3.9	3.8	4.8	4.1
(b) an ability to design and conduct experiments, as well as to analyze and interpret data;	3.7	4.1	4.0	4.3	4.1	4.1
(c) ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;	4.0	4.4	4.0	4.0	4.4	4.2
(d) ability to function on multi-disciplinary teams;	3.7	4.7	4.0	4.5	4.7	4.0
(e) ability to identify and solve applied science problems;	3.5	4.6	3.9	4.5	4.6	4.2
(f) understanding of professional and ethical responsibility;	4.5	4.7	4.3	4.0	4.7	4.0
(g) an ability to communicate effectively	4.5	4.6	4.4	5.0	4.6	4.4
(h) the broad education necessary to understand the impact of solutions in a global economic, environmental, and societal context;	3.3	4.1	4.0	2.5	4.1	3.6
(i) recognition of the need for, and an ability to engage in life-long learning;	4.5	4.1	4.4	3.3	4.1	4.2
(j) a knowledge of contemporary issues	3.0	3.8	4.0	2.5	3.8	3.8
(k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	4.5	4.7	4.2	3.8	4.7	4.2

[1]Respondents rated the importance of each outcome to the option program (1 = unnecessary, 2 =useful but not necessary, 3 = important, 4 = very important, 5 = essential). Table values are the means of the ratings.

Table 5.3. Validation[1] of common learning outcomes in 2019 for ITEC program options (ITEC-M and ITEC-OS) by the External Advisory Council, ABE faculty and program alumni.

Common Learning Outcomes	ITEC-M Options			ITEC-OS Options		
	External Advisory Council	ABE Faculty	Alumni	External Advisory Council	ABE Faculty	Alumni
(a) ability to apply knowledge of mathematics, science, technology and applied sciences;	4.2	4.8	3.8	5.0	4.8	n/a[2]
(b) an ability to design and conduct experiments, as well as to analyze and interpret data;	3.7	4.1	4.1	4.5	4.1	n/a[2]
(c) ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;	4.0	4.4	4.3	4.0	4.4	n/a[2]
(d) ability to function on multi-disciplinary teams;	4.3	4.7	4.2	4.0	4.7	n/a[2]
(e) ability to identify and solve applied science problems;	3.7	4.6	4.0	4.0	4.6	n/a[2]
(f) understanding of professional and ethical responsibility;	4.0	4.7	4.2	4.0	4.7	n/a[2]
(g) an ability to communicate effectively	4.7	4.6	4.2	4.0	4.6	n/a[2]
(h) the broad education necessary to understand the impact of solutions in a global economic, environmental, and societal context;	3.5	4.1	3.6	4.0	4.1	n/a[2]
(i) recognition of the need for, and an ability to engage in life-long learning;	3.8	4.1	4.0	4.5	4.1	n/a[2]
(j) a knowledge of contemporary issues	3.0	3.8	3.5	4.0	3.8	n/a[2]
(k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	3.5	4.7	4.1	4.0	4.7	n/a[2]

[1]Respondents rated the importance of each outcome to the option program (1 = unnecessary, 2 =useful but not necessary, 3 = important, 4 = very important, 5 = essential). Table values are the means of the ratings.
[2]Not applicable due to a low response rate (n=2)

There was a general consensus among all respondents that the common learning outcomes were "very important" to "essential" (a rating > 3.5) for all options. The lowest rated common learning outcomes was (j) "a knowledge of contemporary issues" with a rating just below "very important." No one selected "unnecessary" or "useful but not necessary" for any of the common outcomes, except the External Advisory Committee who suggested that (h) "broad education" and (j) “a knowledge of contemporary issues” were somewhere between “useful but not necessary” and “important” for the AST-MS option.

Stakeholders’ validation of option specific learning outcomes is found in Table 5.4 (outcomes for AST-ABM and AST-MS), and Table 5.5 (outcomes for ITEC-M and ITEC-OS).

Table 5.4 Validation[1] of AST-ABM and AST-MS option specific learning outcomes in 2019 by external advisory council, ABE faculty and program alumni.

Option Specific Learning Outcomes	External Advisory Council	ABE Faculty	Option Alumni
Agricultural Systems Technology - Agriculture and Biosystems Management (AST-ABM)			
(l) an ability to develop, implement, and evaluate best management practices for human and natural resource systems for producing, processing and marketing bio-based products worldwide	4.0	4.3	4.2
(m) an ability to integrate and apply agricultural and biosystems engineering technologies in the bio-based industries	4.0	4.4	4.1
(n) an understanding of the complex systems that sustain our water, air, soils, and food	4.0	4.3	4.0
Agricultural Systems Technology - Machine System (AST-MS)			
(l) an ability to specify, manage, and test machine systems in the context of complete agricultural, biological production or processing systems	2.8	4.7	4.2
(m) an understanding of the technology and application of machine systems including power and information flows, function and interaction with biological materials	2.8	4.6	3.9
(n) an ability to perform energy and cost analyses of complete machine systems to ensure the success and sustainability of an enterprise	3.0	4.3	3.9

[1]Respondents rated the importance of each outcome to the option program (1 = unnecessary, 2 =useful but not necessary, 3 = important, 4 = very important, 5 = essential). Table values are the means of the ratings.

Table 5.5 Validation[1] of ITEC-M and ITEC-OS option specific learning outcomes in 2019 by external advisory council, ABE faculty and program alumni.

Option Specific Learning Outcomes	External Advisory Council	ABE Faculty	Option Alumni
Industrial Technology - Manufacturing (ITEC-M)			
(l) an ability to develop, implement, and evaluate manufacturing processes and facilities	4.9	4.6	4.1
(m) an ability to apply computer aided design and manufacturing, control systems, and automation systems to industrial settings	4.0	4.7	4.2
(n) an ability to implement and analyze the use of manufacturing technologies to enhance production, quality, and profitability of manufacturing systems	4.6	4.8	4.2
Industrial Technology - Occupational Safety (ITEC-OS)			
(l) an ability to develop, implement, and evaluate occupational safety and health programs for businesses and organizations	5.0	4.7	n/a[2]
(m) an ability to identify and analyze hazards and loss producing conditions in work environments	5.0	4.7	n/a[2]
(n) an ability to eliminate or control occupational hazards using appropriate technologies, administrative interventions, and training for behavior modification	5.0	4.7	n/a[2]

[1]Respondents rated the importance of each outcome to the option program (1 = unnecessary, 2 =useful but not necessary, 3 = important, 4 = very important, 5 = essential). Table values are the means of the ratings.
[2]Not applicable due to a low response rate (n=2)

All respondents across all groups thought that all the option-specific learning outcomes were "important" to "essential" (a rating > 4.0) for all options, except for the AST-MS rating by the External Advisory Committee. On average they rated outcomes (l) and (m) slightly below important.

Based on feedback from our stakeholders (external advisory committee, ABE faculty, program graduates) we believe the option specific learning outcomes for each of the four options are valid and appropriate. Future discussions with the External Advisory Committee need to examine their views on the general and option specific outcomes for the AST-MS option.

Alignment of Learning Outcomes with Program Goals

Tables 5.6 through 5.9 display the relationship between program goals and student learning outcomes for the AST-ABM, AST-MS, ITEC-M and ITEC-OS program options, respectively. Many of the program goals address general program option improvements and thus address all the learning outcomes.

Table 5.6. Relationship of Learning Outcomes to Program Goals for the AST-ABM option.

	Learning Outcomes
Short Term Goals	
Continued assessment and determination of whether course offering schedule meets student enrollment needs	All learning outcomes
Recruit students from AST-ABM into the feed technology minor, and further incorporate courses from the feed technology minor into the degree program.	a, c, e, f, g, h, j, k, l, m
Long Term Goals	
Strengthen industry engagement by using specialized AST-ABM option style capstone projects	All learning outcomes
Increase the number of students in the Agricultural Biosystems Management option	All learning outcomes
Complete the transition to the Feed Mill and Grain Science Complex through ABM course and laboratory learning activities.	l, m

Table 5.7. Relationship of Learning Outcomes to Program Goals for the AST-MS option.

	Learning Outcomes
Short Term Goals	
Recruit students from AST-MS into the feed technology minor, and further incorporate courses from the feed technology minor into the degree program.	a, c, e, f, g, h, j, k, l, m
Address the conflicts between hands-on laboratories and number of major and non-major students.	All learning outcomes
Long Term Goals	
Increase number of faculty and improve the student/faculty ratio in Machine Systems option	All learning outcomes
Increase opportunities for international experiences for students in Machine Systems option.	All learning outcomes

Table 5.8. Relationship of Learning Outcomes to Program Goals for the ITec-M option.

	Learning Outcomes
Short Term Goals	
Review scope and sequence of ITEC-M degree plan	All learning outcomes
Resolve complications related to large class size for courses such as TSM 115 and 340.	All learning outcomes
Address situations where faculty ownership of course has changed.	All learning outcomes
Long Term Goals	
Increase number of faculty and improve the student/faculty ratio in manufacturing option.	All learning outcomes
Increase opportunities for international experiences for students in manufacturing option.	All learning outcomes
Explore opportunities for including an additive manufacturing course to the Manufacturing option.	l, m, n

Table 5.9. Relationship of Learning Outcomes to Program Goals for the ITec-OS option.

	Learning Outcomes
Short Term Goals	
Evaluate offering and credit load of TSM 471 (Safety Laboratory) to determine alignment with expectations.	l, m, n
Increase industry involvement from safety professionals in student club activities	All learning outcomes
Increase the opportunity for students in the industrial technology occupational safety option to complete OSHA 10-hour general industry training.	l, m, n
Long Term Goals	
Increase number of students in Occupational Safety option program.	All learning outcomes
Update laboratory equipment so that equipment can be used in-house.	l, m, n
Invigorate industry engagement by using specialized ITEC-OS option style capstone projects	All learning outcomes

Measurement of Learning Outcomes through Workplace Competencies

Workplace competencies are defined as the application of knowledge, skills, attitudes and values, and behaviors in the workplace. Through engagement with more than 200 constituents representing alumni, employers, co-op/intern students, parents, ISU faculty, and partnering international faculty, the conclusion was that the competencies (i.e., "abilities" and "understandings") were measurable through performance. Additionally, we believe that the measurement of performance using competencies provides an indication of student ability (Brumm et al. 2006, located in Appendix C).

Developmental Dimensions International, a global provider of management tools and services (www.ddiworld.com), helped identify and validate 14 workplace competencies (Table 5.10) that are necessary and sufficient to measure the common learning outcomes. The definition of each workplace competencies is clear, concise and independent. Specific to each definition is a set of observable and measurable key actions (Appendix C). Through workplace competency key actions, students develop and demonstrate their ability to attain common learning outcomes through internship experience in the workplace, laboratories, capstone experiences, extra-curricular activities, and in the classroom.

These 14 workplace competencies are mapped to the common learning outcomes (Table 5.11). The mapping was originally identified and validated for the similar outcomes for engineering programs at Iowa State University. In order to validate the mapping for the two technology programs, in 2007, the ABE External Advisory Committee and the ABE faculty were surveyed. The two groups ranked the importance of each competency to each outcome. The resulting score (on a scale of 1 to 5) is a weighting factor, reflecting the importance of the specific competencies in addressing the matched common competencies. All mappings received a ranking of 3.0 (important) or higher. The only exception was the common outcome (j) "a knowledge of contemporary issues" relationship with analysis and judgment, which received an average ranking of 2.83.

Student achievement of common learning outcomes are determined by directly measuring workplace competency demonstration with supervisor evaluation of students in internships. The department has been collecting data from students in all four option programs on internships since the fall of 2006. Students self-assess, and supervisors are asked to assess students on how often students demonstrated key actions associated with 15 different workplace competencies when given the opportunity. Responses are on a Likert scale: 5 = always or almost always; 4 = often; 3 = usually; 2 = sometimes; and 1 = never or almost never.

Comparing the achievement of common learning outcomes to the "perfect" achievement of the common competencies can be accomplished with the following formula:

$$\%\ Achievement = \left(\frac{\sum(workplace\ competency\ ranking)\ x(weighting\ factor)}{\sum(5)\ x\ (weighting\ factor)}\right) x\ 100\%$$

The results of these assessments can be found in Standard 12.

Table 5.10 The 14 workplace competencies identified and validated by constituents.

Workplace Competencies	Definition
Analysis and Judgment	Identifying and understanding issues, problems and opportunities; developing the relevant criteria and comparing data from different sources to draw conclusions; using effective approaches for choosing courses of action or developing appropriate solutions; taking actions that are consistent with available facts, constraints, and probable consequences.
Communication	Clearly conveying information and ideas through a variety of media to individuals or groups in a manner that engages the audience and helps them understand and retain the message.
Continuous Learning	Actively identifying new areas for learning; regularly creating and taking advantage of learning opportunities; using newly gained knowledge and skill on the job and learning through application.
Cultural Adaptability	Being open to and making changes to accommodate the differences found in other cultures in order to interact effectively with individuals and groups from different cultural backgrounds.
Customer Focus	Making customers and their needs a primary focus of one's actions; developing and sustaining productive customer relationships.
Engineering/Technical Knowledge	Having achieved a satisfactory level of knowledge in the relevant specialty areas of engineering, technology, science and mathematics.
General Knowledge	Having achieved a satisfactory level of knowledge outside the areas of engineering, science and mathematics
Initiative	Taking prompt action to accomplish objectives; taking action to achieve goals beyond what is required; being proactive.
Innovation	Generating creative, non-traditional technical solutions in work situations; trying different and novel ways to deal with work problems and opportunities.
Integrity	Maintaining social, ethical, and organization norms; firmly adhering to codes of conduct and professional ethical principles.
Planning	Effectively managing one's time and resources to ensure that work is completed efficiently.
Professional Impact	Creating a good first impression, commanding attention and respect, showing an air of confidence.
Quality Orientation	Accomplishing tasks by considering all areas involved, no matter how small; showing concern for all aspects of the job; accurately checking processes and tasks; being watchful over a period of time.
Teamwork	Effectively participating as a member of a team to move the team toward completion of goals.

Table 5.11 Relationship between common learning outcomes and workplace competencies[1].

Common Learning Outcomes	Workplace Competencies													
	Analysis and Judgment	**Communication**	**Continuous Learning**	**Cultural Adaptability**	**Customer Focus**	**Engineering/Technical Knowledge**	**General Knowledge**	**Initiative**	**Innovation**	**Integrity**	**Planning**	**Professional Impact**	**Quality Orientation**	**Teamwork**
a) an ability to apply knowledge of mathematics, science, and applied sciences	4.43		3.91			4.48		3.78						
b) an ability to design and conduct experiments, as well as to analyze and interpret data	4.30		3.86		3.13	4.30		3.78	3.87		3.96		4.13	3.39
c) an ability to formulate or design a system, process or program to meet desired needs	4.22	3.50	3.96	3.78	4.14	4.17		4.04	4.30		4.04		4.00	3.87
d) an ability to function on multi-disciplinary teams	3.70	4.45		4.09	3.81			3.70		4.22	4.00	3.91		4.57
e) an ability to identify and solve applied science problems	4.26	3.39	3.59		3.13	4.43		3.74	3.70				3.52	3.52
f) an understanding of professional and ethical responsibility	3.91		3.43	3.70			3.64			4.39			3.61	
g) an ability to communicate effectively		4.48			4.27		3.68	4.10				3.96		
h) the broad education necessary to understand the impact of solutions in a global and societal context	3.39		4.09	4.13		3.41	4.00							
i) recognition of the need for, and an ability to engage in life-long learning			4.35					3.86						
j) a knowledge of contemporary issues	2.83		4.00	3.73			3.87							
k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	4.05		3.96	3.00		4.10		3.68					3.57	

[1]Numbers represent constituents' average rating of how essential the workplace competency is to the common learning outcome (5=essential, 4=very important, 3=important, 2=useful but not essential, 1=unnecessary).

Standard 6

Standard 6 - Program Structure and Course Sequencing: Each program/option shall meet minimum foundation semester hour requirements. Programs/options may exceed maximum foundation semester hour requirements specified in each area, as long as minimums are met. A specific list of courses and credit hours that are being counted toward each category shall be included in the Self-Study Report. For institutions on the quarter system they shall convert the course work to the semester system (hours based on Federal Regulations).

SUMMARY RESPONSE

Each of the four program options meet ATMAE's minimum foundation semester hour requirements, and none exceed ATMAE's maximum foundation semester hour requirements specified in each area. Over 55% of the courses used to deliver the four option programs include lab experiences, and all option programs require students to spend at least 20% of their time in lab. Course sequencing is developed by the Technology Curriculum Committee in consultation with relevant course instructors. Changes in course scope and sequence always consider the application of prerequisite content in upper division courses, so that student are continually learning to use core concepts ranging from mathematics to communication in technology-relevant situations.

DETAILED RESPONSE

Program minimum curricular foundation

The specific lists of courses and credit hours counted toward each ATMAE foundation semester hour requirements for the four program/options are provided in Tables 6.1 to 6.4. The order of presentation is Agricultural System Technology – Agricultural and Biosystems Management Option (Table 6.1), Agricultural System Technology – Machine Systems Option (Table 6.2), Industrial Technology – Manufacturing Option (Table 6.3), and Industrial Technology – Occupational Safety Option (Table 6.4). All four options have credit hour ranges within the range specified by ATMAE. None of the program/options exceed the maximum foundation semester hour requirements specified. Therefore, no justifications are required for the six areas (General Education, Mathematics, Physical Sciences, Management, Technical, and Electives).

6.1 Program Minimum Curricula Foundation
Bachelor's Degree: Programs/options shall be a minimum of 120 semester hours and shall meet the following minimum/maximum foundation semester hour requirements:

General Education (must include oral and written communications)	18-36
Mathematics	6-18
Physical Sciences *	6-18
Management and/or Technical**	42-60
Electives	0-18

*Life Sciences may be appropriate for selected programs of study
**Management courses should not exceed 24 hours

Note: Students must successfully complete a minimum of 15 semester hours of junior or senior level major courses at the institution seeking accreditation.

Note: Programs in Safety. The Board of Certified Safety Professionals (BCSP) evaluates programs in safety designed that are designed to gain recognition for students in the safety profession. Program options may have specific requirements based on local market needs and on national professional safety practice studies and standards such as BCSP Education Standard and ANSI Z590.2.

Table 6.1. Iowa State University Agricultural Systems Technology, Agricultural and Biosystems Management option (AST-ABM), bachelor's degree semester hour requirements

ACCREDITED BY ATMAE The Association of Technology, Management, and Applied Engineering **Requirements**	**ISU Degree Requirements Course prefix, number, and title**	**Semester Hours**
General Education **(Humanities, English, History, Sociology, Psychology, Speech, etc.)** **18-36 Semester Hours**	ENGL 150 Critical Thinking and Communication	3
	ENGL 250 Written, Oral, Visual, and Electronic Composition	3
	Business Writing Course (select one of the 3 credit courses) ENGL 302 Business Communication ENGL 309 Proposal and Report Writing ENGL 314 Technical Communication AGEDS 327 Survey of Agriculture and Life Sciences Communication	3
	Public Speaking Course (select one of the 3 credit courses) SP CM 212 Fundamentals of Public Speaking AGEDS 311 Presentation and Sales Strategies for Agricultural Audiences COMST 214 Professional Communications	3
	LIB 160 Information Literacy	1
	ECON 101 Principles of Microeconomics	3
	Ethics Course (TSM 370 Occupational Safety)	3
	U.S. Diversity (University List)	3
	Humanities (College of Agriculture and Life Sciences List)	3
	TSM 270 Principles of Injury Prevention and Safety	3
	Total	28
Mathematics **6-18 Semester Hours**	MATH 145 Applied Trigonometry	3
	MATH 151 Calculus for Business and Social Sciences	3
	STAT 104 Introduction to Statistics	3
	TSM 115 Solving Technology Problems	3
	Total	12

Physical Sciences* 6-18 Semester Hours *Life Sciences may be appropriate for selected programs of study	PHYS 111 General Physics	5
	CHEM 163 College Chemistry	4
	CHEM 163L Laboratory in College Chemistry	1
	Biology Course (select one of the 3 credit courses) BIOL 101 Introductory Biology (3 credits) BIOL 211 Principles of Biology I (3 credits)	3
	Life Sciences (3 credits) (College of Agriculture and Life Sciences list)	3
	Total	16

Management 12-24 Semester Hours	ACCT 284 Financial Accounting	3
	ECON 230 Farm Business Management	3
	TSM 110 Introduction to Technology	1
	TSM 111 Experiencing Technology	1
	TSM 201 Preparing for Workplace Seminar	1
	TSM 214 Managing Technology Projects	1
	TSM 310 Total Quality Improvement	3
	TSM 397 Internship in Technology	R*
	TSM 399 Work Experience in Technology	2
	TSM 415 Applied Project Management in Technology	2
	TSM 416 Technology Capstone	3
	Total	20
Technical 24-36	TSM 116 Introduction to Design in Technology	3
	TSM 210 Fundamentals of Technology	3
	TSM 322 Preservation of Grain Quality	3
	TSM 322L Preservation of Grain Quality Laboratory	1
	TSM 324 Soil and Water Conservation Management	3
	TSM 325 Biorenewables Systems	3
	TSM 327 Animal Production Systems	3
	TSM 330 Agricultural Machinery and Power Management	3
	TSM 363 Electrical Power Systems and Electronics for Agriculture and Industry	4
	TSM 433 Precision Farming Systems	3
	TSM 455 Feed Processing and Technology	3
	Total	32
General Electives 0–18 Semester Hours	*Electives*	9
	International Perspectives (University List)	3
	Total	12

ATMAE Minimum Total 120 Semester Hours		Degree Total	120

* R credit does not have any numerical credit but it is required in curriculum and must be completed prior to graduation.

Table 6.2. Iowa State University Agricultural Systems Technology, Machine Systems option (AST-MS), bachelor's degree semester hour requirements

ACCREDITED BY ATMAE The Association of Technology, Management, and Applied Engineering **Requirements**	**ISU Degree Requirements Course prefix, number, and title**	**Semester Hours**
General Education **(Humanities, English, History, Sociology, Psychology, Speech, etc.)** **18-36 Semester Hours**	ENGL 150 Critical Thinking and Communication	3
	ENGL 250 Written, Oral, Visual, and Electronic Composition	3
	Business Writing Course (select one of the 3 credit courses) ENGL 302 Business Communication ENGL 309 Proposal and Report Writing ENGL 314 Technical Communication AGEDS 327 Survey of Agriculture and Life Sciences Communication	3
	Public Speaking Course (select one of the 3 credit courses) SP CM 212 Fundamentals of Public Speaking AGEDS 311 Presentation and Sales Strategies for Agricultural Audiences COMST 214 Professional Communications	3
	LIB 160 Information Literacy	1
	ECON 101 Principles of Microeconomics	3
	Ethics Course (TSM 370 Occupational Safety)	3
	U.S. Diversity (University List)	3
	Humanities (College of Agriculture and Life Sciences List)	3
	TSM 270 Principles of Injury Prevention and Safety	3
	Total	28
Mathematics **6-18 Semester Hours**	MATH 145X Applied Trigonometry	3
	MATH 151 Calculus for Business and Social Sciences	3
	STAT 104 Introduction to Statistics	3
	TSM 115 Solving Technology Problems	3
	Total	12
Physical Sciences* **6-18 Semester Hours**	PHYS 111 General Physics	5
	CHEM 163 College Chemistry	4
	CHEM 163L Laboratory in College Chemistry	1

*Life Sciences may be appropriate for selected programs of study	*Biology Course* (select one of the 3 credit courses) BIOL 101 Introductory Biology (3 credits) BIOL 211 Principles of Biology I (3 credits) BIOL 212 Principles of Biology II (3 credits) BIOL 251 Biological Processes in the Environment (3 credits)	3
	Life Sciences (3 credits) (College of Agriculture and Life Sciences list)	3
	Total	16

Management **12-24 Semester Hours**	ACCT 284	Financial Accounting	3
	TSM 110	Introduction to Technology	1
	TSM 111	Experiencing Technology	1
	TSM 201	Preparing for Workplace Seminar	1
	TSM 214	Managing Technology Projects	1
	TSM 310	Total Quality Improvement	3
	TSM 397	Internship in Technology	R*
	TSM 399	Work Experience in Technology	2
	TSM 415	Applied Project Management in Technology	2
	TSM 416	Technology Capstone	3
		Total	17
Technical **24-36**	TSM 116	Introduction to Design in Technology	3
	TSM 210	Fundamentals of Technology	3
	TSM 216	Advanced Technical Graphics, Interpretation, and CAD	2
	TSM 240	Introduction to Manufacturing Processes for Metals	3
	Choose 1 credit from list below: ABE 271 ABE 272 ABE 273	 Engineering Applications of Parametric Solid Modeling Parametric Solid Models, Drawings, and Assemblies using Credo Parametric CAD for Process Facilities and Land Use Planning	1
	TSM 330	Agricultural Machinery and Power Management	3
	TSM 335	Tractor Power	4
	TSM 337	Fluid Power Systems Technology	3
	TSM 363	Electric Power Systems and Electronics for Agriculture and Industry	4
	TSM 433	Precision Agriculture	3
	TSM 443	Statics and Strength of Materials for Technology	3
	TSM 465	Automation Systems	3

	Total	35
General Electives 0–18 Semester Hours	*Electives*	9
	International Perspectives (University List)	3
	Total	12
ATMAE Minimum Total 120 Semester Hours	Degree Total	120

* R credit does not have any numerical credit but it is required in curriculum and must be completed prior to graduation.

Table 6.3. Iowa State University Industrial Technology, Manufacturing option (ITEC-M), bachelor's degree semester hour requirements

Requirements	**ISU Degree Requirements Course prefix, number, and title**	**Semester Hours**
General Education **(Humanities, English, History, Sociology, Psychology, Speech, etc.)** **18-36 Semester Hours**	ENGL 150 Critical Thinking and Communication	3
	ENGL 250 Written, Oral, Visual, and Electronic Composition	3
	Business Writing Course (select one of the 3 credit courses) ENGL 302 Business Communication ENGL 309 Proposal and Report Writing ENGL 314 Technical Communication AGEDS 327 Survey of Agriculture and Life Sciences Communication	3
	Public Speaking Course (select one of the 3 credit courses) SP CM 212 Fundamentals of Public Speaking AGEDS 311 Presentation and Sales Strategies for Agricultural Audiences COMST 214 Professional Communications	3
	LIB 160 Information Literacy	1
	ECON 101 Principles of Microeconomics	3
	Ethics Course (TSM 370 Occupational Safety)	3
	U.S. Diversity (University List)	3
	Humanities (College of Agriculture and Life Sciences List)	3
	TSM 270 Principles of Injury Prevention and Safety	3
	Total	28
Mathematics 6-18 Semester Hours	MATH 145 Applied Trigonometry	3
	MATH 151 Calculus for Business and Social Sciences	3
	STAT 104 Introduction to Statistics	3
	TSM 115 Solving Technology Problems	3

	Total	12
Physical Sciences* **6-18 Semester Hours** *Life Sciences may be appropriate for selected programs of study	PHYS 111 General Physics	5
	CHEM 163 College Chemistry	4
	CHEM 163L Laboratory in College Chemistry	1
	Biology Course (select one of the 3 credit courses) BIOL 101 Introduction to Biology (3 credits) BIOL 211 Principles of Biology I (3 credits) BIOL 212 Principles of Biology II (3 credits) BIOL 251 Biological Processes in the Environment (3 credits)	3
	Life Sciences (3 credits) (College of Agriculture and Life Sciences list)	3
	Total	16

Management **12-24 Semester Hours**	ACCT 284 Financial Accounting	3
	TSM 110 Introduction to Technology	1
	TSM 111 Experiencing Technology	1
	TSM 201 Preparing for Workplace Seminar	1
	TSM 214 Managing Technology Projects	1
	TSM 310 Total Quality Improvement	3
	TSM 397 Internship in Technology	R*
	TSM 399 Work Experience in Technology	2
	TSM 415 Applied Project Management in Technology	2
	TSM 416 Technology Capstone	3
	TSM 444 Facility Planning	3
	Total	20
Technical **24-36**	TSM 116 Introduction to Design in Technology	3
	TSM 210 Fundamentals of Technology	3
	TSM 216 Advanced Technical Graphics, Interpretation, and CAD	2
	TSM 240 Introduction to Manufacturing Processes	3
	TSM 241 Introduction to Manufacturing Processes for Plastics	2
	Choose 1 credit from list below: ABE 271 Engineering Applications of Parametric Solid Modeling ABE 272 Parametric Solid Models, Drawings, and Assemblies using Credo Parametric ABE 273 CAD for Process Facilities and Land Use Planning	1
	TSM 337 Fluid Power Systems Technology	3
	TSM 340 Advanced Automated Manufacturing Processes	3

	TSM 363 Electrical Power Systems and Electronics for Agriculture and Industry	4
	TSM 440 Cellular Lean Manufacturing Systems	3
	TSM 443 Statics and Strength of Materials for Technology	3
	TSM 465 Automation Systems	3
	Total	33
General Electives 0–18 Semester Hours	*Electives*	8
	International Perspectives (University List)	3
	Total	13
ATMAE Minimum Total 120 Semester Hours	Degree Total	120

* R credit does not have any numerical credit but it is required in curriculum and must be completed prior to graduation.

Table 6.4. Iowa State University Industrial Technology, Occupational Safety option (ITEC-OS), bachelor's degree semester hour requirements

ACCREDITED BY ATMAE The Association of Technology, Management, and Applied Engineering **Requirements**	**ISU Degree Requirements Course prefix, number, and title**	**Semester Hours**
General Education **(Humanities, English, History, Sociology, Psychology, Speech, etc.)** **18-36 Semester Hours**	ENGL 150 Critical Thinking and Communication	3
	ENGL 250 Written, Oral, Visual, and Electronic Composition	3
	Business Writing Course (select one of the 3 credit courses) ENGL 302 Business Communication ENGL 309 Report and Proposal Writing ENGL 314 Technical Communication AGEDS 327 Survey of Agriculture and Life Sciences Communication	3
	Public Speaking Course (select one of the 3 credit courses) SP CM 212 Fundamentals of Public Speaking AGEDS 311 Presentation and Sales Strategies for Agricultural Audiences COMST 214 Professional Communications	3
	LIB 160 Information Literacy	1
	ECON 101 Principles of Microeconomics	3
	Ethics Course (TSM 370 Occupational Safety)	3
	U.S. Diversity (University List)	3
	Humanities (College of Agriculture and Life Sciences List)	3
	TSM 270 Principles of Injury Prevention and Safety	3

	PSYCH 250	Psychology of the Workplace	3
		Total	31
Mathematics 6-18 Semester Hours	MATH 145	Applied Trigonometry	3
	MATH 151	Calculus for Business and Social Sciences	3
	STAT 104	Introduction to Statistics	3
	TSM 115	Solving Technology Problems	3
		Total	12
Physical Sciences* 6-18 Semester Hours *Life Sciences may be appropriate for selected programs of study	PHYS 111	General Physics	5
	CHEM 163	College Chemistry	4
	CHEM 163L	Laboratory in College Chemistry	1
	BIOL 255	Fundamentals of Human Anatomy	3
	Biology Course (select one of the 3 credit courses) BIOL 101 Introduction to Biology (3 credits) BIOL 211 Principles of Biology I (3 credits) BIOL 212 Principles of Biology II (3 credits) BIOL 251 Biological Processes in the Environment (3 credits)		3
		Total	16

Management 12-24 Semester Hours	ACCT 284	Financial Accounting	3
	TSM 110	Introduction to Technology	1
	TSM 111	Experiencing Technology	1
	TSM 201	Preparing for Workplace Seminar	1
	TSM 214	Managing Technology Projects	1
	TSM 310	Total Quality Improvement	3
	TSM 371	Occupational Safety Management	2
	TSM 372	Legal Aspects of Occupational Safety and Health	2
	TSM 397	Internship in Technology	R*
	TSM 399	Work Experience in Technology	2
	TSM 415	Applied Project Management in Technology	2
	TSM 416	Technology Capstone	3
		Total	21
Technical 24-36	H S 105	First Aid and Emergency Care	2
	TSM 116	Introduction to Design in Technology	3
	TSM 210	Fundamentals of Technology	3
	TSM 240	Introduction to Manufacturing Processes for Metals	3
	TSM 376	Fire Protection and Prevention	3
	TSM 363	Electrical Power Systems and Electronics for Agriculture and Industry	4

	TSM 470	Industrial Hygiene: Physical, Chemical, and Biological Hazards	3
	TSM 471	Safety Laboratory	1
	TSM 477	Risk Analysis and Management	3
		Total	25
General Electives 0–18 Semester Hours	*Electives*		12
	International Perspectives (University List)		3
		Total	15
ATMAE Minimum Total 120 Semester Hours		Degree Total	120

* R credit does not have any numerical credit but it is required in curriculum and must be completed prior to graduation.

Standard 6.2 - Appropriate laboratory activities shall be included in the program/option and a reasonable balance shall be maintained between the practical application of "how" and the conceptual application of "why." Master's degree programs and/or options may not have formal laboratory activities, but must maintain a balance between the practical application of "how" and the conceptual application of "why."

6.2. Appropriate and a Reasonable Balance of Laboratory Activities

Fifty-three percent of Technology Systems Management courses integrate a laboratory experience with the lecture. Moreover, all four options have at least 20% of the total time spent in lab. Table 6.5 lists the number of credits of lecture and laboratory for each TSM course offered in the ABE department. Each lecture hour is equal to one course credit. One course credit is equal to 2-3 laboratory hours. The variation of laboratory time equaling one credit is based on the amount of set-up time needed for various laboratory experiences.

Table 6.6 shows the total number of hours in lecture and lab and the percent of course time spent in lab. The Agricultural System Technology – Agricultural and Biosystems Management Option has 23% of course time spent in Lab. The Agricultural System Technology – Machine Systems Option has 29% of course time spent in Lab. The Industrial Technology – Manufacturing Option has 26% of course time spent in Lab. The Industrial Technology – Occupational Safety Option has 20% of course time spent in Lab.

Table 6.5. Division of lecture and laboratory time in Technology Systems Management (TSM) Courses.

Course Number	Course Title	Lecture Credits	Lab Credits
TSM 110	Introduction to Technology	1	0
TSM 111	Experiencing Technology	0	1
TSM 115	Solving Technology Problems	2	1
TSM 116	Introduction to Design in Technology	2	1
TSM 201	Preparing for Workplace Seminar	1	0
TSM 210	Fundamentals of Technology	3	0
TSM 214	Managing Technology Projects	1	0
TSM 216	Advanced Technical Graphics, Interpretation, and CAD	1	2
TSM 240	Introduction to Manufacturing Processes for Metals	1	2
TSM 241	Introduction to Manufacturing Processes for Plastics	1	1
TSM 270	Principles of Injury Prevention	3	0
TSM 310	Total Quality Improvement	3	0
TSM 322	Preservation of Grain Quality	3	0
TSM 322L	Preservation of Grain Quality Laboratory	0	1
TSM 324	Soil and Water Conservation Management	2	1
TSM 325	Biorenewable Systems	3	0
TSM 327	Animal Production Systems	3	0
TSM 330	Agricultural Machinery and Power Management	2	1
TSM 335	Tractor Power	3	1
TSM 337	Fluid Power Systems Technology	2	1
TSM 340	Advanced Automated Manufacturing Processes	2	1
TSM 363	Electric Power & Electronics for Agriculture & Industry	3	1
TSM 370	Occupational Safety	3	0
TSM 371	Occupational Safety Management	2	0
TSM 372	Legal Aspects of Occupational Safety and Health	2	0
TSM 376	Fire Protection and Prevention	3	0
TSM 397	Internship in Technology	R	0
TSM 399	Work Experience in Technology	2	0
TSM 415	Applied Project Management in Technology	1	1
TSM 416	Technology Capstone	1	2
TSM 433	Precision Agriculture	2	1
TSM 440	Cellular Lean Manufacturing Systems	2	1
TSM 443	Statics and Strength of Materials for Technology	2	1
TSM 444	Facility Planning	3	0
TSM 455	Feed Processing and Technology	3	0
TSM 457	Feed Safety, Ingredient Quality, and Analytics	3	0
TSM 465	Automation Systems	2	1
TSM 470	Industrial Hygiene: Physical, Chemical, and Biological Hazards	3	0
TSM 471	Safety Laboratory	0	1
TSM 477	Risk Analysis and Management.	3	0

Table. 6.6. Amount of lecture and laboratory time by options[1]

DEGREE/OPTION	Total Hrs. Lecture[2]	Total Hrs. Lab[3]	% of Total Time in Labs[4]
Agricultural Systems Technology Agricultural & Biosystems Management option	107	32	23
Agricultural Systems Technology Machine Systems option	102	42	29
Industrial Technology Manufacturing option	111	40	26
Industrial Technology Occupational Safety option	109	28	20

1 Combining total lecture and lab hours do not equal the credit hours in degree program because lab hours have different conversion rates

2 Hours based on relationship of 1 credit equal to 1 hour of lecture

3 Hours based on relationship of 1 credit equal to 2 or 3 hours of lab. The amount used for each course was based on contact hours for instruction type listed in current catalog

4 Percentage assumes that the electives are lecture only courses. Opportunities for selecting electives with labs exist but not counted. If half of the electives had labs then the change in percent would vary from 4 to 6 percentage points.

6.3 - There shall be evidence of appropriate sequencing of courses in each program/option to ensure that applications of mathematics, science, written and oral communications are covered in technical and management courses.

6.3. Appropriate Sequencing of Courses

In the Iowa State University course numbering system, 100 to 299 series courses are primarily for freshmen and sophomore students, 300 to 499 series courses are primarily for junior and senior students, and 500-599 series courses are primarily for graduate students but are open to qualified undergraduates. Advisement and course prerequisites assure proper course sequencing. Enforcement of prerequisites is done by a combination of advising and instructor actions. The on-line 2019-2020 Iowa State University Catalog contains a description of each course and also lists the prerequisites for each course at http://catalog.iastate.edu/azcourses/tsm.

4-year plans are also available for each student. These are intended as a guide for students and may not always be followed exactly as written. The following links show the 4-year plans for each degree option, based on the 2019-2020 catalog:

Agricultural Systems Technology – Agricultural and Biosystems Management Option:
https://www.abe.iastate.edu/files/2019/06/AST_ABM-4-Year-Plan-19-20.pdf

Agricultural Systems Technology – Machine Systems Option:
https://www.abe.iastate.edu/files/2019/06/AST_MS-4-Year-Plan-19-20.pdf

Industrial Technology – Manufacturing Option:

https://www.abe.iastate.edu/files/2019/06/ITec-Manufacturing-4-year-plan-19-20.pdf

Industrial Technology – Occupational Safety Option:

https://www.abe.iastate.edu/files/2020/03/ITec-Occupational-Safety-4-year-plan-19-20.pdf

<u>Applications of Mathematics, Science, and written and oral communications in Technical and Management Courses</u>

Applications of the principles of mathematics and science are incorporated into many of the required and elective General Education and professional courses in the options of the Industrial Technology and Agricultural Systems Technology programs. Virtually all of Technical Core courses incorporate applications of principles of mathematics, science, and written and oral communication. Individual course syllabi for each TSM course are located in the Appendix A.

The syllabi provide more information about the applications of mathematics, science, and written and oral communication in each of the courses. All departmental classes require written and/or oral communication skills. While most homework assignments will require the ability to effectively communicate and justify the reason for a given response, a greater emphasis on communication skills are evaluated in activities such as semester projects, laboratory reports, and class presentations. The written and oral communication skills of students have particular emphasis in capstone classes. Examples include:

1. TSM 116 - *Introduction to Design in Technology,* and TSM 216 - *Advanced Technical Graphics, Interpretation, and CAD,* require the use mathematical skills in geometry and trigonometry to construct two and three-dimensional files.
2. TSM 210 - *Fundamentals of Technology*, requires solving both single and simultaneous algebraic equations for situations involving energy, power, simple machines, psychrometrics, ventilation, electricity and the time value of money. Unit conversions and a solid understanding of significant figures are necessary.
3. TSM 240 - *Introduction to Manufacturing Processes for Metals,* uses both science and mathematics extensively. The course covers the chemical and physical properties of materials used in manufacturing metals.
4. TSM 241 – *Introduction to Manufacturing Processes for Plastics*, uses science and mathematics principles extensively to learn about materials and processes related to plastics. The course addresses chemical and physical properties of materials used in manufacturing plastics.
5. TSM 270 - *Principles of Injury Prevention,* introduces the uses and interpretations of safety statistics. Students learn to calculate injury and death rates. Discussions of many of the safety topics, from fire prevention to ergonomics, have a scientific basis.
6. TSM 310 – *Total Quality Improvement,* introduces quality tools and statistical process control (SPC). Problem solving, logic and management practices are built on foundations of statistical theory.
7. TSM 322 - *Preservation of Grain Quality*, requires solving both single and simultaneous algebraic equations for psychrometrics, drying, and material and energy balances. Unit conversions are frequently used.
8. TSM 322L - *Preservation of Grain Quality Laboratory,* requires the application of trigonometry to design grain equipment layout and understand equipment design, based on material angle of repose and other trigonometry and analytical geometry concepts. Unit conversions and mathematical concepts are frequently used.

9. TSM 324 - *Soil and Water Conservation Management*, introduces students to mathematical models to describe the movement of soil and water across agricultural landscapes. Most of these models are simple in structure, and yet describe the fundamental scientific relationships with enough accuracy to allow for assessment of the impact of management practices.
10. TSM 330 - *Agricultural Machinery and Power Management*, builds on the foundation provided by the core business courses to provide students the ability to make complete economic and cost analyses of agricultural machinery systems.
11. TSM 335 - *Tractor Power*, provides a broad understanding of technologies and operations of mechanical power systems, employing mathematics and scientific principles as the basis for calculations.
12. TSM 337 -*Fluid Power Systems Technology,* provides an understanding of the technologies and operations utilized in fluid power circuits and systems, requiring mathematical and scientific problem-solving.
13. TSM 340 - *Advanced Automated Manufacturing Processes,* uses scientific and mathematical principles to optimize machining operation based on material properties and the calculations of cutting forces and energy consumptions.
14. TSM 363 - *Electrical Power Systems and Electronics for Agriculture and Industry,* requires the use of algebra, trigonometry, and calculus for calculations on circuit analysis problems. Whether analyzing DC or AC circuits, mathematics and scientific concepts are an integral part of each student's experience. This course also requires the use of concepts from Boolean algebra and binary, octal, decimal and hexadecimal number systems.
15. TSM 370 - *Occupational Safety,* uses both mathematics and science to evaluate workplace hazards and test mitigation strategies.
16. TSM 415 – *Applied Project Management in Technology,* requires students to use written and oral communications in their proposal development. The formation of project teams, project and problem definition, and connection with project clients requires extensive communication skills and the ability to solve open-ended technology problems.
17. TSM 416 - *Technology Capstone*, continues the team communications and responsibilities from the earlier semester of TSM 415. Student teams use a variety of communication skills during presentation of project through oral presentations, written reports, and numerous correspondences with project clients.
18. TSM 443 - *Statics and Strength of Materials for Technology,* integrates physics concepts in the calculation of problems in statics and strength of materials. Also, physics concepts are utilized in vector analysis.
19. TSM 444 - *Facility Planning*, uses science and mathematics to calculate takt time, process time, cost information for product and facility, personal allowance, time study for standard time, numbers of operators and machines to optimize the facility design.
20. TSM 470 - *Industrial Hygiene,* is based on the appropriate sciences, including biological and chemical. Specifically, the course includes units related to radiation, heat stress, ergonomics, noise, and ventilation.

6.4 - Further, sequencing should ensure that advanced level courses build upon concepts covered in beginning level courses.

6.4. Sequencing Should Ensure that Advanced Level Courses Build Upon Concepts Covered in Beginning Level Courses

The TSM advanced level courses build upon concepts covered in beginning level TSM courses and other departmental courses (like STAT, CHEM, PHYS, and MATH) required for the four program/options. Examples include:

1. TSM 216 - *Advanced Technical Graphics, Interpretation, and CAD* provides more depth in areas of design and documentation, which were introduced in TSM 116, Introduction to Design in Technology. As well as introduces new concepts related to Technical Graphics. New CAD techniques and commands are also included.
2. TSM 310 – *Total Quality Improvement* builds on content addressed in introductory statistics (STAT 101/104) to measure, manage, and control quality in products, services, and processes. Students continue to apply skills learned in TSM 310 *Total Quality Improvement*, in TSM 440 *Cellular Lean Manufacturing Systems* and the capstone series TSM 415/416.
3. TSM 335 - *Tractor Power*, builds on the foundation provided by TSM 210 - *Fundamentals in Technology* to expand on the students understanding and knowledge of engine technology, mechanical power transmission and traction. In conjunction with TSM 330 - *Agricultural Machinery and Power Management*, TSM 433 - *Precision Agriculture*, and TSM 337 - *Fluid Power Systems Technology*, students are provided with a broad and in-depth understanding of important technologies involved in modern machinery systems within the agricultural, construction and off-road industry.
4. TSM 337 - *Fluid Power Technology*, builds upon students' understanding of the fundamentals of technology and ability to solve problems, taught in TSM 210, *Fundamentals of Technology*, and TSM 115, *Solving Technology Problems*, in order to analyze fluid power systems used in technology applications.
5. TSM 340 - *Advanced Automated Manufacturing Processes*, builds on knowledge of 2D and 3D design modeling and productivity tools for manufacturing taught in TSM 216 *Advanced Technical Graphics, Interpretation, and CAD*, and the knowledge of material selection and manufacturing processes taught in TSM 240 *Introduction to Manufacturing Processes* to develop NC programming operations for advanced CNC machines, and transfer parts descriptions into detailed process plans, tool selection, and NC codes using CAD/CAM software.
6. TSM 370 - *Occupational Safety* builds upon students' understanding of safety and injury prevention techniques taught in TSM 270 - *Principles of Injury Prevention* and the safety management principles taught in TSM 371 - *Occupational Safety Management* in order to eliminate or control hazards found in industrial work environments.
7. TSM 372 - *Legal Aspects of Occupational Safety and Health* builds upon students' understanding of safety management principles taught in TSM 371 - *Occupational Safety Management* in order to fully understand the legal responsibilities of safety professionals

and to develop safety programs that comply with the legal requirements of OSHA, EPA, and DOT regulations.

8. TSM 415 – *Applied Project Management in Technology* and TSM 416 *Technology Capstone* bring together the experiences of *TSM 214 Managing Technology Projects* and the internship experience *TSM 397 Internship in Technology* along with the all the course work and demonstrates these skills through a team project.
9. TSM 440 - *Cellular Lean Manufacturing Systems,* builds upon students' understanding of quality aspects in manufacturing, taught in TSM 310 *Total Quality Management*, and the CNC aspects of machining, taught in TSM 340 *Advanced Automated Manufacturing Processes*, in order to design one-piece flow in cellular manufacturing systems with lean implementation for eliminating wastes.
10. TSM 443 - *Statics and Strength of Materials for Technology*, builds upon student understanding of concepts taught in MATH 151 and PHYS 111 to use analytical techniques in solving problems related to force, moments, stresses, and angular deformation.
11. TSM 444 - *Facility Planning*, build on the knowledge learned from CAD design in TSM 216 *Advanced Technical Graphics, Interpretation, and CAD* to design a manufacturing related facility in a 2D setting, and from manufacturing materials and processes learned from TSM 240 *Introduction to Manufacturing Processes* in order to develop a facility with the purpose of its optimization. An introductory statistics course (STAT 101 or 104) is pre-required for TSM 444 for students to use statistical analysis for better time standard results.
12. TSM 465 - *Automation Systems,* is built upon student fundamental knowledge about electricity, wiring, controls, digital logic circuit, and commonly used industrial sensors, taught in TSM 363 *Electric Power and Electronics for Agriculture and Industry*, to equip students with knowledge and system development skills in industrial automation.
13. TSM 470 - *Industrial Hygiene: Physical, Chemical, and Biological Hazards*, utilizes principles of occupational safety, thought in TSM 371 Occupational Safety Management, and TSM 370, *Occupational Safety*. It also includes knowledge gained in CHEM 163 and CHEM 163L to assess adverse health effects due to exposure to physical, chemical, and biological hazards.
14. TSM 477 - *Risk Analysis and Management*, takes a risk-based approach to safety analysis of complex systems, their interaction with human and with the environment that utilizes a variety of statistical and mathematical tools; thus, background courses such as MATH 151, and STAT 101 or STAT 104 are appropriate. In addition, comprehensive knowledge on adverse health effects of physical, Chemical, and biological hazards as provided in TSM 470 *Industrial Hygiene: Physical, Chemical, and Biological Hazards* is essential.

The course sequence of required courses TSM 110 - *Introduction to Technology*, TSM 111 - *Experiencing Technology*, TSM 201 - *Preparing for Workplace Seminar*, TSM 214, *Managing Technology Projects*, TSM 397 - *Internship in Technology*, and TSM 399 - *Work Experience in Technology,* addresses students' personal and professional development across the breadth of their academic experience. In all of these courses, the focus is on competency development and demonstration.

- The freshmen coursework, TSM 110 *Introduction to Technology* and TSM 111 *Experiencing Technology* focus on transitioning from high school to college. Freshmen students learn skills and strategies necessary for success at the college level, are introduced to competencies, and have hands-on experiences with various technology topics to introduce students to the field of technology.
- The sophomore courses prepare students for one of their first professional experiences in an internship. Competency development and demonstration is a major focus of second year courses, especially as they relate to the course topics. TSM 201 – *Preparing for the Workplace Seminar*, further prepares students for professional practice. TSM 214 – *Managing Technology Projects*, introduces students to project management concepts to prepare them for their internship and professional experiences.
- The internship and work experience courses. TSM 397, *Internship in Technology* and TSM 399, *Work Experience in Technology*, prepare students for the transition to professional life. Concepts of leadership and ethics are explored and emphasized, along with competency development and demonstration. Students must document their achievements through self-reflection and assessment.
- Junior and senior level courses focus on skill attainment and application of scientific and mathematical principles learned in fundamental courses. The capstone course sequence (TSM 415 and TSM 416) blends the technical and disciplinary background of the 300 and 400-level courses with project management (introduced in TSM 214) and professional development skills such as communication.

All four options have a significant number of upper level courses that build upon lower level courses. The Agricultural System Technology – Agriculture and Biosystems Management Option has 11 upper level courses. The Agricultural System Technology – Machine Systems Option has 12 upper level courses. The Industrial Technology – Manufacturing Option has 14 upper level courses. The Industrial Technology – Occupational Safety Option has 10 upper level courses.

Each option has several credits of electives. These electives are often used to gain in-depth understanding in an area of emphasis and vary by student professional interest. Often these elective courses have prerequisites that build on lower level courses as well.

Standard 7

Standard 7 - Student Admission and Retention Standards: There shall be evidence showing that the quality of technology, management, and applied engineering students is comparable to the quality of students enrolled in other majors at the institution. Additionally, the standards for admission and retention of technology, management, and applied engineering students shall compare favorably with institutional standards. (Sources of admission information may include test scores and grade rankings. Sources of retention information shall include general grade point averages of technology, management, and applied engineering students compared to students in other institutional programs).

SUMMARY RESPONSE

Iowa State University admissions programs are "major blind" – that is, the same criteria for admission are used for all undergraduate degree programs at the institution. Similarly, academic probation guidelines are the same across the institution. Thus, the admission and retention standards are identical to institutional standards. An examination of average GPA at graduation shows that two of the four programs are essentially identical to the college average, while two others are slightly lower. In the two latter programs, a large fraction of students includes transfer students (ISU students switching majors) who sometimes earn a low GPA in another major prior to transferring.

DETAILED RESPONSE

Iowa State University and the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) welcome applications for admission from qualified individuals regardless of race, creed, color, national origin, age, orientation, or disability. The University seeks highly motivated candidates whose academic achievements and personal commitments indicate success in an undergraduate academic program.

Student Admission Standards

Student admission standards for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) are identical. The four options follow the university admissions standards provided in the on-line catalog (extracted from http://catalog.iastate.edu/admissions/ and are also available at http://www.admissions.iastate.edu/freshman/requirements.php) and presented below:

Admission decisions are made by admissions officers in accordance with the entrance requirements as set forth in the Iowa Administrative Code as well as the admission policies established by the Faculty Senate.

Students who seek admission must meet the following requirements and also any special requirements for the college or curriculum of their choice.

Applicants must submit an application for admission and the appropriate application fee (see www.admissions.iastate.edu for current application fee information). In addition, applicants must have their secondary school provide an official final transcript of their academic record, including cumulative grade point average, rank in class, and certification of graduation.

Applicants must also arrange to have their ACT or SAT scores reported to Iowa State University directly from the testing agency. U.S. citizen and immigrant applicants who have not graduated from an approved U.S. high school and whose primary language is not English must meet university communication proficiency requirements. This can be accomplished by achieving satisfactory scores on the Test of English as a Foreign Language (TOEFL), the International English Language Testing System (IELTS), or the SAT. Contact the Office of Admissions for minimum score requirements for each examination. Applicants may be required to submit additional information or data to support their applications.

Graduates of approved Iowa high schools who have the subject-matter background required by Iowa State University and who achieve less than a 245 RAI score will be considered for admission on an individual basis.

The RAI score will be calculated for each applicant based on the following equation:

(3 x ACT composite score or converted SAT score)

+ (30 x high school GPA)

+ (5 x number of years of high school core courses completed)

= RAI Score

Note: For purposes of calculating the RAI, SAT scores will be converted to ACT composite equivalents; high school GPA is expressed on a 4-point scale; and number of high school courses completed in the core subject areas is expressed in terms of years or fractions of years of study.

Applicants from high schools that do not present all four of the factors required for calculation of the RAI score will be considered for admission on an individual basis.

Those applicants who are not offered unconditional admission will either be given the opportunity to enroll for a trial period during the preceding summer session or be denied admission.

Nonresidents of Iowa, including international students, may be held to higher academic standards, but must meet at least the same requirements as resident applicants. Applicants who are graduates of non-approved high schools will be considered for admission in a manner similar to applicants from approved high schools, but additional emphasis will be given to scores earned on standardized examinations.

Applications may be considered from students who did not graduate with their high school classes. They will be required to submit all academic data to the extent that it exists and achieve scores on standardized examinations which will demonstrate that they are adequately prepared for academic study. Students with satisfactory academic records may be admitted, on an individual basis, for part-time university study while enrolled in high school or during the summers prior to high school graduation. Exceptional students may be admitted as full-time students before completing high school. Early admission is provided to serve persons whose academic achievement and personal and intellectual maturity clearly suggest readiness for college-level study.

Student Retention Standards

Once a student is on campus at Iowa State University, the faculty and staff work diligently to keep students at the University until graduation. The university community dedicates itself to develop and maintain high-quality instructional programs that provide each student with the opportunity for personal success. Retention of our students until they graduate requires quality education and support programs. To this end, Iowa State University faculty and staff encourage students to meet with faculty and advisors early and often. Students are also encouraged to use the academic support programs that are readily available. Learning communities, tutors, help sessions, student counseling service, Academic Success Center, and learning skills development programs all influence retention. These are examples of resources provided at Iowa State University to help students succeed in their chosen field of study. (http://www.dso.iastate.edu/asc)

Iowa State University's academic policy states that the instructor shall inform the students at the beginning of each course of the evaluation procedures planned for use in the course. The grading system is outlined in the 2019-2020 Iowa State University catalog. (http://catalog.iastate.edu/academiclife/gradingsystem/gradingsystem.pdf)

Grades issued to students are compiled by the Office of the Registrar to compute the student's semester grade point average (GPA) and an accumulated GPA. Academic standing, probation, and honors are based on the calculation of GPAs. Quality points based on letter grade received per credit hour are given in Table 7.1. Credits earned with P, S, or T are not used in calculating the grade point average but may be applied toward meeting degree requirements.

Table 7.1 Iowa State University letter grade and quality points per credit hour assignment

Grade	Quality	Grade	Quality
A	4.00	C	2.00
A-	3.67	C-	1.67
B+	3.33	D+	1.33
B	3.00	D	1.00
B-	2.67	D-	0.67
C+	2.33	F	0.00

The academic progress of students in the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs are monitored closely by departmental academic advisors. The College of Agriculture and Life Sciences also is responsible for monitoring the academic progress of undergraduate students based on policies and minimum requirements set by the Faculty Senate Committee on Academic Standards and Admissions and ratified by the Faculty Senate.

Quality of Students

The scholastic success of students in the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs are comparable to that of students throughout the College of Agriculture and Life Sciences and Iowa State University. Data from the Office of Institutional Research and the Office of the Registrar show that average GPAs of students in all four options programs compare favorably with GPAs of students from the College of Agriculture and Life Sciences and Iowa State University as a whole. See Table 7.2 for the data from 2016 to 2019.

The lowest average cumulative GPA at graduation was 2.81 for the ITEC-M option students in Fall 2017 semester. The highest average cumulative GPA at graduation was 3.27 achieved by AST-ABM option students in the Spring 2017 and Spring 2018 semesters and AST-MS option students in the Spring 2018 semester. There is little variance in the average cumulative GPAs at graduation for all four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) students.

Table 7.2 Comparison of average cumulative GPAs at graduation for students in all four program options and students in the College of Agriculture and Life Sciences (CALS) and at Iowa State University: Fall 2016 to Fall 2019

Term	University Student GPA	CALS Student GPA	AST-ABM Student GPA	AST-MS Student GPA	ITEC-M Student GPA	ITEC-OS Student GPA
Fall 2016	3.01	2.92	3.4 (4)	2.95 (15)	3.02 (28)	N/A
Spring 2017	3.06	2.98	3.27 (12)	2.98 (39)	2.89 (30)	3.08 (1)
Fall 2017	3.03	2.95	2.64 (2)	3.03 (12)	2.81 (26)	2.82 (6)
Spring 2018	3.09	3.02	3.27 (6)	3.27 (20)	2.88 (47)	2.92 (6)
Fall 2018	3.08	3.02	3.02 (3)	2.7 (19)	2.83 (19)	3.26 (6)
Spring 2019	3.11	3.06	3.09 (12)	3.1 (20)	3.09 (45)	3.24 (4)
Fall 2019	3.11	3.07	3.23 (3)	3.06 (17)	2.98 (22)	2.90 (7)
Combined Average	3.07	3.00	3.20	3.05	2.94	3.00

1 Number in ( ) is number of graduated students in that option.

2 NA is not available because the small number of graduates prevented release of the data by the University.

Standard 8

Standard 8 - Transfer Course Work: The institution shall have policies in place to ensure that coursework transferred to the program is evaluated and approved by program faculty

SUMMARY RESPONSE

ISU has standard guidelines for allowing transfer credit for courses in math, English, and other core areas. Essentially, if the institution at which the courses were taken is accredited, and if the offering department has established equivalency, credit is given. For more program specific coursework, the four options follow a departmental policy for validating transfer credits. In this way, all four options programs ensure that transfer coursework meets rigor and content standards.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department follows standardized university policies for coursework being transferred. The various steps for transfer of course work is the same for all four options programs and is reported below.

Transfer Credit Evaluation

Courses from regionally accredited post-secondary institutions will normally transfer to Iowa State if they are comparable to courses offered for academic credit here or would earn academic credit if they were offered.

In general, college-level courses in which passing grades have been earned are acceptable for transfer to the University; some departments may require at least a "C" grade for a specific course to be applied to the degree program.

Transcripts for courses taken at other universities/colleges must be sent to the Office of Admissions, 100 Enrollment Services Center, Ames IA 50011-2011 to be considered for transfer.

http://www.registrar.iastate.edu/students/transfercredit

New Student Transferring Credit

Courses from regionally accredited post-secondary institutions will normally transfer to Iowa State if they are comparable to courses offered for academic credit here or would earn academic credit if they were offered. These courses must have a passing grade to be acceptable for transfer to Iowa State University. Some departments may require at least a “C” grade for specific course to be applied to the degree program. The Office of Admissions reviews the coursework taken at another institution to determine whether the courses are acceptable for transfer. A Transfer Credit Evaluation form indicating which courses have been accepted for transfer will be returned with an offer of admission letter.

http://www.admissions.iastate.edu/transfer_credit.php

Current/Continuing Students Transferring Credit

Current students who have taken courses at another institution since enrolling at Iowa State need to submit an official transcript to the Office of Admissions in order to receive credit. The Registrar's Office will complete a transfer credit evaluation. How the credit applies toward the student's degree program will be determined by his/her academic adviser.

http://www.registrar.iastate.edu/students/transfercredit

Military Service Students

Continuing and reentry students serving in the military will be awarded credit for successful completion of technical or specialized schools attended while on active duty with the armed forces to the extent that the material is applicable toward degree requirements at Iowa State University. Application for such credit is made through the Office of the Registrar by submitting just your JST transcript.

http://www.admissions.iastate.edu/military/credit.php

Course Equivalency Guides

There are course equivalency guides for community college in Iowa, and select community colleges in Illinois, and Minnesota. These guides list how each of those courses corresponds to courses offered at Iowa State University. These guides are date specific and when the course was taken also influence the transfer of credit. Guides will:

- provide Iowa State University course identifiers and number when there is a direct equivalent
- use 100- or 200- or a 1T** or 2T** for courses that are not directly equivalent
- allow a maximum of sixteen semester hours of CAREER/TECH credits to be transferred to Iowa State University

http://www.admissions.iastate.edu/equiv/index.php

College Transfer Plans

The Agricultural and Biosystems Engineering (ABE) department participates in the college transfer plan program to assist transfer students in finding those courses that meet the requirements for the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs. These plans are subject to change and it is recommended to confirm any transfer with an academic advisor.

https://www.admissions.iastate.edu/transfer/plans.php

The ABE department's college transfer guides are mainly for the Iowa community college courses. The transfer guides for AST-ABM and AST-MS options are listed as Agricultural System Technology and the transfer guides for ITEC-M and ITEC-OS options are listed as Industrial Technology because the course work covered in these guides is general enough to be valid for more than one option.

http://www.abe.iastate.edu/prospective-students/transfer-guides/

Departmental Policy for Validating Transfer Credits

If a transfer course has not already been approved and included in the university's transfer equivalency guide or the departmental transfer plans, then the department handles these courses on an individual basis using the following process:

1. The student will provide a copy of the syllabus for the transferred course to the academic advisor for pre-approval and then to the chair of the ABE Technology Curriculum Committee.
2. The chair of the ABE Technology Curriculum Committee will send the syllabus to the appropriate faculty member(s) based on the content of the course and request feedback concerning how the transfer course fits into departmental curriculum and which department course (if any) would the transfer course serve as an appropriate substitution.
3. The chair then brings the faculty recommendation to the ABE Technology Curriculum Committee for discussion and action.
4. If the appropriate faculty member(s) and the ABE Technology Curriculum Committee consider the new transfer course to be equivalent to a departmental course, then the committee approves the use of that course for that student. If the committee deems the course to be equivalent to, or a reasonable substitution for, a departmental course, the committee may also decide to initiate action to have that course added to the university transfer course equivalency guide.

Standard 9

Standard 9 - Student Enrollment: Program enrollment shall be tracked and verified. There shall be evidence of an adequate number of program majors to sustain the program, and to operate it efficiently and effectively, as defined by your state or institution standards.

SUMMARY RESPONSE

Student enrollments in each option program have been in the following ranges during the past five years: AST-ABM – 31 to 39; AST-MS – 113 to 177; ITEC-M – 222 to 261; ITEC-OS – 18 to 32. The recent trend has been toward stable enrollments, with some program options seeing slight increases or decreases. Although the university and department intentions are not to offer courses with an enrollment below 15 undergraduates, student numbers in all required classes have been sufficient to allow classes to be offered without disruption.

DETAILED RESPONSE

In 2015 and 2016, Iowa State University enrollment reached its peak, at 36,001 and 36,550, respectively. Since 2017, total enrollment has decreased from over 36,000 to 33,391 students in the fall of 2019 (Source: 2019-2020 Iowa State University Factbook). During that same time, total enrollment in departmental programs has increased slightly, with small increases noted in the ITEC program (ITEC-M and ITEC-OS). Enrollment in both the AST programs (AST-ABM, AST-MS) has decreased modestly. Even with the decrease in the AST degree program, all four option programs have maintained an adequate number of program majors to both sustain the program and operate it efficiently and effectively. All required and elective courses are being taught with full classes, and no required classes for any of the four options have been cancelled due to low student enrollment.

The combined totals of the undergraduate students in the four option (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs position the ABE department as the third largest undergraduate enrollment of the 15 departments in the College of Agriculture and Life Sciences for 2019-2020, making up nearly 11% of the undergraduate college enrollment (https://www.registrar.iastate.edu/enrollment/enrollment-by-major).

Table 9.1. Students[1] by option in AST and ITEC degree programs: Fall 2014 to Fall 2019

	Fall 2014	Fall 2015	Fall 2016	Fall 2017	Fall 2018	Fall 2019
AST Degree						
AST-ABM	43	39	38	35	31	38
AST-MS	142	169	177	153	131	113
AST-OU*	40	10	0	2	13	16
AST-Total	225	218	215	190	175	167
ITEC Degree						
ITEC-M	172	222	245	261	253	248
ITEC-OS	14	18	16	32	32	26
ITEC-OU*	47	21	0	0	0	0
ITEC-Total	233	261	261	293	285	274
Combined Total	458	479	476	483	460	441

[1] Numbers were requested from Records & Registration office.
* OU is option unspecified by the student but the degree is selected.

Option Enrollment data

Figure 9.1 illustrates the enrollment trends for the AST-ABM, AST-MS, and AST-with option unspecified programs since 2014. The average enrollment in AST-ABM program during the five-year period (2014-2019) was 37 students, a reduction in the past five years. The average enrollment in AST-MS program during the five-year period (2014-2019) was 148 students, an increase in the past five years. Not all students select an option upon entering the AST program. These AST degree-seeking students are tracked as option unspecified until they select an option, typically by the end of the first year. The number of students seeking an AST degree with an unspecified option has decreased but this unspecified option group remains significant enough to track with an average of 14 students.

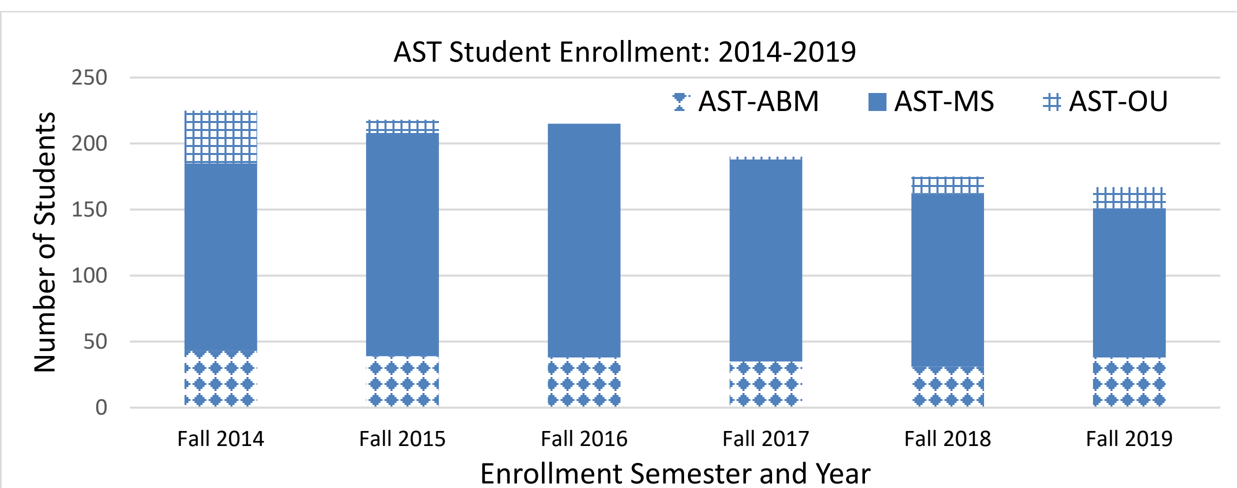

Figure 9.1. Students by option in AST degree programs: Fall 2014 to Fall 2019

Figure 9.2 illustrates the enrollment trends for the ITEC-M, ITEC -OS, and ITEC -with option unspecified programs since 2014. The average enrollment in ITEC-M program during the five-year period (2014-2019) was 137 students, an increase in the past five years. The average enrollment in ITEC -OS program during the five-year period (2014-2019) was 15 students, which has remained stable during the last five years. Not all students select an option when they enter the ITEC program. These ITEC degree-seeking students are tracked as option unspecified until they select an option, typically by the end of the first year. The number of students seeking an ITEC degree with an unspecified option has varied and has been at zero the last three years. Because the number of students who enter the ITEC program as freshmen is small, very few students enter the major without declaring an option. For this reason, continued measurement of "option unspecified" ITEC students may not continue in the future.

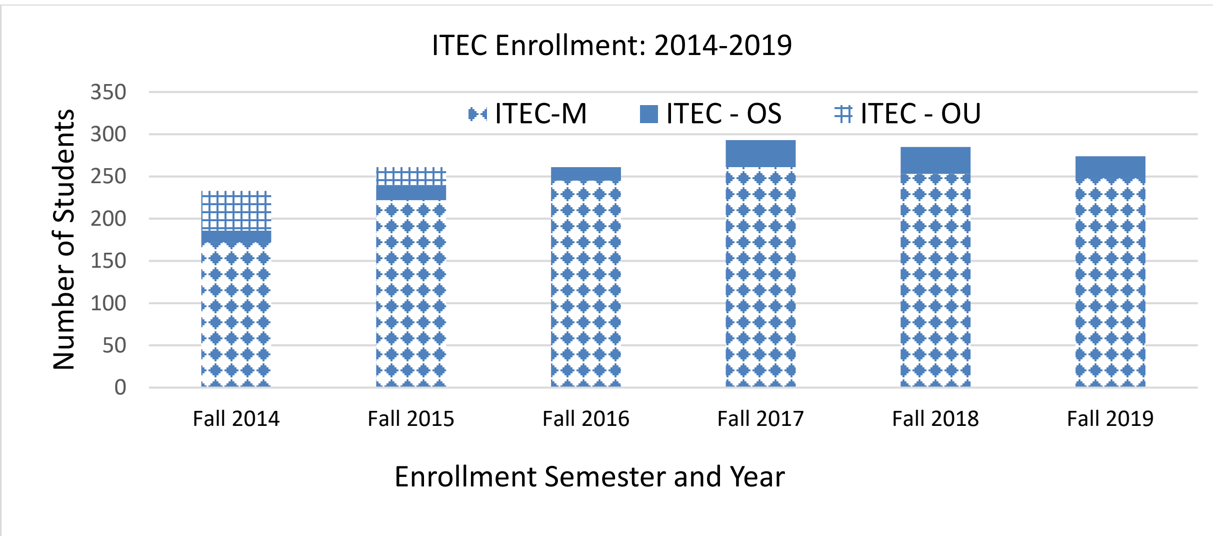

Figure 9.2 Students by option in ITEC degree programs: Fall 2014 to Fall 2019

Standard 10

Standard 10 - Administrative Support & Faculty Qualifications: There must be evidence of appropriate support from the institution for the technology, management, and applied engineering program/option.

> **10.1 -** Appropriately qualified administrators are assigned to the program/options.
>
> **10.2 -** An adequate number of appropriately qualified full-time faculty members are available and assigned to teach courses in the technology, management, and applied engineering program/option.
>
> **10.3 -** Full time faculty qualifications shall include emphasis upon the extent, currency and pertinence of: (a) academic preparation; (b) industrial professional experience (such as technical supervision and management); (c) practical business experience using applied technology; (d) membership and participation in appropriate technology, management, and applied engineering professional organizations; and (e) scholarly activities. The following minimum qualifications for full time faculty are required (except in unusual circumstances which must be individually justified):
>
> > B. Bachelor’s Degree: The minimum academic qualifications for tenure track, or full-time faculty members shall be an earned graduate degree in a discipline closely related to the instructional assignment. A minimum of fifty percent of the tenure track, or full-time, faculty members assigned to teach in the program of study content area(s) shall have an earned doctorate or other appropriately earned terminal degree as defined by the institution. Exceptions may be granted to this standard if the institution has a program in place that will bring the faculty demographics into compliance within a reasonable period of time.
>
> **10.4 -** Policies and procedures for faculty selection, appointment, reappointment and tenure shall be clearly specified and shall be conducive to the maintenance of high-quality instruction. This should include policies and procedures for the selection and reappointment of part-time/adjunct faculty.
>
> **10.5 -** Faculty teaching, advising, and service loads shall be reasonable and comparable to the faculty in other professional program areas.
>
> **10.6 -** Appropriate criteria shall be in place to assure part time or non-tenure track faculty are highly qualified to deliver and evaluate student performance in courses assigned.

SUMMARY RESPONSE

There is a high-level of institutional support for all four program options. Financial support is in excess of $4,000 per student per year when base budget and differential tuition fees are considered. Additional evidence of the value of the program to top administration comes in the form of the key roles that the College of Agriculture and Life Sciences and College of Engineering Deans played in securing funding for the $74M facility where ABE programs are now housed (62% of the undergrad ABE population are in the four program options relevant to this self-study). Support is also evidenced by the human resources which the ABE department commits toward the program. For example, the seven-faculty-member curriculum committee that oversees all four options programs is populated by highly qualified and successful faculty members dedicated to student learning and curricular excellence. Tenured/tenure-eligible faculty with industrially-relevant research and extension programs and term teaching faculty with strong industrial backgrounds provide the core instruction for all four program options. Additionally, adjunct faculty members who are currently employed in relevant industries also participate in departmental teaching activities.

DETAILED RESPONSE

10.1 Qualified Administrators

The Agricultural Systems Technology (AST) and Industrial Technology (ITEC) programs are administered by the Department of Agricultural and Biosystems Engineering (ABE), which is chaired by Dr. Steven K. Mickelson. The chair is responsible for appointing an Associate Chair for Teaching, to provide support for all four BS degree programs offered by ABE. Dr. Amy Kaleita-Forbes, as the Associate Chair for Teaching, advises the chair on course scheduling, teaching assignments, and other issues related to the undergraduate programs. The department chair also appoints the Chair and Vice-Chair of the ABE Technology Curriculum Committee (TCC), which oversees the AST and ITEC degree program and program options. In consultation with the ABE TCC Chair, the department chair annually assigns faculty members to the ABE TCC. Although these roles are up for renewal annually, the general practice on the ABE ECC is to have dedicated faculty who willingly serve for multiple years.

All substantive departmental curricular decisions, including those related to course substitutions, are the jurisdiction of the faculty membership of the ABE Technology Curriculum Committee as a whole. To ensure the quality of the program, membership on the ABE TCC consists of faculty members who have been recognized at multiple levels (departmental, college, university, and nationally) for their teaching abilities, and who are committed to a vision of excellence for the department’s technology programs. ABE Technology programs prioritize an understanding of how scientific and mathematical principles can be leveraged to meet critical human needs in technology a through hands-on, career-relevant instruction.

The ABE department Technology Curriculum Committee chair and vice-chair have primary responsibility for program leadership. This includes overseeing the continuous improvement process, authoring the ATMAE self-study report, and running and documenting meetings of the ABE Technology Curriculum Committee. In addition, the ABE department Engineering Curriculum Committee chair also has primary responsibility for overseeing edits to the course catalogs – which are the “contract” with our students – and for signing on student substitution forms. Able assistance in execution of these last two tasks is provided by the three professional academic advising staff members, who serve in non-voting roles on the ABE Technology Curriculum Committee, while decisions on substitutions and curricula are made by voting members of the ABE Technology Curriculum Committee.

10.2 Adequate Number of Full Time Faculty Members

The faculty in the Agricultural and Biosystems Engineering Department consist of 37 professionals with full-time appointments. All of these faculty members are active within their profession and are strongly committed to their students, department, colleges, and the university. Additionally, 26 ISU faculty in other departments or in industry have courtesy appointments in ABE due to their close interdisciplinary work and collaborations with ABE faculty. The primary responsibility for teaching TSM courses for the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs rests with 25 departmental professionals that include full-time tenured/tenure-eligible faculty, term teaching faculty, and advisers, although every faculty member has interactions with students in the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS).

All faculty members are associated with one of five major research focus areas with several faculty members straddling more than one area. There is significant faculty expertise in the Advanced Machinery Engineering and Manufacturing Systems research focus group, whose members teach the majority of the technology discipline-specific coursework for three options (AST-ABM, AST-MS, and ITEC-M) programs. Faculty in the Occupational Safety Engineering research focus group also teach critical courses in the curriculum for the program option in ITEC, occupational safety (ITEC-OS). In addition, they are playing a lead role in current departmental and college level efforts to improve lab and shop safety protocols and are assisting with the launch of an online safety system that monitors students' use of laboratory equipment and tools.

The level of faculty experience is high, totaling over 275 person-years of industrial experience and over 640 person-years of faculty (teaching) experience. Table 10.1 summarizes our current faculty qualifications including the highest level of degree earned, rank, appointment, and years of experience. Two-page resumes of all our faculty members are included in Appendix B.

The faculty are highly engaged with students as demonstrated by their mentoring of capstone teams, involvement with research experience for undergraduate student programs, participation at learning community activities, and attendance at student club events and departmental socials.

Table 10.1. Agricultural and Biosystems Engineering department current faculty qualifications.

Faculty Name	Highest Degree Earned, Field, and Year	Rank[1]	Type of Academic Appointment[2]	FT or PT[3]	Years of Experience		
					Government or Industry Practice	Teaching	At Iowa State University
Andersen, Daniel	Ph.D. AE 2012	AP	T	FT	1	2	2
Anderson, Michael	M.S. AE 1979	PP	Term	FT	31	5	5
Bell, Steven	M.S. Constr Mgmt 1981	ATP	Term	FT	33	7	4
Birrell, Stuart	Ph.D. AE 1995	P	T	FT	0	27	21
Brumm, Thomas	Ph.D. AE 1990	AP	T	FT	9	21	26
Cook, Samuel	M.S. Grain Science 2015	ASTP	TE	FT	8	7	4
Darr, Matthew	Ph.D. Ag & BE 2007	P	T	FT	5	11	11
Eisenmann, David	Ph.D. MSE 2015	ASTP	Term	FT	20	19	1
Freeman, Steven	Ph.D. AE 1993	UP	T	FT	0	27	22
Harmon, Jay	Ph.D. AE 1989	P	T	FT	0	30	27
Haughery, John	Ph.D. Industrial & Ag Tech 2017	ASP	TE	FT	8	7	5
Helmers, Matthew	Ph.D. Ag & BE 2003	P	T	FT	0	0	16
Hoffman, Russell	M.S. Industrial Technology 2006	ASTP	Term	FT	15	2	9
Howe, Adina	Ph.D. Environmental Eng.2009	ASP	TE	FT	4	3	3
Hurburgh, Charles	Ph.D. AE 1981	P	T	FT	4	25	43
Kaleita, Amy	Ph.D. AE 2003	P	T	FT	1	16	16
Kanwar, Ramesh	Ph.D. AE 1981	DP	T	PT	0	50	43
Keren, Nir	Ph.D. Interdisciplinary Eng 2003	AP	T	FT	19	13	13
Koziel, Jacek	Ph.D. Civil Eng 1998	P	T	FT	0	17	14
Maier, Dirk	Ph.D. AE 1992	P	T	FT	10	28	4
McNaull, Robert	Ph.D. ABE 2016	O	Term	FT	13	6	6
Mickelson, Steven	Ph.D. AE 1991	P	T	FT	1	37	37
Misra, Manjit	Ph.D. AE 1978	P	T	FT	0	19	40
Mosher, Gretchen	Ph.D. Industrial & Ag Tech 2011	AP	T	FT	0	17	11
Peschel, Joshua	Ph.D. Computer Science 2012	ASP	TE	FT	10	19	2
Raman, D. Raj	Ph.D. BE 1994	MP	T	FT	2	22	9
Ramirez, Brett	Ph.D. ABE 2017	ASP	TE	FT	1	7	4
Rosentrater, Kurt	Ph.D. AE 2001	AP	T	FT	14	11	9
Ryan, Saxon	M.S. Industrial & Ag Tech 2016	ASTP	Term	FT	3	6	6
Schwab, Charles	Ph.D. AE 1989	P	T	FT	0	33	25
Shahan, James	M.S. AE 1985	A	Term	FT	10	36	38
Shepherd, Tim	M.S. AE 2007	ATP	Term	FT	5	5	9
Soupir, Michelle	Ph.D. BSE 2008	AP	T	FT	1	12	12
Steward, Brian	Ph.D. AE 1999	P	T	FT	5	22	20
Tang, Lie	Ph.D. AE 2002	AP	T	FT	2	17	15
Tekeste, Mehari	Ph.D. AE 2006	ASP	TE	FT	8	7	4
Tim, U. Sunday	Ph.D. Environmental Eng. 1987	AP	T	FT	0	29	29
Wright, James	Ph.D. Industrial Technology 2003	ATP	Term	FT	30	11	5
Yu, Chenxu	Ph.D. BSE 2003	AP	T	FT	2	12	12

[1] Key: DP = Distinguished Professor; UP = University Professor; MP = Morrill Professor; P = Professor; AP = Associate Professor; ASP = Assistant Professor; PP = Professor of Practice; ATP= Associate Teaching Professor; ASTP = Assistant Teaching Professor; A= Adjunct; O = Other
[2]Key: T = Tenured; TE = Tenure eligible; Term = Term appointment
[3]FT = full time, PT = part time

10.3 Faculty Qualifications

Faculty competence can be judged by factors such as academic preparation, diversity of backgrounds, engineering/applied engineering/technology experience, industrial/business experience, teaching experience, participation in professional societies, licensure as professionals, and scholarly activities. Examples of factors are:

- 30 of 39 ABE faculty hold a doctorate degree
- 16 universities are represented in the highest degrees of all ABE faculty
- 3 ABE faculty represent underrepresented ethnic minority groups
- 4 ABE faculty are women
- 13 ABE faculty have engineering or technology experience outside the United States
- 30 ABE faculty have employment or consulting experience in industry

Taken together, the ABE faculty have a deep and multifaceted educational background that enables us to deliver our curricula. We have faculty from diverse backgrounds, engineering/applied engineering/technology experience, and teaching experience, with a depth of faculty expertise in each program option area and strong leadership in professional societies, as illustrated in Table 10.2. Furthermore, the ABE faculty's combined 275 person-years of past industrial/business experience, many continue to actively engage with industrial and business partners in applied research, professional society task forces, and curricular continuous improvement. Moreover, our faculty are active in professional development activities. Faculty members demonstrate strong citizenship by serving as chairs and members on many department, college, and university committees. Faculty members connected with the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs belong to a variety of professional organizations including:

- American Society of Agricultural and Biological Engineering (ASABE)
- American Society for Engineering Education (ASEE)
- American Society of Safety Professionals (ASSP)
- Association of Technology Management and Applied Engineering (ATMAE)
- International Society of Agriculture Safety and Health (ISASH)
- International Technology and Engineering Educators Association (ITEEA)
- International Honor Society for Technology - Epsilon Pi Tau (EPT)
- Society of Manufacturing Engineers (SME)

One major strength of our department is our faculty. Recruitment and retention of outstanding faculty is the ABE department's and the University's top priority. The department chair takes a proactive approach in assessing individual faculty needs such as provisions for spousal accommodation, competitive salary adjustments and annual raises, and strong start up packages. The chair also adjusts teaching loads and committee work for newly hired faculty during the first few years of their appointment and recognizes faculty contributions with various award nominations.

The composition of full-time faculty, instructors, and advising staff has grown since 2016 to reflect the steady increase in student enrollment. Leadership from the College of Agriculture and Life Science and the College of Engineering have strongly supported ABE's teaching and research needs. To that end, 9 additional faculty members have been hired, including multiple instructors with nearly 100% teaching responsibilities, to serve the increase in student population. We have also increased the full-time advising staff to five persons, and have three full-time teaching lab coordinators who assist our faculty in maintaining high-quality, safe lab spaces as addressed below.

New hires to the TSM teaching faculty include the following:

- Michael Anderson, M.S., Professor of Practice
- Steven D. Bell, M.S., Associate Teaching Professor
- Sam Cook, M.S., Assistant Teaching Professor
- David Eisenmann, Ph.D., Assistant Teaching Professor
- John R. Haughery, Ph.D., Assistant Professor
- Dirk E. Maier, Ph.D., Professor
- Tim Shepherd, M.S., Associate Teaching Professor
- Saxon J. Ryan, M.S., Assistant Teaching Professor
- James O. Wright, Ph.D., Associate Teaching Professor

Academic Advisers:

Five professional staff members serve undergraduate students in the two engineering majors and two technology majors in ABE. The function of advising for the four options (AST-ABM, AST-MS, ITEC-M and ITEC-OS) in the technology core programs is specifically managed by two academic advisers and two student services specialists.

- Mr. Ashtyn Beek's full-time academic advising role is divided between the AST-ABM and AST-MS options. Hired in February of 2018, he instructs TSM 110, Introduction to Technology (technology core course). Mr. Beek also manages many of the details of the AST program including, but not limited to, meeting prospective students, handling program inquiries, organizing orientation programs, distributing recruiting information, monitoring four-year plans and other related tasks.
- Ms. Tamara Kerns is the academic adviser for the two industrial technology degree option students, was hired in 2013. Her time is divided between ITEC-M and ITEC-OS options. She instructs TSM 111, Experiencing Technology (technology core course). Ms. Kerns also manages many of the details of the industrial technology program including, but not limited to, handling program inquiries, orientation, distributing recruiting information, monitoring four-year plans, and other related tasks. In addition, she serves as the co-adviser for the Industrial Technology Club.
- Ms. Elaine Phompheng, student services specialist, was hired in November 2015 to manage the student services front desk, coordinate data collection and continuous improvement activities for accreditation, and support teaching and student services

activity. Ms. Phompheng also serves as the contact person for departmental diversity and inclusion programming and leads the TSM 397/399 internship course.

- Mr. Ben McCarty was hired in May 2014 to manage several tasks in the student services office. His primary job is in classroom scheduling and course enrollment management. Each semester he uses data from student wait lists to determine the number of sections taught and the appropriate classroom assignment. Mr. McCarty provides leadership on catalog editing for the technology programs and manages student hourly workers (along with Ms. Phompheng). He also provides advising to engineering students.

10.4 Faculty Selection and Appointment Policy and Procedures

As opportunities to recruit new faculty become available, the teaching needs of the department are a primary priority. The chair initiates a proposal for a new appointment after consultation with the members of the department. Upon receipt of approval from the dean(s) and provost, the department follows university search protocols.

When a candidate has been identified for the appointment, the chair specifies the conditions of appointment in the Letter of Intent as well as an offer of appointment including the position responsibility statement.

The Letter of Intent form and the appointment letter must be approved by the dean and, in the case of a tenured or tenure eligible appointment, by the provost. Approval must also be obtained from the Office of Equal Opportunity and Diversity confirming that the required search procedures have been followed in filling the position. The stipulated conditions include the academic rank, salary for the first year (in the case of new appointment), the ending date of the probationary period if one is established, the date by which a notification of intent not to renew is to be given if the appointment is renewable, and any special factors that apply to the appointment.

Subsequently, the person to whom the appointment is offered signs the form, indicating acceptance of the appointment and the specified conditions. Faculty appointments are made as tenured/tenure-eligible faculty (with rank of assistant professor, associate professor, or professor) or as term faculty (e.g. teaching faculty, practice faculty, clinical faculty, research faculty, or adjunct faculty). The type of appointment influences such considerations as fringe benefits, tenure status, and renewal procedures. Appointments to the faculty are ordinarily made for the nine-month academic year (B-base). Twelve-month (A-base) appointments are reserved for administrative positions and for persons whose responsibilities require year-round service. As professionals, faculty members and administrators arrange their own work schedules during their appointment periods so as to carry out their on-going responsibilities to the university.

10.5 Teaching, Advising and Service Loads

Table 10.2 shows the Faculty Workload Summary for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS). For tenured and tenure-eligible faculty, typical expectations for a 50 percent teaching appointment are to teach 9 semester hours annually, or three three-credit classes per year. For term faculty with a higher teaching appointment, the typical faculty teaching expectations are higher, with as many as four three-credit courses per semester. However, the department leadership appreciates that variations in course type (lecture versus lab intensive), course enrollment (one small section versus multiple large ones) experience with course (new prep versus multiple offerings), stage of career, and graduate teaching assistant support mean that the credit hour per FTE value must have significant flexibility to be equitable.

There are currently 16.5 FTEs in teaching positions in the department. Student credit hours in the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) are approximately 68% of the total of student credit hours in terms of faculty effort annually. Therefore, the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) utilize approximately 11 FTEs in teaching. In calculating FTEs in teaching, several factors are not included in the accounting. These include graduate student instructors, adjunct or affiliate faculty who teach only one course in TSM, and others with partial contracts who are not included in the faculty head counts.

Table 10.2. Current Agricultural and Biosystems Engineering TSM teaching faculty workload summary.

Faculty Name	PT or FT[1]	Rank	TSM Courses Taught
Andersen, Daniel	FT	Associate Professor	327
Anderson, Michael	FT	Professor of Practice	415, 416
Beek, Ashtyn	FT	Academic Adviser	110
Bell, Stephen	FT	Associate Teaching Professor	201, 214, 371, 415, 416
Birrell, Stuart	FT	Professor	330, 335
Bowers, Erin	FT	Adjunct Assistant Professor	457
Brumm, Thomas	FT	Associate Professor	210, 325
Cook, Sam	FT	Assistant Teaching Professor	115, 322, 322L, 455
Curtzweiler, Greg (FSHN)	FT	ASP	241
Darr, Matthew	FT	Professor	433
Doyle, Tanya	PT	Lecturer	440
Eisenmann, David	FT	Assistant Teaching Professor	116, 443, 449X
Freeman, Steven	FT	University Professor	493D
Haughery, John	FT	Assistant Professor	115, 363
Hoffman, Russell	FT	Assistant Teaching Professor	116, 240, 444
Hong, Shelly	PT	Assistant Teaching Professor	465
Kaleita, Amy	FT	Professor	324
Keren, Nir	FT	Associate Professor	376, 470, 477
Kerns, Tamara	FT	Academic Adviser	111
Koziel, Jacek	FT	Professor	415, 416
Maier, Dirk	FT	Professor	455
Mickelson, Steven	FT	Professor	697
Mosher, Gretchen	FT	Associate Professor	310, 415, 416
Phompheng, Elaine	FT	Academic Adviser	397, 399
Ryan, Saxon	FT	Assistant Teaching Professor	337, 340
Shahan, James	FT	Adjunct Assistant Professor	216
Shepherd, Tim	FT	Associate Teaching Professor	443,493B
Simpson, Steven	PT	Adjunct Assistant Professor	471
Tang, Lie	FT	Associate Professor	465
Tenboer, Heather	PT	Graduate Student Instructor	115, 116
Wright, James	FT	Associate Teaching Professor	270, 370, 372

[1] Key: FT = Full time; PT = Part time

10.6 Faculty qualifications

Faculty Tenure Policy and Procedures

Academic freedom is the freedom to discuss all relevant matters in the classroom, to explore all avenues of scholarship, research, and creative expression and to speak or write as a public citizen without institutional discipline or restraint in areas of faculty expertise. Academic responsibility implies the faithful performance of academic duties and obligations, the recognition of the demands of the scholarly enterprise, and the candor to make it clear that the individual is not speaking for the institution in matters of public interest.

Tenure is the keystone for academic freedom; it is essential for safeguarding the right of free expression and for encouraging risk-taking inquiry at the frontiers of knowledge. Both tenure and academic freedom are part of an implicit social compact, which recognizes that tenure serves important public purposes and benefits society. The public is best served when faculty are free to teach, conduct research, provide extension/ professional practice services, and engage in institutional service without fear of reprisal or without compromising the pursuit of knowledge and/or the creative process.

In return, faculty have the responsibility of furthering high-quality programs of research, teaching, and extension/professional practice, and are fully accountable for their performance of these responsibilities. Additionally, a well-designed tenure system attracts capable and highly qualified individuals as faculty members, strengthens institutional stability by enhancing faculty members' institutional loyalty, and encourages academic excellence by retaining and rewarding the most meritorious people. Tenure and promotion imply selectivity and choice; they are granted for scholarly and professional merit. The length and intensity of the review leading to the granting of tenure ensures the retention of only productive faculty; periodic performance reviews ensure the continuance of a commitment to excellence.

The system of academic tenure at Iowa State University emphasizes (1) recruitment of the most highly qualified candidates available, (2) creation of an opportunity for scholarly performance in teaching, research/creative activity, and extension/professional practice, (3) continuing evaluation of performance on the basis of areas of responsibilities in the employment agreement, and (4) the positive evaluation of performance resulting in the award of tenure. The awarding of tenure requires an affirmative decision, based upon an explicit judgment of qualifications resulting from continuous evaluation of the faculty member during the probationary period in light of the applicable criteria.

Iowa State University is a public land-grant institution where liberal and professional education is merged with basic and applied research in pursuit of advancing society's potentials and assisting in solving its problems. The university serves the people of Iowa, the nation, and the world through its interrelated programs of teaching, research/creative activities, and extension/professional practice.

Evaluation of a faculty member for promotion and/or tenure is based primarily on evidence of scholarship in the faculty member's teaching, research/creative activities, and/or extension/professional practice. In all areas of professional activity, a faculty member is expected to uphold the values and follow the guidelines in the Statement of Professional Ethics found in "Professional Policies and Procedures."

A key tool in the promotion and tenure review process is the position responsibility statement, which describes the individual's current position responsibilities and activities in the following areas: (1) teaching, (2) research/creative activities, (3) extension/ professional practice, and (4) institutional service. This statement is used by all evaluators to interpret the extent, balance, and scope of the faculty member's scholarly achievements.

All tenured and probationary faculty members are expected to engage in scholarship in their teaching, research/creative activities, and extension/professional practice. Scholarship is creative, systematic, rational inquiry into a topic and the honest, forthright application or exposition of conclusions drawn from that inquiry. It builds on existing knowledge and employs critical analysis and judgment to enhance understanding. Scholarship is the umbrella under which research falls, but research is just one form of scholarship. Scholarship also encompasses creative activities, teaching, and extension/professional practice.

Scholarship results in a product that is shared with others and is subject to the criticism of individuals qualified to judge the product. This product may take the form of a book, journal article, critical review, annotated bibliography, lecture, review of existing research on a topic, or speech synthesizing the thinking on a topic. Also falling under the umbrella of scholarship are original materials designed for use with the computer; inventions on which patents are obtained; codes and standards; art exhibits by teacher-artists; musical concerts with original scores; novels, essays, short stories, poems; and scholarly articles published in non-research based periodicals, newspapers, and other publications; etc. In short, scholarship includes materials that are generally called "intellectual property."

Scholarship generally implies that one has a solid foundation in the professional field addressed and is current with developments in that field. However, it must be noted that significant advances sometimes accrue when a scholar extends her or his scope of topics beyond those traditional to a particular discipline.

An assistant professor should have a strong academic record and ordinarily should have earned the accepted highest degree in his/her field. The assistant professor rank is recognition that the faculty member has exhibited the potential to grow in an academic career. Appointment at or promotion to this rank should be based on evidence that the faculty member can be expected to become qualified for promotion to associate professor in due course.

An associate professor should have a solid academic reputation and show promise of further development and productivity in his /her academic career. The candidate must demonstrate the following: excellence in scholarship that establishes the individual as a significant contributor to the field or profession, with potential for national distinction, effectiveness in areas of position responsibilities, and satisfactory institutional service. Furthermore, a recommendation for promotion to associate professor and granting of tenure must be based upon an assessment that the candidate has made contributions of appropriate magnitude and quality and has a high likelihood of sustained contributions to the field or profession and to the university.

A professor should be recognized by his/her professional peers within the university, as well as nationally and/or internationally, for the quality of the contribution to his /her discipline. The candidate must demonstrate the following: national distinction in scholarship, as evident in candidate's wide recognition and outstanding contributions to the field or profession, effectiveness in areas of position responsibilities, and significant institutional service. Furthermore, a recommendation for promotion to professor must be based upon an assessment, since the last promotion, that the candidate has made contributions of appropriate magnitude and quality and has demonstrated the ability to sustain contributions to the field or profession and to the university.

Additional information regarding the policies and procedures on promotion and tenure are found in the ABE Departmental Governance Document and at the following links: College of Agriculture and Life Sciences Governance Document, Office of the Senior Vice President and Provost faculty advancement and review webpage, and Iowa State University Faculty Handbook.

Standard 11

Standard 11 - Facilities, Equipment & Technical Support: Facilities and equipment shall be adequate to support program/option goals.

> **11.1 -** Appropriate technical support necessary to assure safety and for maintenance is available.
> **11.2 -** Current computer equipment and software programs to cover functions and applications in each program area is available.
> **11.3 -** Facility and equipment needs shall be included in the long-range goals and budget plans for the program.

SUMMARY RESPONSE

In the Sukup and Elings Hall buildings, each program option makes use of several rooms in the complex during the four-year sequence of courses. Modern classroom spaces offer a range of class sizes are used for lecture delivery, while well-equipped and safe lab spaces are available for labs. Staff and faculty work together to maintain and manage the teaching laboratories.

DETAILED RESPONSE

11.1 Appropriate Technical support

A technical support staff of four, including three lab coordinators and one IT professional manage the resources – including student workers – needed to ensure that the labs support all option programs. Significant funds (~$700/student/year available to the department) from tuition are used to support these staff, and the repair/supply/replacement costs associated with these equipment-intensive programs.

Three teaching lab coordinator position were created to maintain, manage, and coordinate multiple teaching laboratories in Elings and Sukup Hall facilities. Teaching lab coordinators ensure that equipment is in safe working order and that laboratories are clean and stocked with necessary supplies. They also instruct teaching assistants on the proper use of laboratory equipment and supports student clubs in the proper use of shop equipment and space.

Facilities

The Agricultural and Biosystems Engineering (ABE) Department has its primary facility in Elings and Sukup Halls, located within the Biorenewables Complex, which also includes Sukup Atrium and the Biorenewables Research Laboratory. These three combined spaces provide ABE with over 100,000 square feet of modern research labs, classrooms, student spaces, and offices. Together, these provide a state-of-the-art learning and innovation environment. There are also faculty and ABE program space in the National Swine Research Information Center (NSRIC) and the Environmental Health and Safety Services Building. ABE Facility spaces utilized through December 2019 are shown in Table 11.1.

Table 11.1. Facility Space used by ABE through 2019

ABE Building	**Total Space (sq. ft.)**
Elings Hall	25,650
Sukup Hall and Atrium	72,723
National Swine Research Information Center	3,475
Environmental Health & Safety	819
Total	102,667

11.2 Current computer equipment and software programs for each program option

All classrooms, computer labs, teaching labs, research labs, and student spaces located in Elings Hall and Sukup Hall are detailed in tables 11.2, 11.3 and 11.4. Room 0022 in Sukup Hall and 0308 Elings Hall are considered university auditoriums and therefore are maintained and controlled by the university. All other classrooms and teaching labs are departmental spaces and subject to departmental control for space and scheduling. The majority of departmental courses required for AST and ITEC programs are taught in Sukup or Elings Hall. Large lecture sections may use other university classrooms, especially at peak times of the day. Modern classroom spaces offering a range of class sizes are used for lecture delivery, and well-equipped and safe spaces are available for labs.

ABE currently maintains four computer labs in Sukup Hall (0214, 2217, 4219, and 4222). Students in all programs utilize these labs. Computer equipment in these labs are detailed in Table 11.2. Software available in the computer labs include ArcView GIS, Autodesk Software (i.e. AutoCAD, Inventor, Mechanical Desktop), JMP Statistical, MatLAB, Microsoft Office, Adobe Creative Cloud, Pro/Engineer and Pro/Mechanica, Solid Edge, SolidWorks, Staad Pro, and Visual Studio. Computer labs also have class specific software installed.

Table 11.2. ABE Teaching classrooms, labs and equipment

Room	**Area (ft^2)**	**Capacity**	**TSM Courses Taught**	**Key Function & Equipment**
0308 Elings	2248	80	241,310, 330, 335, 337, 363, 415, 416	Classroom
0022 Sukup	3698	153	201, 210, 214, 325, 363, 433	Classroom
0214 Sukup	1550	48	115, 116, 216, open computer lab	Computer lab: Dell Precision Tower 3420 with dual 22" monitors (48), black and white laser printer (1), color laser printer (1)
2217 Sukup	1727	48	115, 116, 216, 322, 440, 443, 465, open computer lab	Computer lab: Dell Precision Tower 3420 with dual 22" monitors (52), black and white laser printer (1)
2306 Elings	1293	60	110,111, 324, 327, 340, 363, 440, 443, 444, 415, 416	Classroom
3219 Sukup	1104	24	371, 455, 457, special courses	Classroom Safety Training Instruction & Research Center (STIR)
4219 Sukup	724	24	330, open computer lab	Computer lab: Precision Tower 3420 with dual 22" monitors (24), black and white laser printer (1), color laser printer (1)
4220 Sukup	1697	60	111, 322, 363, 415, 444, 477	Classroom
4222 Sukup	675	22	open computer lab	Computer Lab: Dell T1700 Precision workstations with dual 22" monitors (22), black and white laser printer (1), color laser printer (1)
1230 EH&S	819	42	471	Classroom

Table 11.3 ABE Student meeting, creation space, and equipment

Room	Area (ft^2)	Capacity	TSM Courses Taught	Key Function & Equipment
1311 Elings	542	Other	None	*Student Meeting Space and Peer Mentoring*: Precision Tower 3420 with 24" monitors (6), black and white laser printer (1)
0212 Sukup	256	Other	None	*Student Clubs Meeting Room*
0218, 0220, 0222, 0224 Sukup	125 each	6	415, 416	*Teaming Rooms* (4): Dedicated capstone team meeting rooms equipped with high-performance computers including webcams for video conferencing capabilities
1209 and 1215 Sukup	3450	82 (capacity for both 1209 and 1215)	415, 416	*Student Innovation Center Lab and Maker Space:* Water jet, welding booth, grinders, sanders, drill press, 3-D printers (2), chop saw, belt sander, Dell T1700 Precision workstation with dual monitors (2), loaded movable toolboxes for individual team use, Dell Latitude E5450 laptops (20)

Table 11.4. ABE Teaching laboratories with equipment

Room	Area (ft^2)	Capacity	TSM Courses Taught	Key Function & Equipment
0209 Sukup	4527 (including adjacent office, storage space)	23	240	*Manufacturing Process Metals Teaching Lab:* Haas Computer Numerical Control CNC lathe machines (5), Computer Numerical Control CNC mill, manual mills (2), vertical and horizontal band saws, drill press (2), metal cutoff saws, welding equipment, DLP 3-D printers (3), FDM 3-D printers (10), Haas Computer Numerical Control CNC Simulator (7)
0221 Sukup	1451	23	241	*Manufacturing Process Plastics Teaching Lab*: Injection molding machine, vibration molder, compression molder, blown film extruder, vacuum former, silk screening equipment
1208 Sukup	1740	35	330	*Automated Machine Systems Lab:* Grain bins, conveyors, tension and compression tester
1212 Sukup	1785	20	433	*Precision Machine Systems*: GPS carts (7)
1218 Sukup	2640	20	330, 416	*Off-Road Machine Systems High Bay*: Specific equipment utilized for 416 capstone teams, key sets of equipment for testing, teaching demonstrations
1219 Sukup	1078	22	335	*Engines Lab:* John Deere engines (10 stations)
1222 1222A Sukup	1517	40	335	Vehicle Power Systems Lab: Engine hydraulic dynamometers and power control room
1223 Sukup	1451	8	340	*Automated Manufacturing Lab*: Milltronics Computer Numerical Control CNC units (2), equators – coordinate measuring machines (2), Dell All-In-One 9020 desktop workstations (4)

Table 11.4. ABE Teaching laboratories with equipment (continued)

Room	Area (ft^2)	Capacity	TSM Courses Taught	Key Function & Equipment
2207 Sukup	1042	20	433	*Precision Agriculture GIS Lab*: Dell Latitude E5400 laptops (20) with SMS software and integra labs, displays and receivers
2209 Sukup	676	24	337,433,493B	*Power and Machinery Teaching space*
2211 Sukup	1410	18	337	*Fluid Power Lab:* Fluid hydraulic training test stands (14) – ten teaching and four reserved for student projects, pneumatic trainers (2), Dell Precision Tower 3420 with single 24” monitors (12), black and white laser printer (1)
3220 Sukup	1047	24	363	*Electricity and Electronics Lab*: Electric Workstations (15) – Single Phase, Three-Phase, Wye, Delta services
3221 Sukup	703	NA	Research	*Safety Lab*: (Schwab, Freeman, Keren, Mosher)
3224 Sukup	1381	24	493B	*Measurement and control systems*: Customized Dell Latitude laptops with single 22” external monitors and software stations (18)
4209 Sukup	1046	35	240, 324, 330, 443, 444	Dell Precision Tower 3420 with 24” monitors (35)
4215 Sukup	1075	24	465	*Automation Systems Teaching Lab:* Dell Precision Tower 3420 with single 24” monitors (15), PLC trainers (15), Robotic arm test stands (5)

Table 11.4. ABE Teaching laboratories with equipment (continued)

Room	Area (ft^2)	Capacity	TSM Courses Taught	Key Function & Equipment
4220 Sukup	1697	60	110, 111, 330, 415, 443, 477	Computer Lab: Dell Latitude E7400 Laptops no external monitors (60)
4223 Sukup	703	20	322L	Grain Quality Teaching Lab: Carter Day Dockage Tester (1), GAC Grain Meters (2), PQ SeedBuro Single Kernel Tester

All teaching facilities are staffed with responsible authorities while class is in session. An individual faculty or staff member are in charge of each lab to ensure lab safety, equipment training, equipment maintenance, and overall oversight.

The ABE Facilities and Safety Committee periodically visits labs/shops to check for potential safety issues. Regular visits by the Fire Marshall also occur, helping to ensure that buildings are meeting fire codes. Recently, the safety process has come under scrutiny due to tragic injuries at several prestigious US institutions. It is departmental policy that no student work in a laboratory without proper safety training and equipment, and that primary responsibility for this lies with the faculty member in charge of a particular course or research lab space. The Shop Safety Enhancement Learning and Training project (SSELT) was launched in 2015 and supports a system that includes rigorous shop safety training modules and the supporting infrastructure to enable the functions listed below:

- Document management and handling system
- Training renewal alert system (providing instructors and academic administrative units alerts when required retraining has not been completed)
- The system will interface with:
    - Access control management system(s) (available for controlled access systems once installed)
    - Tool secure lock-out functions
    - Tool specific training modules
    - Learning systems (e.g., EH&S WebLearner and Canvas)
    - Registrar’s databases to facilitate authoritative functions

11.3Facility and equipment included in long-range goals and budget plans

As part of the continuous improvement process, faculty and staff seek opportunities to update equipment in the teaching laboratories. Through partnerships with industrial partners and in-kind donations, new equipment can be secured to facilitate a hands-on and experiential educational experience for students. In addition, significant funds (~$700/student/year available to the department) from tuition and other resources are used to support the repair/supply/ replacement costs associated with the equipment-intensive program.

Agricultural Systems Technology – Agricultural and Biosystems Management Option AST-ABM

The following are TSM courses specific to the ABM option. Table 11.5 details the dedicated facility space, room capacities, and equipment resources for the ABM option.

- TSM 322 (S.) 3 cr. Preservation of Grain Quality
- TSM 322L (S.) 1 cr. Preservation of Grain Quality Laboratory
- TSM 324 (S.) 3 cr. Soil and Water Conservation Management
- TSM 325 (F.) 3 cr. Biorenewable Systems
- TSM 327 (F.) 3 cr. Animal Production Systems
- TSM 330 (S.) 3 cr. Agricultural Machinery and Power Management
- TSM 433 (F.) 3 cr. Precision Agriculture
- TSM 455 (F.) 3 cr. Feed Processing and Technology

Table 11.5 AST-ABM classrooms and teaching laboratories with equipment

Room	**Area (ft^2)**	**Capacity**	**TSM Courses Taught**	**Key Function & Equipment**
0308 Elings	2248	80	330	Classroom
2306 Elings	1293	60	324, 327	Classroom
0022 Sukup	3698	153	325, 433	Auditorium
1208 Sukup	1740	35	330	*Automated Machine Systems Lab*: Grain bins, conveyors, tension and compression tester
1212 Sukup	1785	20	433	*Precision Machine Systems*: GPS carts (7)
1218 Sukup	2640	35	330	*Off-Road Machine Systems High Bay:* Specific equipment utilized for 416 capstone teams, key sets of equipment for testing, teaching demonstrations
2207 Sukup	1042	20	433	*Precision Agriculture GIS Lab*: Dell Latitude E5400 laptops (20) with SMS software and integra labs, displays and receivers
2209 Sukup	676	24	433	*Power and Machinery Teaching Classroom*: Lectures for 433

Table 11.5 AST-ABM classrooms and teaching laboratories with equipment (continued)

2217	1727	48	322	*Computer lab:* Dell Precision Tower 3420 with dual 22" monitors (52), black and white laser printer (1), color laser printer (1)
4218 Sukup	674	24	327	Ventilation controllers, fans, inlets, evaporative coolers
4219 Sukup	724	25	330	*Computer Lab*: Dell T1700 Precision workstations with dual 22" monitors (24), black and white laser printer (1), color laser printer (1)
4220 Sukup	1697	64	330	*Computer Lab:* Dell Latitude E7400 Laptops no external monitors (60)
4223 Sukup	703	20	322L	*Grain Quality Teaching Lab:* Carter Day Dockage Tester (1), GAC Grain Meters (2), PQ SeedBuro Single Kernel Tester
0013 Curtiss	993	56	322, 325	Distance Education Classroom

<u>Agricultural Systems Technology – Machine Systems Option AST-MS</u>

The following are TSM courses specific to the MS option. Table 11.6 details the facility space, room capacities, and equipment resources.

- TSM 216 (F.S.) 3 cr. Advanced Technical Graphics, Interpretation, and CAD
- TSM 240 (F.S.) 3 cr. Introduction to Advanced Manufacturing and Metals Processing
- TSM 330 (S.) 3 cr. Agricultural Machinery and Power Management
- TSM 335 (F.) 4 cr. Tractor Power
- TSM 337 (F.S.) 3 cr. Fluid Power Systems Technology
- TSM 433 (F.) 3 cr. Precision Agriculture
- TSM 443 (F.S.) 3 cr. Statics and Strength of Materials for Technology
- TSM 465 (F.S.) 3 cr. Automation Systems

Table 11.6 AST-MS Classrooms and teaching laboratories with equipment

Room	**Area (ft^2)**	**Capacity**	**TSM Courses Taught**	**Key Function & Equipment**
0022 Sukup	3698	153	433	Classroom
0209 Sukup	4527	20	240	*Manufacturing Process Metals Teaching Lab:* Haas Computer Numerical Control CNC lathe machines (5), Computer Numerical Control CNC mill, manual mills (2), vertical and horizontal band saws, drill press (2), metal cutoff saws, welding equipment, DLP 3-D, printers (3), FDM 3-D Printers (10), Haas Computer Numerical Control CNC Simulator (7)
0308 Elings	2248	80	240, 330, 335, 337	Classroom
0214 Sukup	1550	48	216	*Computer Lab*: Dell T1700 Precision workstations with dual 22” monitors (48), black and white laser printer (1), color laser printer (1)
1208 Sukup	1740	35	330	*Automated Machine Systems Lab:* Grain bins, conveyors, tension and compression tester
1212 Sukup	1785	20	333	*Precision Machine Systems*: GPS carts (7)
1218 Sukup	2640	20	330	*Off-Road Machine Systems High Bay:* Specific equipment utilized for 416 capstone teams, key sets of equipment for testing, teaching demonstrations
1219 Sukup	1078	22	335	*Engines Lab:* John Deere engines (10 stations), Tool sets (10)

Table 11.6 AST-MS Classrooms and teaching laboratories (continued)

1222 1222A Sukup	1517	40	335, 337	*Vehicle Power Systems Lab:* Engine dynamometer, Hydrostatic transmission test stand, power control room
2207 Sukup	1042	20	433	*Precision Agriculture GIS Lab:* Dell Latitude E5400 laptops (20) with SMS software and integra labs, displays and receivers
2209 Sukup	676	24	337, 433	*Power and Machinery Teaching Classroom:* Lectures for 337 and 433
2211 Sukup	1410	18	337	*Fluid Power Lab*: Fluid hydraulic training test stands (14) – ten teaching and four reserved for student projects, pneumatic trainers (2), Dell Precision Tower 3420 with single 24" monitors (12), black and white laser printer (1)
2217 Sukup	1727	48	443, 465	*Computer Lab*: Precision Tower 3420 with dual 22" monitors (52), black and white laser printer (1), color laser printer (1)
4215 Sukup	1075	24	465	Automation Systems Teaching Lab: Dell Precision Tower 3420 with single 24" monitors (15), PLC trainers (15), Robotic arm test stands (5)
4219 Sukup	724	25	330	Computer Lab: Precision Tower 3420 with dual 22" monitors (24), black and white laser printer (1), color laser printer (1)
4220 Sukup	1697	64	330, 443	Classroom

Industrial Technology – Manufacturing Option ITEC-M

The following are TSM courses specific to the M option. Table 11.7 details the facility space, room capacities, and equipment resources.

- TSM 216 (F. S.) 3 cr. Advanced Technical Graphics, Interpretation, and CAD
- TSM 240 (F.S.) 3 cr. Introduction to Advanced Manufacturing and Metals Processing
- TSM 241 (F.S.) 2 cr. Introduction to Manufacturing Processes for Plastics
- TSM 337 (F.S.) 3 cr. Fluid Power Systems Technology
- TSM 340 (F.S.) 3 cr. Advanced Automated Manufacturing Processes
- TSM 440 (F.S.) 3 cr. Cellular Lean Manufacturing Systems
- TSM 443 (S.) 3 cr. Statics and Strength of Materials for Technology
- TSM 444 (F.) 3 cr. Facility Planning
- TSM 465 (S.) 3 cr. Automation Systems

Table 11.7 ITEC-M Classrooms and teaching laboratories with equipment

Room	**Area (ft^2)**	**Capacity**	**TSM Courses Taught**	**Key Function & Equipment**
0209 Sukup	4527	23	240	*Manufacturing Process Metals Teaching Lab:* Haas Computer Numerical Control CNC lathe machines (5), Computer Numerical Control CNC mill, manual mills (2), vertical and horizontal band saws, drill press (2), metal cutoff saws, welding equipment, DLP 3-D, printers (3), FDM 3-D Printers (10), Haas Computer Numerical Control CNC Simulator (7)
0214 Sukup	1550	48	216, 444	*Computer Lab:* Dell Precision Tower 3420 with dual 22" monitors (48), black and white laser printer (1), color laser printer (1)
0221 Sukup	1451	23	241	*Manufacturing Process Plastics Teaching Lab:* Injection molding machine, vibration molder, compression molder, blown film extruder, vacuum former, silk screening equipment
1223 Sukup	1451	8	340	*Automated Manufacturing Lab*: Haas Computer Numerical Control CNC Mills (2), Haas Computer Numerical Control CNC Lathes (2), Haas Computer Numerical Control CNC 5 axis Mill, Computer Controlled Coordinate Measuring Machines (2), Manual Coordinate Measuring Machines (1), Haas Computer Numerical Control CNC Simulator (5)

Table 11.7 ITEC-M Classrooms and teaching laboratories with equipment (Continued)

2209 Sukup	676	20	337	*Power and Machinery Teaching Space*
2211 Sukup	1410	18	337	Fluid Power Lab: Fluid hydraulic training test stands (14) – ten teaching and four reserved for student projects, pneumatic trainers (2), Dell T1700 Precision workstations with single 24” monitors (12), black and white laser printer (1)
2217 Sukup	1727	48	440, 443, 465	Computer Lab: Dell T1700 Precision workstations with dual 22” monitors (52), black and white laser printer (1), color laser printer (1)
4215 Sukup	1075	24	465	Automation Systems Teaching Lab: Dell T1700 Precision workstations with single 24” monitors (15)
4220 Sukup	1697	64	240, 444, 465	Classroom
0308 Elings	2248	80	240, 337, 440, 444	Classroom
2306 Elings	1293	60	340, 440,443, 444, 465	Classroom

Industrial Technology – Occupational Safety Option ITEC-OS

The following are TSM courses specific to the OS option. Table 11.8 details the facility space, room capacities, and equipment resources.

- TSM 240 (F.S) 3 cr. Introduction to Advanced Manufacturing and Metals Processing
- TSM 371 (S.) 2 cr. Occupational Safety Management
- TSM 372 (F.) 2 cr. Legal Aspects of Occupational Safety and Health
- TSM 376 (F.) 3 cr. Fire Protection and Prevention
- TSM 470 (S.) 3 cr. Industrial Hygiene: Physical, Chemical, and Biological Hazards
- TSM 471 (S.) 1 cr. Safety Laboratory
- TSM 477 (F.) 3 cr. Risk Analysis and Management

Table 11.8 ITEC-OS Classrooms and teaching laboratories with equipment

Room	**Area (ft^2)**	**Capacity**	**TSM Courses Taught**	**Key Function & Equipment**
0308 Elings	2248	80	240	Classroom
0209 Sukup	4527	23	240	Manufacturing Process Metals Teaching Lab: Haas Computer Numerical Control CNC lathe machines (5), Computer Numerical Control CNC mill, manual mills (2), vertical and horizontal band saws, drill press (2), metal cutoff saws, welding equipment, DLP 3-D, printers (3), FDM 3-D Printers (10), Haas Computer Numerical Control CNC Simulator (7)
3219 Sukup	1104	24	371	Safety Training Instruction & Research Center (STIR)
4209 Sukup	1046	35	240	Dell Precision Tower 3420 with 24” monitors (35)
4220 Sukup	1697	64	240, 477	Classroom
1230 EH&S	819	42	471	Classroom

Standard 12

Standard 12 - Program/Option Operation: Evidence shall be presented showing the adequacy of instruction including:

- **12.1 -** Scheduling of instruction and student advising
- **12.2 -** Quality of instruction and motivation of students
- **12.3 -** Observance of safety standards
- **12.4 -** Availability of resource materials
- **12.5 -** Teaching and measurement of competencies (specific measurable competencies shall be identified for each course along with the assessment measures used to determine student mastery of the competencies)
- **12.6 -** Supervision of instruction
- **12.7 -** Placement services available to graduates
- **12.8 -** Management and/or technical course syllabi must clearly describe appropriate course objectives and student competencies.
- **12.9 -** Each student learning competencies shall be mapped to the program learning outcomes established for the program/option.
- **12.10 -** Courses delivered by distance. Appropriate criteria are in place to assure the adequacy of distance and/or non- traditional instruction

SUMMARY RESPONSE

- 12.1. AST students (both options) and ITEC students (both options) are each advised by a single professional advisor. Student ratings of advising demonstrate the high quality of advisor. Scheduling of instruction is done with input from faculty and students to maximize availability and minimize course conflicts. Nearly all Technology Systems Management (TSM) courses are offered every fall and spring semesters.
- 12.2. Quality of instruction is assessed for each class taught by the department, and feedback is used to improve instructions and as part of faculty evaluations. Student evaluation of instruction ratings indicate high instructor effectiveness (average rating of 4.18 out of 5.00 for all TSM courses) and a high achievement of learning outcomes (average rating of 4.18 out of 5.00 for all TSM courses). Motivating students is a joint effort between the program advisers and the faculty and includes the use of learning communities.
- 12.3. Laboratory courses observe safety standards that are ensured through required training and is being strengthened as the department is a leader in a campus-wide effort to increase laboratory safety.
- 12.4. Students have access to a wide variety of up-to-date resource materials, ranging from reference books in a world-class library, to well-equipped manufacturing labs, to computer labs with workstation-level dual-screen computers.
- 12.5. Courses are mapped to competencies, and direct and indirect measures of competency achievement are made.

- 12.6. The Department Chair and Associate Department Chair for Teaching supervise instruction for all program options. Student evaluation of instruction and peer evaluations are used to gauge instructional effectiveness.
- 12.7. Placement services are available to all students through the College of Agriculture and Life Sciences Career Services. Multiple career fairs are available to students throughout the academic year.
- 12.8. Appendix A gives the syllabi for all Technology Systems Management (TSM) courses. Each includes appropriate course learning outcomes.
- 12.9. Student learning outcomes are mapped to competencies for each program option.
- 12.10. Courses delivered at a distance (online) have the same quality standards, expectations and evaluation processes as traditional courses. They are taught by ABE faculty.

DETAILED RESPONSE

Information presented in this section is the same for all four program options (AST-ABM, AST-MS, ITEC-M and ITEC-OS) unless specifically identified by a single option.

12.1 Scheduling of instruction and student advising

Scheduling class offerings is done by professional staff in the department with faculty input. Student input, through representation on the curriculum committee and through feedback to advisors, is also considered. Overlapping classes and conflicts between courses normally taken during the same semester are held to a minimum, so the accessibility of the course offerings to the students is high. The ABE departmental undergraduate advisers assist the students with preparing their schedules each semester to help ensure student completion of degree requirements in a timely and appropriate fashion.

Course scheduling is coordinated by the department Chair Dr. Steven Mickelson and Associate Chair Dr. Amy Kaleita Forbes, who consult with faculty members concerning the schedule. Most required courses are offered each semester or at least once per year. Multiple sections of introductory courses (100 level courses) are sometimes necessary. Scheduled course offerings are coordinated to minimize course conflicts. Courses are scheduled between the hours of 8:00 a.m. and 9:00 p.m. on weekdays. Technology Systems Management (TSM) courses that are in high demand and/or that are prerequisites for courses in high demand are scheduled both during fall and spring semesters.

ABE advisers work with the students to develop an academic program that meets the student's career objectives as well as the requirements of the academic program in which the student is enrolled. The adviser acts as a resource person for university course offerings, programs, and procedures. It is the student's responsibility to be informed about the requirements for his or her degree and to ensure that these requirements are met. Academic advising is a shared set of responsibilities (http://catalog.iastate.edu/registration/).

Students are responsible for:

- knowing Iowa State University policies and procedures;
- knowing graduation requirements for degree program;

- understanding and accepting the consequences of their academic decisions;
- seeking, evaluating, and acting upon advising assistance; and
- taking responsibility for accomplishing his/her degree plan.

The academic adviser is responsible for:
- assisting students in achieving the learning outcomes of their academic program, their college, and the university;
- referring students to appropriate campus resources;
- empowering students to develop an academic plan appropriate to the student's abilities, interests, academic and career goals; and
- providing students with accurate information on relevant university policies and procedures.

ABE advisers work with each student to develop an academic program that meets the student's career objectives as well as the requirements of the four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS). When students first enroll in the department, they are assigned to an academic adviser based on their degree program. Table 12.1 lists the staff who advise all students in the department. In 2018, a new academic advisor assumed the duties of advising AST-ABM and AST-MS students. Additionally, the department employs a student services specialist to handle tasks like course listing, catalog editing, academic administrative record keeping, and other tasks to allow academic advisers to focus more on the students. Advisers are assigned specific degree-options students to advise. However, all advisers are capable of handling general questions from any of the students in all the degree-options within the ABE department, providing backup when one adviser may be unavailable.

Table 12.1. Staff who advise students in the ABE department.

Degree-Option Program	Rank or position	Adviser
AST-ABM, AST-MS	Academic Adviser II	Mr. Ashtyn Beek
ITEC-M, ITEC-OS	Academic Adviser III	Ms. Tamara Kerns
AE & BSE & OSC[1]	Academic Adviser III	Ms. Lindsay Frueh
All Degree-Options	Student Services Specialist III	Mr. Ben McCarty

[1]AE = agricultural engineering; BSE = biological systems engineering; OSC = occupational safety certificate.

Evaluation of advising by students in all four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) occurs annually. Evaluation of advising uses the same survey instrument for all four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS). Evaluation is conducted in the spring semester before registration for the following academic terms. Table 12.2 lists the questions students are asked and the ranking scale for those questions. Advisers receive their individual results at the end of the semester and are considered in their annual evaluations. The quantitative results for the past two years of student advising evaluations are given in Figure 12.1. Students are generally very satisfied with the quality of advising they receive.

Table 12.2 Questions asked in the annual student evaluation of advising.

General Areas of Adviser Evaluation	Questions	Ranking Scale
Knowledge	My adviser is well informed about rules, procedures, and course selection. If the answer isn't known, my advisor helps direct my question to appropriate resources	1. Strongly disagree 2. Disagree 3. Neither agree or disagree 4. Agree 5. Strongly agree
Availability	My adviser is available through office hours, telephone, email, or office appointments, if necessary	
Reliable	My adviser keeps appointments when made. My adviser follows through with efforts to determine answers to questions	
Approachable	My adviser encourages me to contact her. My adviser expresses interest in me and shows concern for my problems and my progress in the program.	
Advice	My adviser offers suggestions and evaluations. My adviser informs me about university, community, and professional resources. My adviser helps me make contacts or appointments when necessary.	
Respect	My adviser treats me in a professional manner. My adviser creates a supportive environment and discusses decision-making strategies. My adviser gives me her full attention during my visit(s).	
Career Guidance	My adviser provides adequate guidance relating to my career goals.	
Overall	How satisfied are you with your adviser's overall effectiveness?	1. Very unsatisfied 2. Unsatisfied 3. Neither satisfied or unsatisfied 4. Satisfied 5. Very satisfied
Adviser Help	My adviser has helped me the most by…	Open-ended response
Adviser Strength	What are the strengths of your adviser?	
Suggestion for my adviser	In what areas could your adviser improve?	
Other comments	Please provide any additional comments about your advisor or the department's advising service in general.…	

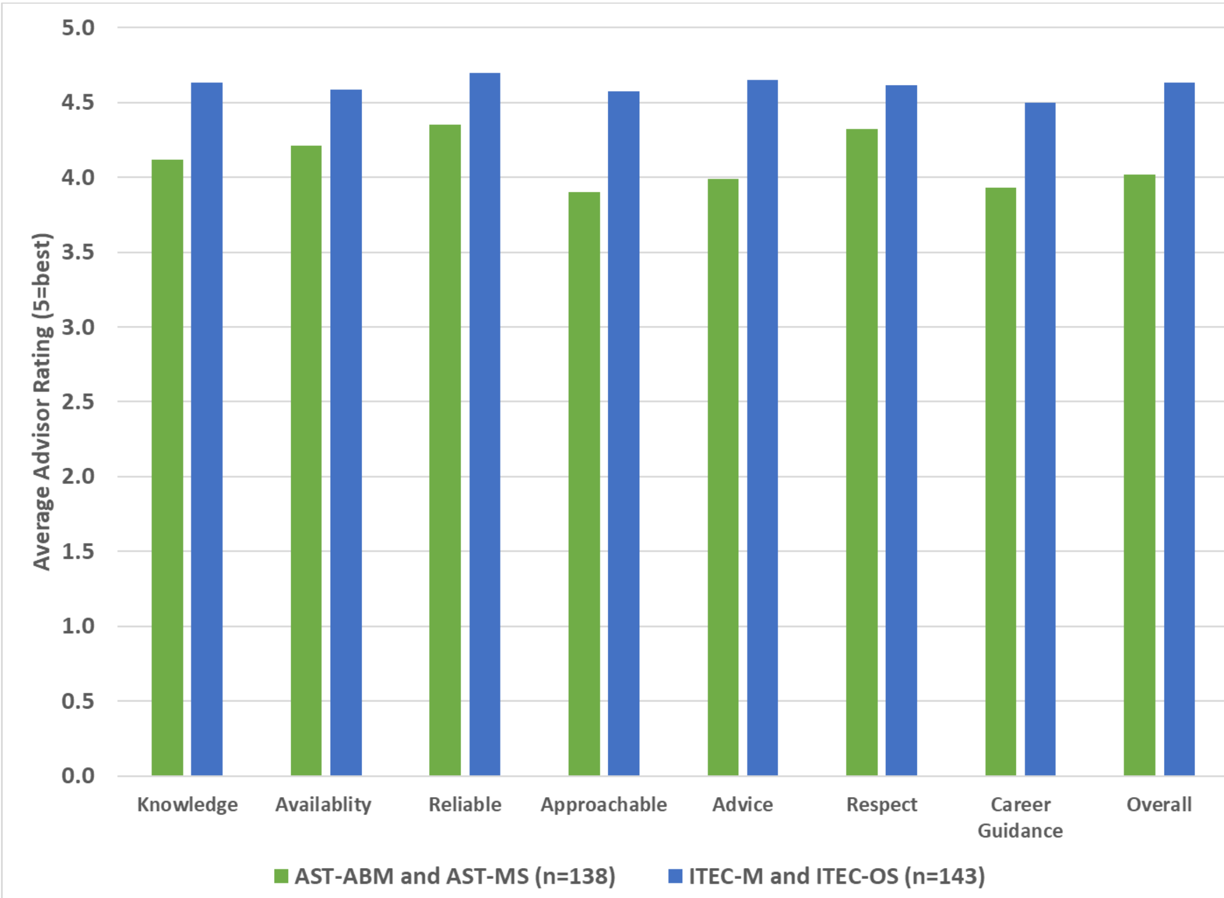

Figure 12.1. Results of student evaluations of academic advisers for 2018-2019.

12.2 Quality of Instruction and Motivation of Students

The Agricultural and Biosystems Engineering department has procedures for implementing the student evaluation of instruction (SEI) for all TSM courses offered by our faculty and instructors. These student evaluations of instruction are required by department in the chair's annual faculty evaluation materials and these evaluations are also reported the promotion and tenure materials. The feedback is used by the instructors to improve the teaching of future courses and by the department to monitor the overall teaching efforts.

Each semester all ABE faculty and instructors administer SEIs for each section of course they teach (unless those courses have below an acceptable number of students like 393, 490, and 493). The Students complete the evaluation on-line. The ABE department unified SEI for all four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) and those are the results that are presented in this document. Prior years are available but not included in this self-study report. The SEI questions are in Appendix 7.11.

The ABE department's student evaluation of instruction for all TSM classes during Fall 2018 and Spring 2019 are given in Table 12.3. The scale used for these evaluations (except for question 19) are 0 as "unacceptable", 3 as "some success" and 5 as "outstanding" and considered the top score. The scores mean values (except for question 19) ranged from 4.03 to 4.39.

Table 12.3 Reported mean scores and standard deviations from student evaluation of instruction in TSM courses for Fall 2018 and Spring 2019 (approximately 1,400 students per semester).

		Fall 2018 (n=27 classes)		Spring 2019 (n = 27 classes)	
#	Question	Mean	StDev[1]	Mean	StDev[1]
1	Student learning objectives & expectations clear	4.23	0.20	4.21	0.28
2	Instructor explained concepts	4.19	0.26	4.13	0.35
3	Teaching methods enhanced outcomes achievement	4.17	0.21	4.11	0.36
4	Instructor illustrated relevance	4.29	0.22	4.23	0.31
5	Class participation encouraged	4.26	0.19	4.22	0.31
6	Assignments related to learning outcomes	4.28	0.21	4.24	0.30
7	Appropriate assignment depth & complexity	4.15	0.24	4.13	0.32
8	Timely feedback	4.16	0.26	4.10	0.35
9	Useful Feedback	4.08	0.26	4.03	0.35
10	Grades reflect learning	4.13	0.27	4.15	0.30
11	Resources effective in outcome achievement	4.14	0.21	4.09	0.34
12	Instructor availability	4.24	0.17	4.21	0.27
13	Instructor effectiveness for students achieving learning outcomes	4.22	0.25	4.15	0.35
14	Student appropriate effort	4.24	0.18	4.23	0.23
15	Student achieved student learning objectives	4.20	0.22	4.17	0.26
16	Course content had value	4.32	0.20	4.26	0.31
17	Instructor prevented academic dishonesty	4.26	0.19	4.20	0.22
18	Instructor treated students with respect	4.37	0.21	4.38	0.24
19	Course rigor[2]	3.03	0.27	2.98	0.35

[1] Standard deviation between classes.
[2] Does not use same Likert scale as others – instead: 1= too easy, 3 = appropriate, 5 = too hard.

The results of instructor effectiveness (question #13) and student learning (question #15) over a longer span of time are presented in Table 12.4. Mean scores of these questions range from 3.97 to 4.24 over the past eight semesters.

Table 12.4. Reported mean scores from student evaluation of instruction for questions # 13 and #15 from 2015 to 2019 for all TSM courses (approximately 1,400 students and 25 classes per semester).

Year	Semester	Question #13 Mean Score	Question #15 Mean Score
2015	Spring	3.97	4.02
2015	Fall	4.16	4.16
2016	Spring	4.11	4.08
2016	Fall	4.10	4.10
2017	Spring	4.07	4.11
2017	Fall	4.11	4.20
2018	Spring	4.24	4.20
2018	Fall	4.21	4.19
2019	Spring	4.15	4.17
2019	Fall	4.24	4.24

Learning Communities

The ABE department is one of the leaders in Learning Communities at Iowa State University, which is highly ranked nationally in this educational innovation. Learning communities are groups of students sharing a common schedule of some introductory classes and/or living assignment. We've taken the basic learning community model and expanded it.

All students in the four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) participate in the academic portion of the learning community. The ABE department offers an optional living community opportunity for all ABE students (AE, BSE, AST and ITEC degree programs). Freshmen and sophomore students may live together on a residence hall floor, half of which is reserved for ABE learning community students.

General goals for the ABE learning community initiative are:

- to build community for entering freshmen and sophomores within the ABE undergraduate curricula,
- to increase the retention of freshman and sophomore students in the ABE undergraduate curricula,
- to increase recruitment of students into the ABE programs, especially women and minorities, and
- to use collaborative, learning-based educational methodology in the learning community courses to enhance learning and team skills.

Learning Community courses for freshman, sophomore, and junior students in the four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) are shown in Table 12.5. Students will often choose three or four learning community courses during a semester, but not all, depending on which courses they need.

Table 12.5 Learning community course offering by semester and classification for all four option programs.

Classification	Semester	Courses	Credit	Course Title
Freshman	Fall 2018	CHEM 163	4	College Chemistry
		CHEM 163L	1	Laboratory in College Chemistry
		MATH 145	3	Applied Trigonometry
		PSYCH 131	1	Academic Learning Skills
		TSM 110	1	Introduction to Technology
		TSM 115	1	Solving Technology Problems
		TSM 116	3	Introduction to Design in Technology
		MATH 151	3	Calculus for Business & Social Sciences
	Spring 2019	BIOL 101	3	Introductory Biology
		PHYS 111	5	General Physics
		LIB 160	1	Information Literacy
		MATH 151	3	Calculus for Business & Social Sciences
		TSM 111	1	Experiencing Technology
		TSM 115	1	Solving Technology Problems
		TSM 116	3	Introduction to Design in Technology
Sophomore	Fall 2018	BIOL 101	3	Introduction to Biology
		MATH 151	3	Calculus for Business & Social Sciences
		TSM 201	1	Preparing for Workplace Seminar
		TSM 210	3	Introduction to Technology
		TSM 214	1	Managing Technology Projects
		TSM 216	3	Advanced Technical Graphics, Interpretation, and CAD
	Spring 2019	BIOL 101	3	Introduction to Biology
		MATH 151	3	Calculus for Business & Social Sciences
		STAT 104	3	Introduction to Statistics
		TSM 111	1	Experiencing Technology
		TSM 240	3	Intro to Manufacturing Processes (metals)

Assessment of our learning community students has shown that we are achieving most of our goals. Students quickly become integrated into the ABE community. First-year retention rates (students who persist in our department from first-year to second-year) have soared from 63% in 1998 when we started the ABE Learning Communities to average over 90.0 % for years 2015 to 2018. The average one-year retention for technology students (AST-ABM, AST-MS, ITEC-M, ITEC-OS) from Fall 2016 to Fall 2018 was 84.2% and 94.2% for first-year and second-year students respectively.

12.3 Observance of Safety Standards

Our first approach to safety is direct training and supervision. Students, faculty and staff are required to complete a training needs assessment. Students are not allowed to operate laboratory equipment until they have been trained on safety operating procedures and fully understand the hazards associated with the equipment and/or processes. In addition to the training on safety awareness and operating procedures, the department has strict policies on supervision in all departmental laboratories. Teaching labs are staffed by the instructor or laboratory coordinator at all times. When it is deemed necessary to have more than one supervisor to ensure a safe environment, the instructor will be assigned additional student help to assist. No students are allowed access to laboratory equipment without supervision during scheduled lab time, open lab time, or during make-up labs.

The safety process has come under scrutiny due to tragic injuries at several prestigious US institutions in the past decade. The ABE faculty continues to stress that it is departmental policy that no student work in a laboratory without proper safety training and equipment, and that primary responsibility for this lies with the faculty member in charge of a particular course or research lab space. ABE faculty led a project to improve lab safety across the College of Engineering entitled the Shop Safety Enhancement Learning and Training (SSELT) Infrastructure Project. The SSELT has established a system that includes rigorous shop safety training modules and the supporting infrastructure. More information about shop safety audit, tool use agreement, training, and additional information for laboratory and shop safety can be found on the departmental website. (http://www.abe.iastate.edu/abe-department/abe-facility-safety/)

Building a culture of safety is also important. There are a variety of ways that departmental students themselves through our safety courses or through the ASSE student section explore safety. For example, students in TSM 371 Introduction to Occupational Safety have routinely conducted safety audits of campus laboratory facilities and helped in identifying hazards as well as intervention methods. Student teams have developed lockout/tagout procedures for all equipment in the manufacturing labs even though these educational settings are exempt from the OSHA standard. As a class assignment, student teams have also been asked to identify hazards and recommend solutions for all aspects of educational environment. The results of these assignments are passed on to appropriate administration for consideration and action. Other courses where safety projects have been used are the capstone courses TSM 415 and 416 projects. These courses on occasion involve projects that have a safety focus.

12.4 Availability of Resource Materials

Many instructors of TSM courses use supplemental reference materials. These materials include DVDs, reference materials, periodicals, software, and the Internet. Many of these materials are reflected in the course syllabi located in Appendix A. Examples of supplemental materials include:

- TSM 210 Fundamentals of Technology uses Canvas to provide access to syllabus, assignments, homework and supplemental video instruction.
- TSM 371 Introduction to Occupational Safety Technology uses Canvas to provide access to syllabus, projects, homework, and current journal articles related to safety management. Canvas is also used to engage students in reflections on learning posting to Canvas.
- TSM 376 Fire Protection and Prevention uses DVDs, videos and YouTube for delivery of specialized message not otherwise available to students.

The ISU Library encourages use of its collections and many services, and provides multiple points of contact for assistance, including the Main Desk, chat and email reference (Ask Us), Interlibrary Loan/Document Delivery, Special Collections/University Archives, and individual appointments with subject specialist librarians. A one-credit course in the use of library resources is required for undergraduate students, and librarians also give class presentations, workshops, and tours upon request.

The library's website provides access to local books, journals, and standards; course reserves; instructional guides; and over 400 indexing and abstracting databases. The capabilities of Compendex, the world's most extensive engineering literature database, are particularly useful to students seeking to understand the literature relevant to specific technology systems. Subscriptions to library databases, e-journals, and e-books are accessible off-campus to ISU users. Faculty publications such as journal articles, conference papers, and reports, as well as student theses and dissertations, are available free to students and to the world through the ISU Digital Repository maintained by the library.

Students in all four option programs have access to computer software for downloads at no additional cost and required software is also available on departmental computers located in our computer labs. Contemporary computer software has an important role in many of the TSM courses. The software packages available in the computer labs and downloads include: Abaqus SE, Ansys, Autodesk Products, Bentley Microstation, ChemBioDraw, EndNote, IHT, JetBrains Tools, JMP, Mathematica, MathType, MATLAB, Microsoft Office, OriginPro, PTC Creo, PTC MathCAD, SOLIDWORKS, and Tecplot.

12.5 Teaching and Measurement of Program Learning Outcomes

As described in Standard 5, the program/option learning outcomes are written in terms of "abilities." Abilities are complex combinations of motivations, dispositions, attitudes, values, strategies, behaviors, self-perceptions and knowledge of concepts and processes. A complex ability is difficult to observe directly but can be inferred from performance. Workplace competencies are the application of knowledge, skills, attitudes, values and behaviors. They are directly measurable through actions by an individual.

We have identified, validated and mapped a set of workplace competencies to the program/option learning outcomes. By measuring the demonstration of the workplace competencies, achievement of learning outcomes can be determined. Student achievement of common learning outcomes are determined by directly measuring workplace competency demonstration with supervisor evaluation of students in internships. The process by which this was done is described by Brumm et. al (2006) and can be found in Appendix C.

The department has been collecting data from students in all four option programs on internships since the fall of 2006. Students self-assess, and supervisors are asked to assess students on how often students perform key actions associated with 15 different workplace competencies when given the opportunity. Responses are on a Likert scale: 5 = always or almost always; 4 = often; 3 = usually; 2 = sometimes; and 1 = never or almost never.

The average results of these assessments from 2016 to 2019 are listed in Table 12.9. The minimum average rating of all option program students by their supervisors was 4.20 – students, on average, clearly demonstrated the workplace competencies. For all workplace competencies, supervisors rated students higher than the students rated themselves.

Table 12.9 Average results[1] of competency assessment by option programs in internships from Spring 2016 through Summer 2019 semesters.

	AST-ABM		AST-MS		ITEC-M		ITEC-OS	
Workplace Competency	Super-visor (n=45)	Self (n=47)	Super-visor (n=171)	Self (n=173)	Super-visor (n=276)	Self (n=283)	Super-visor (n=44)	Self (n=47)
Analysis & Judgment	4.32	4.32	4.51	4.35	4.44	4.41	4.49	4.30
Cultural Adaptability	4.25	4.17	4.45	4.15	4.39	4.23	4.32	4.28
Communication	4.35	4.34	4.57	4.38	4.48	4.42	4.51	4.29
Continuous Learning	4.53	4.36	4.62	4.34	4.67	4.54	4.51	4.54
Customer Focus	4.29	4.41	4.51	4.31	4.44	4.23	4.37	4.28
General Knowledge	4.47	4.42	4.57	4.29	4.53	4.38	4.56	4.44
Initiative	4.23	4.29	4.40	4.21	4.38	4.20	4.43	4.23
Innovation	4.19	4.16	4.42	4.14	4.27	4.19	4.18	3.93
Integrity	4.79	4.72	4.81	4.68	4.79	4.74	4.70	4.75
Planning	4.51	4.47	4.66	4.45	4.48	4.43	4.34	4.28
Professional Impact	4.72	4.57	4.74	4.54	4.71	4.59	4.65	4.67
Quality Orientation	4.57	4.59	4.63	4.52	4.63	4.58	4.53	4.58
Safety Awareness	4.31	4.43	4.60	4.28	4.57	4.38	4.68	4.61
Teamwork	4.44	4.50	4.61	4.47	4.55	4.52	4.53	4.55
Technical Knowledge	4.43	4.27	4.55	4.29	4.52	4.38	4.47	4.29

[1] The survey question is: when given the opportunity, how often do does the student (or you) perform the key actions associated with each of the competencies? Response scale is 1. Never or almost never; 2. Seldom; 3. Sometimes; 4. Often; or 5. Always or almost always.

Achievement of Common Program Learning Outcomes

As described in Standard 5, comparing the achievement of common learning outcomes to the "perfect" achievement of the common competencies can be accomplished with the following formula:

$$\% \, Achievement = \left(\frac{\sum (workplace \; competency \; ranking) \, x (weighting \; factor)}{\sum (5) \, x \, (weighting \; factor)} \right) x \; 100\%$$

Our target is that students in all four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) should attain at least an 80% achievement of each common learning outcome (a-k) as measured by their demonstration of workplace competencies in internships. Figures 12.2 through 12.5 shows the achievement of common learning outcome by students in all four options, as determined by supervisors (direct measurement) and student self-assessment (indirect measurement) in an internship setting. Students have achieved the target achievement for each common learning outcomes and these achievement scores have improved since the previous accreditation visit.

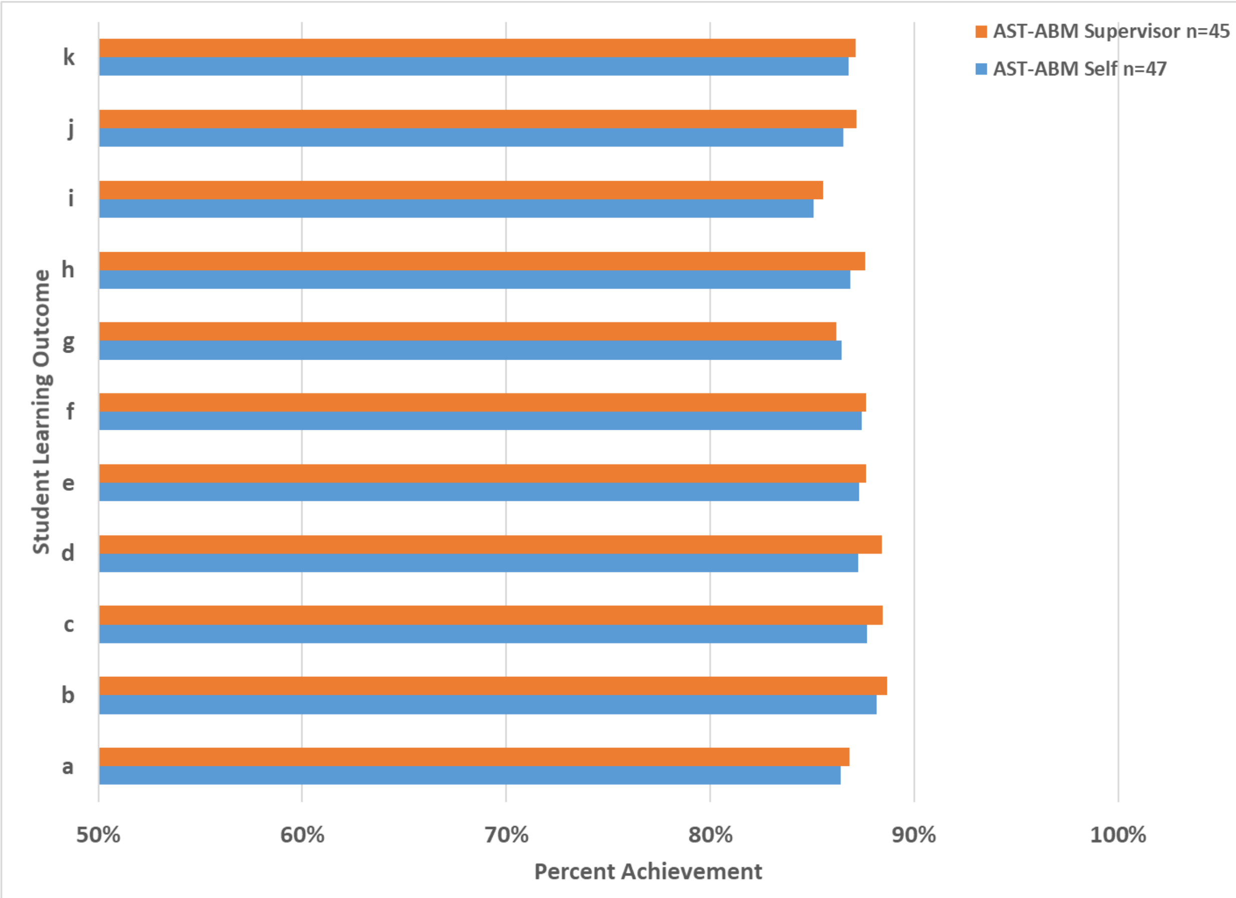

Figure 12.2. Percent achievement of common learning outcomes by AST-ABM students in an internship setting as determined by supervisor and self-assessment (2016-2019).

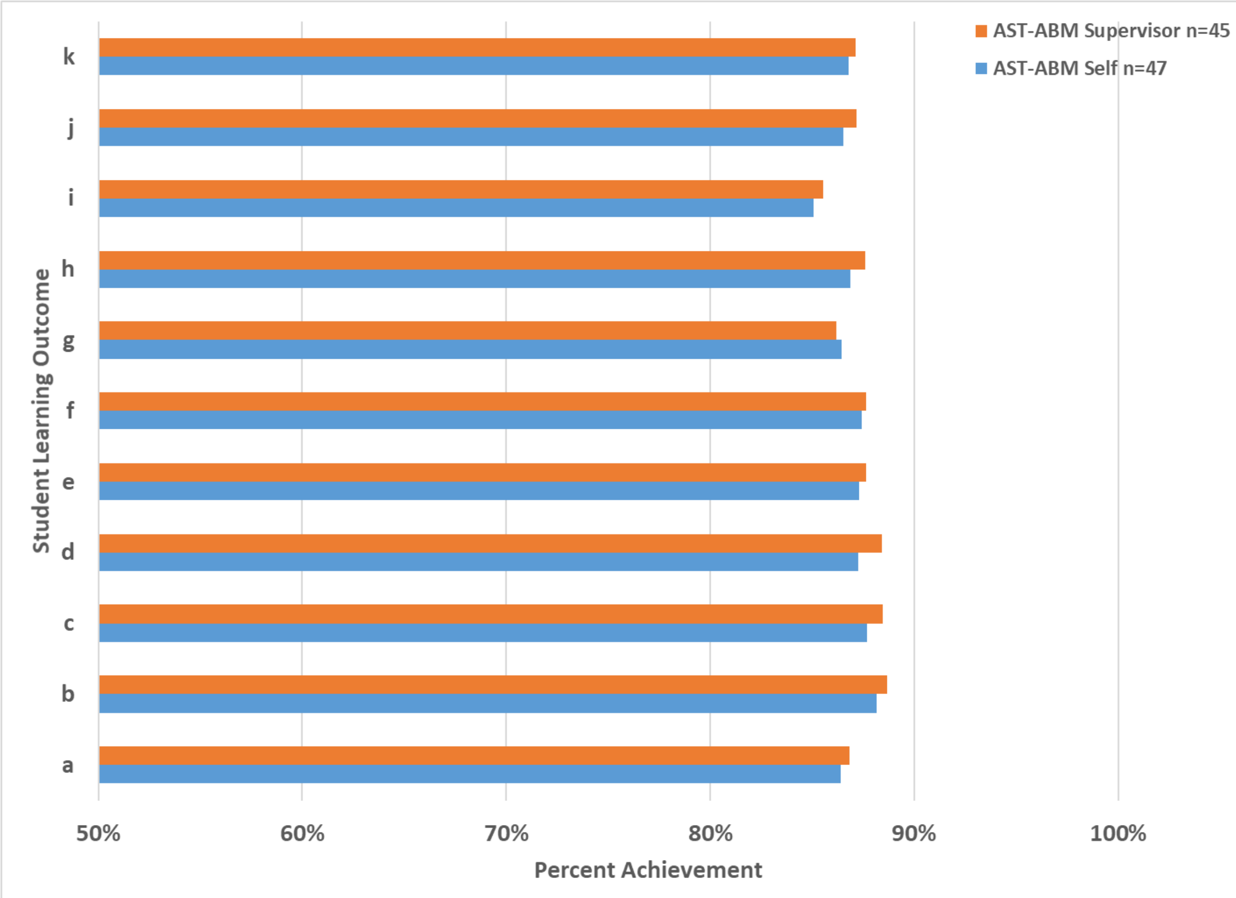

Figure 12.3. Percent achievement of common learning outcomes by AST-MS students in an internship setting as determined by supervisor and self-assessment (2016-2019).

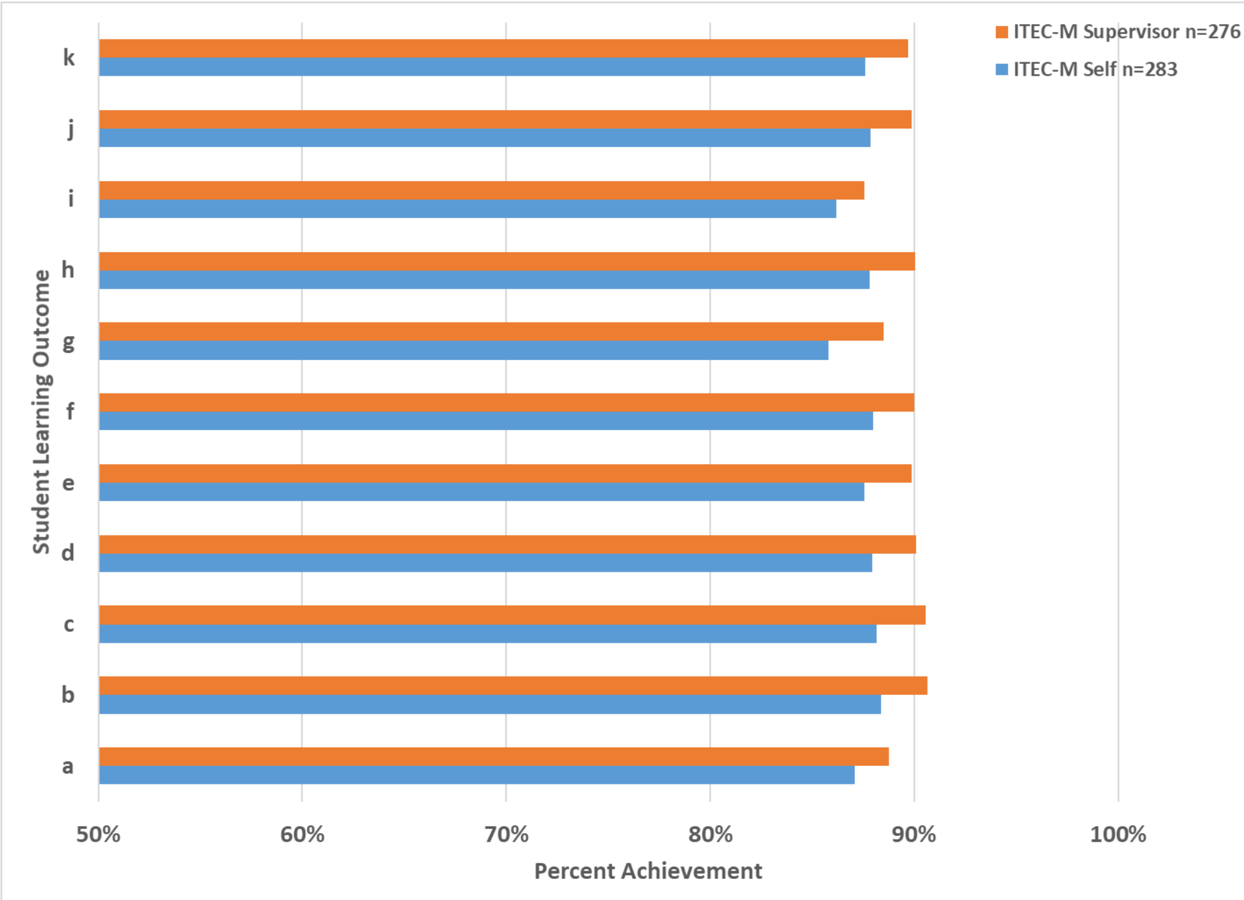

Figure 12.4. Percent achievement of common learning outcomes by ITEC-M students in an internship setting as determined by supervisor and self-assessment (2016-2019).

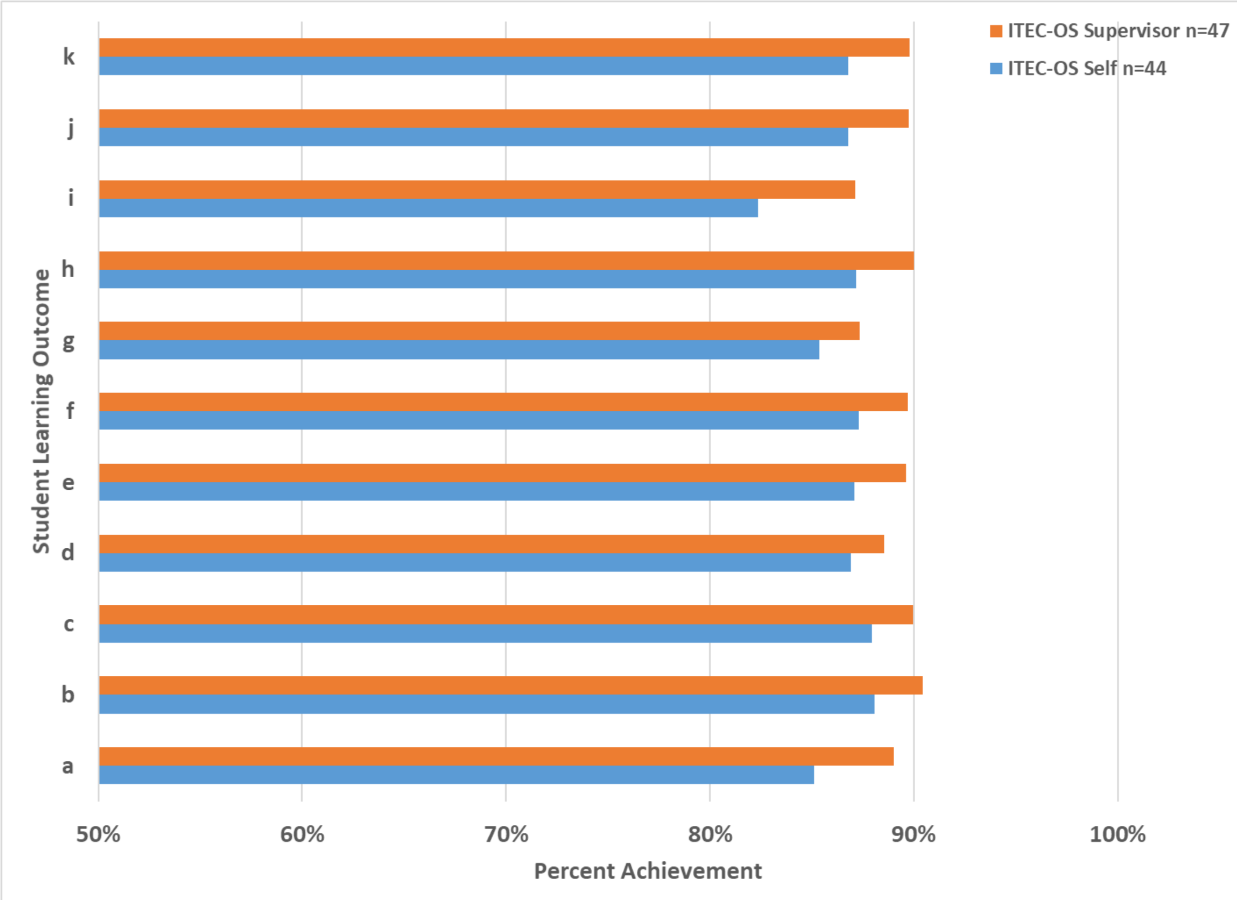

Figure 12.5. Percent achievement of common learning outcomes by ITEC-OS students in an internship setting as determined by supervisor and self-assessment (2016-2019).

12.6 Supervision of Instruction

The Agricultural and Biosystems Engineering Department has an established practice of assessing instruction that includes Student Evaluation of Instruction (SEI), peer evaluation of instruction and annual instructor performance reviews. The department encourages instructors to seek peer evaluation of courses being taught. This peer evaluation is used to strengthen the course and to document the faculty teaching abilities during the promotion and tenure process. Instructional effectiveness is part of annual faculty reviews by the Department Chair. The Associate Chair for Teaching and Department Chair also monitor instructor performance via the SEI described earlier. Adjustment in assignments can be made accordingly by the Chair.

Iowa State University offers opportunities to instructors to improve instruction through the Center for Excellence in Learning and teaching (CELT). Various teaching related seminars are sponsored by CELT. (http://www.celt.iastate.edu/)

12.7 Placement Services Available to Graduates

Iowa State University provides career services offices in each college. Each office serves students and alumni in identifying experiential learning assignments and permanent career employment. Students in all four option programs (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) use the College of Agriculture and Life Sciences Career Services (http://www.career.cals.iastate.edu/)

Students in all four option programs are encouraged to register with ISU Agriculture and Life Sciences Career Services. The following services are available through Agriculture and Life Sciences Career Services:

- Registration
- Resume tips
- Interview tips
- Part time opportunities
- Company links
- Job databases
- Salary, housing, and internship information
- Graduate student information
- On-campus interviews
- Mock interviews
- Presentations to clubs and organizations
- Ag Career Day

Agriculture and Life Sciences Career Services has developed and nurtured strategic relationships with industrial and employer partners. Activities include periodic internal and external review meetings, training, and ongoing communications regarding the partnering process. Students can take advantage of trips, project activities, and industrial contacts offered by the partners.

Students in all four option programs also have access to participate in the Engineering Career Services career fair (two in the fall, one in the spring). The department has secured the ability of our technology students to participate in this career fair. Each fair has over 350 companies participating (https://www.engineering.iastate.edu/ecs/students/career-fair-students/).

Additionally, the Industrial Technology (student) Club organizes a Technology Industry Night each semester where 20 to 30 employers of students from all four program/options. Students discuss career options and share their resumes with prospective employers.

12.8 Syllabi clearly describe course objectives and student competencies.

Appendix A contains the syllabi for all TSM courses. Each syllabus clearly describes the objectives (learning outcomes) for the course and the common program learning outcomes (a-k) the course addresses.

12.9 Learning competencies mapping to program learning outcomes.

Table 12.6 details the mapping of TSM courses common to all options vs. the common program learning outcomes (a-k). Individual common competencies have from 7 to 14 courses or sequences supporting their attainment. These courses represent 62 of the 120 required credits.

Free electives, social science and humanities, biological and natural resource, and communication credits for all four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs contribute further to the attainment of the common competencies.

Table 12.6 Relationship of courses common to all four option (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs to common learning outcomes.

Courses Common to All Options	Common Learning Outcomes[1]										
	a	b	c	d	e	f	g	h	i	j	k
TSM 110 (Introduction to Technology)				x		x	x		x	x	
TSM 111 (Experiencing Technology)	x	x		x			x			x	x
TSM 115 (Solving Technical Problems)	x				x		x				x
TSM 116 (Intro to Design in Technology)	x		x	x		x	x		x		x
TSM 201 (Preparing for Workplace Seminar)						x	x	x	x	x	
TSM 210 (Fundamentals of Technology)	x			x	x		x	x			x
TSM 270 (Principles of Injury Prevention)	x		x	x	x	x	x		x	x	x
TSM 310 (Total Quality Improvement)	x		x	x	x	x	x		x		x
TSM 363 (Electric Power and Electronics for Agriculture and Industry)	x	x	x		x	x	x				x
TSM 370 (Occupational Safety)	x		x	x	x	x	x	x		x	x
TSM 397, 399 (Internship in Technology) & (Work Experience in Technology)	x	x	x	x	x	x	x	x	x	x	x
TSM 415, 416 (Technology Capstone I & II)	x	x	x	x	x	x	x	x	x	x	x
Chem 163 (College Chemistry)	x										
Chem 163L (Laboratory in College Chemistry)		x		x			x				
Econ 101 (Principles of Microeconomics)								x		x	x
English 150 (Critical Thinking and Communication)				x			x	x			
English 250 (Written, Oral, Visual, and Electronic Composition)				x			x	x			
Lib 160 (Information Literacy)							x		x		
Math 145, 151 (Trigonometry) & (Calculus for Business and Social Sciences)	x										
Phys 111 (General Physics)	x	x		x			x				x
Stat 104 (Introduction to Statistics)	x	x		x			x				x

[1] (a) ability to apply knowledge of mathematics, science, technology and applied sciences; (b) an ability to design and conduct experiments, as well as to analyze and interpret data; (c) ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; (d) ability to function on multi-disciplinary teams; (e) ability to identify and solve applied science problems; (f) understanding of professional and ethical responsibility; (g) an ability to communicate effectively; (h) the broad education necessary to understand the impact of solutions in a global economic, environmental, and societal context; (i) recognition of the need for, and an ability to engage in life-long learning; (j) a knowledge of contemporary issues; and (k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Table 12.7 shows the specific option core TSM courses contribute to attainment of the common competencies (a-k) within the two AST options. AST-ABM specific option competencies have from 1 up to 8 courses or sequences supporting their attainment. These courses represent 21 of the 120 required credits. AST-MS specific option competencies have from 1 up to 8 courses or sequences supporting their attainment.

Table 12.7 Relationship of option specific core courses for AST-ABM and AST-MS option programs to common learning outcomes.

Option Core Courses	Common Learning Outcomes[1]										
	a	b	c	d	e	f	g	h	i	j	k
AST-ABM Option											
TSM 322 (Preservation of Grain Quality)	x		x		x			x			x
TSM 322L (Preservation of Grain Quality Lab)	x	x	x	x	x		x				x
TSM 324 (Soil and Water Conservation Management)	x		x		x	x	x			x	x
TSM 325 (Biorenewable Systems)	x		x				x	x		x	x
TSM 327 (Animal Production Systems)	x		x	x	x		x			x	x
TSM 330 (Ag Machinery and Power Management)	x	x	x	x	x		x				x
TSM 333 (Precision Farming Systems)	x	x	x			x		x	x		x
ECON 230 (Farm Business Management)	x	x						x			x
AST-MS Option											
TSM 216 (Advanced Graphics)	x		x		x		x				x
TSM 240 (Intro to Manufacturing Processes)	x			x	x		x				x
TSM 330 (Ag Machinery and Power Management)	x	x	x	x	x		x				x
TSM 333 (Precision Farming Systems)	x	x	x			x		x	x		x
TSM 335 (Tractor Power)	x	x	x		x		x			x	
TSM 337 (Fluid Power Systems Technology)	x	x	x		x		x				x
TSM 443 (Statics and Strength of Materials for Technology)	x	x	x		x						x
TSM 465 (Automation Systems)	x	x	x	x	x		x				x

[1] (a) ability to apply knowledge of mathematics, science, technology and applied sciences; (b) an ability to design and conduct experiments, as well as to analyze and interpret data; (c) ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; (d) ability to function on multi-disciplinary teams; (e) ability to identify and solve applied science problems; (f) understanding of professional and ethical responsibility; (g) an ability to communicate effectively; (h) the broad education necessary to understand the impact of solutions in a global economic, environmental, and societal context; (i) recognition of the need for, and an ability to engage in life-long learning; (j) a knowledge of contemporary issues; and (k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Table 12.8 shows how the specific option TSM core courses contribute to attainment of the common competencies (a-k) within the two ITEC options. ITEC-M specific option competencies have from 1 up to 8 courses or sequences supporting their attainment. These courses represent 24 of the 120 required credits. ITEC-OS specific option competencies have from 2 up to 8 courses or sequences supporting their attainment. These courses represent 22 of the 120 required credits.

Table 12.8 Relationship of option specific core courses for ITEC-M and ITEC-OS option programs to common competencies.

Option Core Courses	Common Learning Outcomes[1]										
	a	b	c	d	e	f	g	h	i	j	k
ITEC-M Option											
TSM 216 (Advanced Graphics)	x		x		x		x				x
TSM 240 (Intro to Manufacturing Processes)	x			x	x		x				x
TSM 337 (Fluid Power Systems Technology)	x	x	x		x		x				x
TSM 340 (Advanced Automated Manufacturing Systems)	x		x		x		x				x
TSM 440 (Lean Manufacturing)	x	x	x	x	x		x		x		x
TSM 443 (Statics and Strength of Materials for Technology)	x	x	x		x						x
TSM 444 (Facility Planning)	x		x	x	x	x	x	x	x	x	x
TSM 465 (Automation Systems)	x	x	x	x	x		x				x
ITEC-OS Option											
TSM 240 (Intro to Manufacturing Processes)	x			x	x		x				x
TSM 371 (Intro to Occupational Safety)	x		x	x	x	x	x		x	x	x
TSM 372 (Legal Aspects of Occupational Safety & Health)	x		x	x	x	x	x	x	x	x	x
TSM 376 (Fire Protection and Prevention)	x		x		x	x	x				x
TSM 470 (Industrial Hygiene)	x	x	x		x	x	x			x	x
TSM 471 (Safety Laboratory)	x	x	x	x	x	x	x				x
TSM 477 (System Safety Analysis)	x	x	x	x	x	x	x				x
H S 105 (First Aid and Emergency Care)						x			x		
PSYCH 250 (Psychology of the Workplace)			x			x	x	x			x

[1] (a) ability to apply knowledge of mathematics, science, technology and applied sciences; (b) an ability to design and conduct experiments, as well as to analyze and interpret data; (c) ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability; (d) ability to function on multi-disciplinary teams; (e) ability to identify and solve applied science problems; (f) understanding of professional and ethical responsibility; (g) an ability to communicate effectively; (h) the broad education necessary to understand the impact of solutions in a global economic, environmental, and societal context; (i) recognition of the need for, and an ability to engage in life-long learning; (j) a knowledge of contemporary issues; and (k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Additionally, Tables 12.9 through 12.12 illustrate how completion of TSM option core courses by the AST-ABM, AST-MS, ITEC-M, and ITEC-OS option programs contribute to the attainment of each option specific competency (l-m). These specific option competencies have a range from 2 to 8 courses supporting their attainment.

Table 12.9 Relationship of option specific core courses for AST-ABM option program to option specific learning outcomes.

Option Core Courses	Option Specific Learning Outcomes[1]		
	l	m	n
TSM 322 (Preservation of Grain Quality)	x	x	x
TSM 322L (Preservation of Grain Quality Lab)	x		x
TSM 324 (Soil and Water Conservation Management)	x	x	x
TSM 325 (Biorenewable Systems)	x	x	x
TSM 327 (Animal Production Systems)	x	x	x
TSM 330 (Ag Machinery and Power Management)	x		x
TSM 333 (Precision Farming Systems)	x	x	x
ECON 230 (Farm Business Management)	x		

[1] (l) an ability to develop, implement, and evaluate best management practices for human and natural resource systems for producing, processing and marketing bio-based products worldwide; (m) an ability to integrate and apply agricultural and biosystems engineering technologies in the bio-based industries; and (n) an understanding of the complex systems that sustain our water, air, soils, and food.

Table 12.10 Relationship of option specific core courses for AST-MS option program to option specific learning outcomes.

Option Core Courses	Option Specific Learning Outcomes[1]		
	l	m	n
TSM 216 (Advanced Graphics)	x		
TSM 240 (Intro to Manufacturing Processes)	x		
TSM 330 (Ag Machinery and Power Management)	x	x	x
TSM 333 (Precision Farming Systems)	x	x	
TSM 335 (Tractor Power)	x	x	x
TSM 337 (Fluid Power Systems Technology)	x	x	
TSM 443 (Statics and Strength of Materials for Technology)	x	x	
TSM 465 (Automation Systems)	x		

[1] (l) an ability to specify, manage, and test machine systems in the context of complete agricultural, biological production or processing systems; (m) an understanding of the technology and application of machine systems including power and information flows, function and interaction with biological materials; and (n) an ability to perform energy and cost analyses of complete machine systems to insure the success and sustainability of an enterprise.

Table 12.11 Relationship of option specific core courses for ITEC-M option program to option specific learning outcomes.

Option Core Courses	Option Specific Learning Outcomes[1]		
	l	m	n
TSM 216 (Advanced Graphics)	x	x	
TSM 240 (Intro to Manufacturing Processes)	x	x	
TSM 337 (Fluid Power Systems Technology)	x	x	
TSM 340 (Advanced Automated Manufacturing Systems)	x	x	x
TSM 440 (Lean Manufacturing)	x	x	x
TSM 443 (Statics and Strength of Materials for Technology)	x	x	
TSM 444 (Facility Planning)	x	x	x
TSM 465 (Automation Systems)	x	x	x

[1] (l) an ability to develop, implement, and evaluate manufacturing processes and facilities; (m) an ability to apply computer aided design and manufacturing, control systems, and automation systems to industrial settings; and (n) an ability to implement and analyze the use of manufacturing technologies to enhance production, quality, and profitability of manufacturing systems.

Table 12.12 Relationship of option specific core courses for ITEC-OS option program to option specific learning outcomes.

Option Core Courses	Option Specific Learning Outcomes[1]		
	l	m	n
TSM 240 (Intro to Manufacturing Processes)		x	
TSM 371 (Intro to Occupational Safety)	x	x	x
TSM 372 (Legal Aspects of Occupational Safety & Health)	x		x
TSM 376 (Fire Protection and Prevention)	x	x	x
TSM 470 (Industrial Hygiene)	x	x	x
TSM 471 (Safety Laboratory)		x	x
TSM 477 (System Safety Analysis)		x	x
H S 105 (First Aid and Emergency Care)	x		
PSYCH 250 (Psychology of the Workplace)	x		

[1] (l) an ability to develop, implement, and evaluate occupational safety and health programs for businesses and organizations; (m) an ability to identify and analyze hazards and loss producing conditions in work environments; and (n) an ability to eliminate or control occupational hazards using appropriate technologies, administrative interventions, and training for behavior modification.

12.10 Adequacy of courses delivered by distance

Several TSM courses are delivered by distance (online), especially courses specific to the ITEC-OS program option. Online courses are the same as those offered on campus in that they are held to the same academic standards, carry residential credit, and are taught by ABE faculty. Credit earned becomes a part of the academic record at Iowa State University and may be used to meet degree requirements the same as credit earned on campus.

Online TSM courses utilize the similar types of student engagement and assessment practices used in face-to-face course instruction. The courses are evaluated through the same processes used for face-to-face courses (see Standard 12.2). ABE faculty work with instructional technology specialists in the College of Agriculture and Life Sciences and the Center for Excellence in Learning and Teaching to improve online education practices and methods.

Standard 13

Standard 13 - Graduate Satisfaction with Program/Option: Graduate evaluations of the program/option shall be made on a regular basis (two to five years). These evaluations shall include attitudes related to the program learning outcomes identified for the program/option. Summary data shall be available for the graduate evaluations of the program/option.

SUMMARY RESPONSE

Evaluations of graduate satisfaction with the programs are made every semester. Students are satisfied with their ability to meet general and option specific competencies. Students also report that they are satisfied with the quality of the classes, the facilities, the department's academic culture and the support they receive.

DETAILED RESPONSE

At the time of graduation, students in the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) are given the opportunity to provide evaluation and comments about their educational experience at Iowa State University, their degree program/option, and a self-assessment of how they met each of the program learning outcomes. To facilitate the collection of these data, the department administers an anonymous survey at the end of each semester.

On the survey, students in the four program options are asked to self-assess how well they met each of the student learning outcomes (a-k) and (l-n). A one-to-five scale was used in response to this question: How well did you achieve the outcome? 1-Not at all, 2-Somewhat, 3-Adequately, 4-Above Average, and 5-Extremely Well. Tables 13.1, 13.2, 13.3, and 13.4 give the results of student self-assessments for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS), respectively. Generally, students in all options believed they achieved the learning outcomes for their option. Little variation was apparent from year to year in the student self-assessment data.

Table 13.1 Mean self-assessment[1] by AST-ABM option graduates of their achievement of student learning outcomes.

Learning Outcome	2015-16 (n = 5)	2016-17 (n = 6)	2017-18 (n = 2)	2018-19 (n = 10)	Mean
(a) Ability to apply knowledge of mathematics, science and engineering/technology	3.6	3.4	4.1	3.6	3.7
(b) Ability to design and conduct experiments, as well as to analyze and interpret data	3.5	3.5	4.2	3.6	3.7
(c) Ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	3.6	3.6	4.3	3.5	3.8
(d) Ability to function on multi-disciplinary teams	3.9	3.8	4.2	4.0	4.0
(e) Ability to identify and solve science problems	3.9	3.5	4.2	3.9	3.9
(f) Understanding of professional and ethical responsibility	4	3.8	4.2	4.0	4.0
(g) Ability to communicate effectively	3.9	3.9	4.3	3.9	4.0
(h) Broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context	3.6	3.6	4.3	3.5	3.8
(i) Recognition of the need for, and an ability to engage in, life-long learning	3.8	3.6	4.2	3.7	3.8
(j) Knowledge of contemporary issues	3.3	3.3	3.9	3.5	3.5
(k) Ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	3.9	3.7	4.2	3.6	3.9
(l) an ability to develop, implement, and evaluate best management practices for human and natural resource systems for producing, processing and marketing bio-based products worldwide	3.8	3.3	4.0	3.8	3.7
(m) an ability to integrate and apply agricultural and biosystems engineering technologies in the bio-based industries	3.8	3.6	4.3	3.8	3.9
(n) an understanding of the complex systems that sustain our water, air, soils, and food	4.1	3.4	4.2	3.8	3.9

[1]Scoring Scale: How well did you achieve the outcome? 1-Not at all, 2-Somewhat, 3-Adequately, 4-Above Average, and 5-Extremely Well.

Table 13.2 Mean self-assessment[1] by AST-MS option graduates of their achievement of student learning outcomes.

Learning Outcome	2015-16 (n = 16)	2016-17 (n = 21)	2017-18 (n = 14)	2018-19 (n = 20)	Mean
(a) Ability to apply knowledge of mathematics, science and engineering/technology	3.6	3.4	4.1	3.6	3.7
(b) Ability to design and conduct experiments, as well as to analyze and interpret data	3.5	3.5	4.2	3.6	3.7
(c) Ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	3.6	3.6	4.3	3.5	3.8
(d) Ability to function on multi-disciplinary teams	3.9	3.8	4.2	4.0	4.0
(e) Ability to identify and solve science problems	3.9	3.5	4.2	3.9	3.9
(f) Understanding of professional and ethical responsibility	4.0	3.8	4.2	4.0	4.0
(g) Ability to communicate effectively	3.9	3.9	4.3	3.9	4.0
(h) Broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context	3.6	3.6	4.3	3.5	3.8
(i) Recognition of the need for, and an ability to engage in, life-long learning	3.8	3.6	4.2	3.7	3.8
(j) Knowledge of contemporary issues	3.3	3.3	3.9	3.5	3.5
(k) Ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	3.9	3.7	4.2	3.6	3.9
(l) an ability to specify, manage, and test machine systems in the context of complete agricultural, biological production or processing systems	3.2	4.0	3.5	3.4	3.5
(m) an understanding of the technology and application of machine systems including power and information flows, function and interaction with biological materials	2.8	4.0	3.0	3.7	3.4
(n) an ability to perform energy and cost analyses of complete machine systems to ensure the success and sustainability of an enterprise	2.8	4.0	3.5	3.8	3.5

[1]Scoring Scale: How well did you achieve the outcome? 1-Not at all, 2-Somewhat, 3-Adequately, 4-Above Average, and 5-Extremely Well.

Table 13.3 Mean self-assessment[1] by ITEC-M graduates of their achievement of student learning outcomes.

Learning Outcome		2015-16 (n = 16)	2016-17 (n = 14)	2017-18 (n = 19)	2018-19 (n = 35)	Mean
(a)	Ability to apply knowledge of mathematics, science and engineering/technology	3.9	3.9	4.1	3.8	3.9
(b)	Ability to design and conduct experiments, as well as to analyze and interpret data	3.8	3.4	4.0	3.9	3.8
(c)	Ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	4.1	3.8	4.0	3.7	3.9
(d)	Ability to function on multi-disciplinary teams	4.1	3.9	4.3	4.1	4.1
(e)	Ability to identify and solve science problems	4.3	3.8	4.1	4.0	4.1
(f)	Understanding of professional and ethical responsibility	4.0	3.8	4.2	4.1	4.0
(g)	Ability to communicate effectively	3.8	3.8	4.3	4.1	4.0
(h)	Broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context	3.6	3.5	4.0	3.7	3.7
(i)	Recognition of the need for, and an ability to engage in, life-long learning	3.7	3.9	4.3	4.1	4.0
(j)	Knowledge of contemporary issues	3.2	3.1	3.8	3.6	3.4
(k)	Ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	3.8	3.9	4.2	3.9	4.0
(l)	an ability to develop, implement, and evaluate manufacturing processes and facilities	4.2	4.0	4.4	4.1	4.2
(m)	an ability to apply computer aided design and manufacturing, control systems, and automation systems to industrial settings	3.8	3.6	4.4	4.1	4.0
(n)	an ability to implement and analyze the use of manufacturing technologies to enhance production, quality, and profitability of manufacturing systems	4.0	3.9	4.4	4.0	4.1

[1]Scoring Scale: How well did you achieve the outcome? 1-Not at all, 2-Somewhat, 3-Adequately, 4-Above Average, and 5-Extremely Well.

Table 13.4 Mean self-assessment[1] by ITEC-OS option graduates of their achievement of student learning outcomes.

Learning Outcome	2015-16 (n = 2)	2016-17 (n = 0)	2017-18 (n = 0)	2018-19 (n = 7)	Mean
(a) Ability to apply knowledge of mathematics, science and engineering/technology	3.9	ND	ND	3.8	3.9
(b) Ability to design and conduct experiments, as well as to analyze and interpret data	3.8	ND	ND	3.9	3.9
(c) Ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability	4.1	ND	ND	3.7	3.9
(d) Ability to function on multi-disciplinary teams	4.1	ND	ND	4.1	4.1
(e) Ability to identify and solve science problems	4.3	ND	ND	4.0	4.2
(f) Understanding of professional and ethical responsibility	4.0	ND	ND	4.1	4.1
(g) Ability to communicate effectively	3.8	ND	ND	4.1	4.0
(h) Broad education necessary to understand the impact of solutions in a global, economic, environmental, and societal context	3.6	ND	ND	3.7	3.7
(i) Recognition of the need for, and an ability to engage in, life-long learning	3.7	ND	ND	4.1	3.9
(j) Knowledge of contemporary issues	3.2	ND	ND	3.6	3.4
(k) Ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	3.8	ND	ND	3.9	3.9
(l) an ability to develop, implement, and evaluate occupational safety and health programs for businesses and organizations	4.0	ND	ND	3.8	3.9
(m) an ability to identify and analyze hazards and loss producing conditions in work environments	4.0	ND	ND	4.0	4.0
(n) an ability to eliminate or control occupational hazards using appropriate technologies, administrative interventions, and training for behavior modification	3.5	ND	ND	3.8	3.7

[1]Scoring Scale: How well did you achieve the outcome? 1-Not at all, 2-Somewhat, 3-Adequately, 4-Above Average, and 5-Extremely Well. ND = no data

Students in all four program options had similar responses to departmental elements of the degree programs (Tables 13.5 and 13.6). Students used a satisfaction scale of 1 to 5 with 5 being excellent and 1 representing poor. Students rated departmental advising, departmental faculty, and internship/co-op experiences very positively.

Students were also asked about their satisfaction with their departmental experience and with the departmental culture. Tables 13.5 and 13.6 gives the results for both AST students (both options) and ITEC students (both options), respectively. Average satisfaction was "very good" or higher for faculty, teaching, advising and their overall experience.

Table 13.5. Mean satisfaction rating[1] by AST-ABM and AST-MS option graduates of departmental experience and culture.

Description	2015-2016 (n=21)	2016-2017 (n=28)	2017-2018 (n=14)	2018-2019 (n=29)	Mean
Department supported my educational goals	4.2	3.9	4.6	4.1	4.2
Supportive faculty	4.5	4.3	4.5	4.3	4.4
Departmental teaching	3.8	3.6	4.3	4.1	4.0
Departmental advising	4.7	4.7	4.7	3.9	4.5
Overall departmental experience	4.3	4.0	4.6	4.3	4.3
Number of departmental faculty known[2]	1.5	1.8	2.3	2.7	2.1

[1]Satisfaction Scale: 1-poor, 2-fair, 3-average, 4-very good, and 5-Excellent.
[2]This question reports the average of the actual number listed by students.

Table 13.6. Mean satisfaction rating[1] by ITEC-M and ITEC-OS option graduates of departmental experience and culture.

Description	2015-2016 (n=19)	2016-2017 (n=14)	2017-2018 (n=23)	2018-2019 (n=29)	Mean
Department supported my educational goals	3.9	4.1	4.8	4.3	4.3
Supportive faculty	4.0	4.1	4.6	4.4	4.3
Departmental teaching	3.6	3.9	4.2	4.2	4.0
Departmental advising	4.1	4.3	4.6	4.5	4.4
Overall departmental experience	3.9	4.1	4.6	4.3	4.2
Number of departmental faculty known[2]	2.2	2.1	3.1	2.8	2.6

[1]Satisfaction Scale: 1-poor, 2-fair, 3-average, 4-very good, and 5-Excellent.
[2]This question reports the average of the actual number listed by students.

Students were asked about their satisfaction with departmental facilities and career support, Tables 13.7 and 13.8 for AST students (both ABM and MS options) and ITEC students (both M and OS options), respectively.

Table 13.7. Mean satisfaction rating[1] by AST-ABM and AST-MS option graduates of departmental facilities and career support.

Category Descriptions	2015-2016 (n=21)	2016-2017 (n=28)	2017-2018 (n=14)	2018-2019 (n=29)	Mean
Lecture facilities	4.6	4.6	4.8	4.4	4.6
Lab facilities	4.7	4.6	4.8	4.5	4.7
Lab equipment	4.7	4.4	4.6	4.4	4.5
Computing facilities	4.3	4.5	4.6	4.4	4.5
Internship/co-op experience	4.5	4.1	4.6	4.1	4.3
Placement services	4.2	3.8	4.3	3.9	4.1

[1]Satisfaction Scale: 1-poor, 2-fair, 3-average, 4-very good, and 5-Excellent.

Table 13.8. Mean satisfaction rating[1] by ITEC-M and ITEC-OS option graduates of departmental facilities and career support.

Category Descriptions	2015-2016 (n=19)	2016-2017 (n=14)	2017-2018 (n=23)	2018-2019 (n=29)	Mean
Lecture facilities	4.6	4.6	4.6	4.4	4.6
Lab facilities	4.7	4.7	4.8	4.5	4.7
Lab equipment	4.6	4.6	4.8	4.4	4.6
Computing facilities	4.5	4.6	4.7	4.4	4.6
Internship/co-op experience	4.3	3.9	4.3	4.2	4.2
Placement services	3.6	4.0	3.9	4.1	3.9

[1]Satisfaction Scale: 1-poor, 2-fair, 3-average, 4-very good, and 5-Excellent.

Graduating students were also asked about their satisfaction with the courses they took while at Iowa State. Tables 13.9 and 13.10 give the mean responses for AST and ITEC students. All students generally rated courses within the department as "very good" as compared to various courses offered by other departments, rated as merely "adequate." Additionally, students felt that the courses within the department had an appropriate amount of rigor and intellectual challenge.

Table 13.9. Mean satisfaction rating[1] by AST-ABM and AST-MS option students of course quality within and outside of their departmental program.

Category Descriptions	2015-2016 (n=21)	2016-2017 (n=28)	2017-2018 (n=14)	2018-2019 (n=29)	Mean
TSM course quality?	4.2	4.1	4.4	4.1	4.2
Math departmental course quality?	3.0	2.9	2.9	2.7	2.9
Chemistry departmental course quality?	3.3	2.8	3.0	2.8	3.0
Physics departmental course quality?	3.3	2.8	2.9	2.4	2.9
English departmental course quality?	2.9	3.1	3.0	2.7	2.9
U.S. diversity course quality?	3.0	2.8	2.9	2.5	2.8
International perspective course quality?	3.0	2.8	2.9	2.7	2.9
TSM course intellectual challenge?[2]	3.0	3.0	2.9	3.0	3.0

[1]Satisfaction Scale: 1-poor, 2-fair, 3-average, 4-very good, and 5-Excellent.
[2]Scale: 1-not challenging, 3-appropriate amount of challenge, 5-too challenging

Table 13.10. Mean satisfaction rating[1] by ITEC-M and ITEC-OS option students of course quality within and outside of their departmental program.

Category Description	2015-2016 (n=19)	2016-2017 (n=14)	2017-2018 (n=23)	2018-2019 (n=29)	Mean
TSM course quality?	3.9	4.0	4.3	4.2	4.1
Math department course quality?	2.9	3.0	3.3	3.4	3.2
Chemistry departmental course quality?	3.2	3.2	3.2	3.4	3.3
Physics departmental course quality?	3.1	2.7	3.1	3.2	3.0
English departmental course quality?	3.3	3.0	3.4	3.6	3.3
U.S. diversity course quality?	3.5	3.3	3.2	3.5	3.4
International perspective course quality?	3.6	3.4	3.5	3.6	3.5
TSM course intellectual challenge?[2]	2.7	2.5	3.0	2.9	2.8

[1]Satisfaction Scale: 1-poor, 2-fair, 3-average, 4-very good, and 5-Excellent.
[2]Scale: 1-not challenging, 3-appropriate amount of challenge, 5-too challenging

Standard 14

Standard 14 - Employment of Graduates: Placement, job titles, and salaries of graduates shall be tracked on a regular basis (two to five years) including the degree to which jobs held by graduates are consistent with program learning outcomes. Summary data shall be available for the employment of graduates.

SUMMARY RESPONSE

The average placement rates for all four programs over the past five years for which data is available ranges from 82% to 100%, and average starting salaries for the graduates range from $47,000 to $65,000 per year. These are strong rates of placement and strong starting salaries. We believe that our strong placement and salary results are indicative of the overall program quality, ability to attract strong students, and high regard with which key external constituencies view our programs.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department presents data collected by the College of Agriculture and Life Sciences Career Services and analyzed by members of the Technology Curriculum Committee.

Placement

The four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs experienced high placement rates from 2015 to 2019. Detailed data about the number of graduates, total employed, those employed in Iowa, those employed out of Iowa, those seeking further education, and placement rates from 2015 to 2019 are given by option in Table 14.1. For all program options, placement six months after graduation was 90% or higher.

Job Titles

The initial jobs held by Agricultural Systems Technology and Industrial Technology graduates in all four options are consistent with the respective program goals. The evidence of initial placement job titles is provided below for all four options programs in Tables 14.2 to 14.5.

Companies Hiring Graduates

The initial jobs held by Agricultural Systems Technology and Industrial Technology graduates in all four options are consistent with the respective program goals. The identified employers' names for those that hired the AST-ABM and AST-MS option graduates over this period of time, who responded, are listed in Tables 14.6 and 14.7 respectively. The identified employers' names for those that hired the ITEC-M and ITEC-OS option graduates over this period of time, who responded, are listed in Tables 14.8 and 14.9 respectively.

Table 14.1 Placement for data all graduates six months post-graduation from 2015-2019.

Academic Year	# of Graduates	# Survey Respondents	Total Employed	Employed in Iowa	Employed out of Iowa	Further Education	% Placed	Seeking	Not Seeking	No Information
AST-ABM										
2015-2016	15	14	13	9	4	1	100	0	0	0
2016-2017	16	14	14	7	7	0	100	0	0	0
2017-2018	9	9	9	6	3	0	100	0	0	0
2018-2019	16	16	16	11	5	0	100	0	0	0
Total	56	53	52	33	19	1	100	0	0	0
AST-MS										
2015-2016	32	32	31	24	7	0	97	1	0	0
2016-2017	56	46	44	29	15	0	96	1	0	1
2017-2018	33	32	30	23	7	0	94	0	0	0
2018-2019	39	39	36	22	14	0	92	0	0	3
Total	160	149	141	98	43	0	95	2	0	4
ITEC-M										
2015-2016	65	45	42	29	13	2	98	0	0	1
2016-2017	62	45	42	30	12	0	93	1	0	2
2017-2018	79	57	52	34	18	1	93	2	0	2
2018-2019	71	56	46	31	15	0	82	0	0	10
Total	277	203	182	124	58	3	91	4	0	15
ITEC-OS										
2015-2016	7	6	5	1	4	0	83	0	0	1
2016-2017	2	2	1	0	1	1	100	0	0	0
2017-2018	11	11	11	4	7	0	100	0	0	0
2018-2019	11	11	9	3	6	0	82	0	0	2
Total	31	30	26	8	18	1	90	0	0	3

Table 14.2 Job titles[1] for AST-ABM option graduates: 2015-2019.

Crop insurance, customer service technician, data systems manager, dealership sales specialist, design engineer, dredge operator, engineering technician, family farmer, field service technician, manufacturing engineer, operations management trainee, owner, precision ag specialist, procurement, product specialist- power systems, project engineer, sales/integrated solution consultant, sales support specialist, sampling associate, sprayer test engineer
[1] Data obtained from the College of Agricultural and a Life Sciences Placement Service. Job titles are arranged in alphabetical order and duplicative job titles have been deleted.

Table 14.3 Job titles[1] for AST-MS option graduates: 2015-2019.

Account manager, agronomy sales advisor, applicator/operations staff, combine operator, design engineer, contract engineer, cross-platform trainee, customer product support, design engineer, engineering technician, equipment tester, estimator/process engineer, experimental technician, explosives crew, facilities manager, family farmer, field service representative, field service technician, fish farm technician, JD harvester customer support team, junior applications developer, lighting design project engineer, manufacturing engineer, milling/ASOM trainee, pilot, police cadet, precision technology specialist, product evaluation engineer, product specialist, product support technician, programming engineer, production staff, quality engineer, research technician, sales, sales engineer, service training and development, technical support, temporary/contract, test technician
[1] Data obtained from the College of Agricultural and a Life Sciences Placement Service. Job titles are arranged in alphabetical order and duplicative job titles have been deleted.

Table 14.4 Job titles[1] for ITEC-M option graduates: 2015-2019.

Aftermarket engineer, agricultural engineer, automation associate, application engineer, CAD engineer, CAD operator, CAD specialist, continuous improvement engineer, customer service, engineering model maker, data processor, design engineer, designer, detailer/draftsman, ensign-pilot, fabrication planner, fabricator and installation technician, facilities engineering manager, field operator, industrial engineer, inside sales engineer, inventory and logistics, lean engineer, lighting technician, machinist, manufacturing engineer, marketing rep, mechanic, mechanical engineer, mechanical drafter, millwright project estimator, naval student aviator, operations analyst, operations engineer, owner, packaging engineer, process engineer, production manager trainee, production operator, production supervisor, project manager, process technician, quality engineer, quality technician, R&D lab manager, rental representative, safety contractor, safety coordinator, safety specialist, shop manager, substitute teacher, testing/development, tool design engineer, weld engineer
[1] Data obtained from the College of Agricultural and a Life Sciences Placement Service. Job titles are arranged in alphabetical order and duplicative job titles have been deleted.

Table 14.5 Job titles[1] for ITEC-OS option graduates: 2015-2019.

Construction engineer, EHS assistant, EHS coordinator, EHS engineer, EHS manager, occupational health and safety specialist, OSHA safety compliance officer, pipefitter, product development, quality engineer, safety and health coordinator, safety coordinator, safety engineer, safety specialist
[*] Data obtained from the College of Agricultural and a Life Sciences Placement Service. Job titles are arranged in alphabetical order and duplicative job titles have been deleted.

Companies Hiring Graduates

The initial jobs held by Agricultural Systems Technology and Industrial Technology graduates in all four options are consistent with the respective program goals. The employers that hired the Agricultural Systems Technology ABM and MS option graduates over the 5-year period between 2015 and 2019 are listed in Tables 14.6 and 14.7, respectively. The employers that hired Industrial Technology M and OS option graduates over the 5-year period between 2015 and 2019 are listed in Tables 14.8 and 14.9 respectively.

Table 14.6 Companies[1] hiring AST-ABM option graduates: 2015-2019.

ADM, AgriVision, Archer Daniels Midland, Bunge, CGB, Continuum Ag, DuPont Pioneer, family farm, Gavilon, Iowa Army National Guard, John Deere, Kuhn, LandMark Implement, MBS Family Farms, Modern Hog Concepts, Noteboom Implement, Puck Custom Enterprises, Renewable Energy Group, Sage Ag, SMA Elevator Construction, Steinbeck and Sons, Stewart Farms, Sudenga, Sukup, Vision Ag, Vittetoe, Wendling Quarries,Winfield Solutions, Winegard
[1] Company names are arranged in alphabetical order and duplicative names have been deleted.

Table 14.7 Companies[1] hiring AST-MS option graduates: 2015-2019.

AGCO, Art's Way Manufacturing, Buhler, Cedar Family Farms, Claas, CNH, CPS, Eberhart Farm Center, Easy Automation, family farm, Farmer's Union Coop, Georgia Pacific, Greiner Implement, Hegland Farms, HNI Corp, Innovative Ag Services, IA Select Farms, Heritage FS, Hog Slat, Hopper Seeds, ISU Research Farm, Jet Co, John Deere, Johnson Controls, Kuhn, Landus Cooperative, Martin Marietta, Mason City Red Power, MaxYield Coop, Monsanto, New Coop, NW Ag Systems, Palmer Group, Peterbilt, Polaris, Police Academy, Prairie Lane Farms, Puck Custom Enterprises, Quick Supply, RDO Equipment, Sage Ag, Stanton Flat Farms, Sukup, Three Rivers, Titan, Todd & Sergeant, Trackside Solutions, US Army, US Marines, Van Wall Group, Vermeer, Viafeld Petroleum Services, Vizient, Weiler
[1] Company names are arranged in alphabetical order and duplicative names have been deleted.

Table 14.8 Companies[1] hiring ITEC-M option graduates: 2015-2019.

3M, A to Z Drying, Ag Leader, American Ordinance, Amcor Plastics, American Packaging, ATEK, ATI Alloys, Barilla, CaptiveAire, Cargill, Columbarium Concepts, Continental Mfg., Danfoss, Dee Zee, Donaldson Filtration, DuPont, Eagleone Safety Solutions, Emerson Process Mgmt, First Class Signs, Fleenor Mfg., Flowers Baking Co, Ford, GE, Global Fabrication, Hach, HNI, Hartfiel Automation, Hearth and Home, Hockel Machine, Hormel, Howe's Welding and Metal Fabrication, Insta-Pro, ISU R&D, Jen-Weld, John Deere, Justright Mfg., Kemin Industries, Kryton Engineered Metals, Lab Builders Inc., Liberty Real Estate, Lift Systems, Mandli Comm, Masterbrand Cabinets, Meredian, Miller Mechanical, Musco Lighting, Newport, NVISIA, Oshkosh, Pella, PepsiCo, PMI, Productive Resources, PSC, Puck Custom, PUTCO, Raytech, Rolfes @ Boone, Ryko, Scott Equip, Scoular Co, Seaboard Foods, SL Montevideo Tech, Smithfield Foods, SpaceX, SPX, State of IA, Stellar Industries, Streck, Sukup, Sun Hydraulics, TDK, Thermomass, TPI, TSI, Tyson Foods, US Cellular, U.S. Navy, USMC, Venture Solutions, Vermeer, Vizient Mfg., Williamsburg Mfg., Winbco Tank Co
[1] Company names are arranged in alphabetical order and duplicative names have been deleted.

Table 14.9 Companies[1] hiring ITEC-OS option graduates: 2015-2019.

Berry Plastics, Brecks Inc., Bridgestone, International Paper, INVISTA, Flint Hills, Green Plains, John Deere, Kiewit, Knoll, Leopardo, Persona, Pilgrim's, PMI, State of IA, Trackside Solutions, University of Chicago
[1] Company names are arranged in alphabetical order and duplicative names have been deleted.

Salaries of Graduates

Salaries from the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) were recorded from 2015 to 2019. Detailed data about the number of graduates, number of salaries reported, lowest value, average value, and highest value are given for four time periods by option in Table 14.10.

Table 14.10 Starting salaries for all graduates by program option: 2015-2019**.**

Academic Year	# Graduates	# Salaries Reported	Low	Average	High
AST-ABM					
2015-2016	15	0	n/a	n/a	n/a
2016-2017	16	6	46,000	52,000	58,000
2017-2018	9	4	40,000	49,000	57,500
2018-2019	16	5	50,000	55,000	60,000
Combined	56	15			
AST-MS					
2015-2016	32	11	40,000	47,000	60,000
2016-2017	56	7	35,000	47,000	55,000
2017-2018	33	13	40,000	53,000	62,000
2018-2019	39	13	40,000	54,900	71,400
Combined	160	44			
ITEC-M					
2015-2016	65	17	30,000	55,000	65,000
2016-2017	62	16	36,000	55,000	68,000
2017-2018	79	17	30,000	55,000	75,000
2018-2019	71	16	31,200	57,200	70,000
Combined	321	66			
ITEC-OS					
2015-2016	7	2	60,000	65,000	70,000
2016-2017	1	0	n/a	n/a	n/a
2017-2018	11	4	44,000	54,000	65,000
2018-2019	11	3	35,000	48,000	58,000
Combined	30	9			

Standard 15

Standard 15 - Job Advancement of Graduates: The advancement of graduates within organizations shall be tracked on a regular basis (two to five years) including promotions to positions of increasing responsibility. Summary data shall be available for the job advancement of graduates.

SUMMARY RESPONSE

A survey of program graduates two to five years after graduation shows that all graduates have advanced (taken positions of increased responsibility) at least once in their careers so far. On average, option graduates have advanced twice or more. These data show that all program options are providing students with the knowledge and skills to contribute materially to their employers and to advance through the ranks on the basis of their contributions.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department has used several approaches to collect information about job advancement for graduates of the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs. Although the department has been diligent in attempting to track data on graduates through survey and other methods, the response rate remains low. Securing supervisor evaluative comments has been even more difficult. To address these challenges, we have elected to directly survey graduates about the advancement of their careers in the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs. Table 15.1 gives the response rate to the portion of our alumni survey that addressed advancement.

Table 15.1. Number of respondents and response rate to 2019 advancement survey.

Group	Number of respondents	Response rate
AST-ABM alumni	7	15%
AST-MS alumni	18	16%
ITEC-M alumni	18	10%
ITEC-OS alumni	1	6%

Graduates of the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs from 2015 to 2018 were asked to respond to the following three questions about job advancement:

1. How many organizations or companies have you been employed by since graduation?
2. Approximately how many years have you been working for the organization or company in which you are currently employed?
3. How many times have you taken a position of increased responsibility, either through promotion within the same organization or company or by taking another position with a different organization or company?

The average responses to the questions posed are presented in Table 15.2 for the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs.

Table 15.2. Average responses by option to the alumni survey advancement questions.

Question	AST-ABM	AST-MS	ITEC-M	ITEC-OS
Number of responses	7	18	18	1
Number of companies/organizations since graduation	1.3	1.3	1.4	2.0
Years at the current company/organization	2.7	2.3	1.8	2.0
Number of times of increased responsibility	2.0	2.6	1.5	2.0

On average, graduates for all four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs have worked for more than one organization or company. No graduates responded that they had worked for more than three companies.

On average, graduates have been employed by their current organization or company for about two or more years. AST-ABM graduates averaged 2.7 years while ITEC -M graduates average 1.8 years.

On average, program graduates of the AST-ABM, AST-MS and ITEC-OS options advanced at least twice since graduation. The ITEC-M graduates averaged 1.5 advancements. All respondents indicated that they achieved at least one advancement. This speaks well of the graduates from all options in that they appear to be advancing well in their careers.

Standard 16

Standard 16 - Employer Satisfaction with Job Performance: Employer satisfaction with the job performance of graduates shall be tracked on a regular basis (two to five years) including employer attitudes related to the importance of the specific program learning outcomes for the program. Summary data shall be available showing employer satisfaction with the job performance of graduates.

SUMMARY RESPONSE

For a variety of legal reasons, employers are extremely reluctant to provide feedback on individual employees. Thus, we have used feedback provided by companies participating in recruiting events on campus, evaluations by those who hire and supervise interns, and surveys of the External Advisory Council, to assess how well our students are meeting the standards of professionalism and their competencies. Employers are generally very positive on the professionalism of our graduates, and of their performance in the workplace.

Another indication of employer satisfaction of our graduates is the data provided by placement rates and starting salaries of graduates. The average placement rates for all four programs over the past five years for which data is available is 90% or above and average starting salaries for the graduates range from $47,000 to $65,000 per year. These strong rates of placement and strong starting salaries are indicative of the overall program quality, ability to attract strong students, and high degree of satisfaction that employers have with graduates of our programs.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department aims to collect information about employer satisfaction of individual graduates of the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs. Our efforts have yielded low response rates, in part because of legal constraints. Companies have explained that they are at legal risk when they provide to outside entities any performance evaluations of current employees. Acknowledging this reality, the department has elected to ask employers (as represented by the External Advisory Council) of our graduates directly about the satisfaction for the four program options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS).

Satisfaction with program option graduates

We surveyed our External Advisory Council in 2019 to determine their general satisfaction with the graduates of the four option programs. We received 12 responses out of the 16 council members for a response rate of 75%. EAC members were asked the following:

> *When thinking about the ISU graduates from the [degree option] program that your organization has hired over the past six years, how satisfied are you and/or your organization with their job performance?*

Their responses were according to this ranking scale: 5 = very satisfied, 4 = satisfied, 3 = neither satisfied or dissatisfied, 2 = dissatisfied, and 1 = very dissatisfied. The results are given in Table 16.1. No responses lower than “4 = satisfied” were given for any of the program options. Note that the survey combined the two AST degree options into one response as employers have indicated that they often don’t know the AST option their employee has graduated from.

Table 16.1. Employer satisfaction with program option graduates as expressed by the ABE External Advisory Council.

Program option	Average Response[1] (n=12)
AST (ABM and MS)	4.4
ITEC-M	4.1
ITEC-OS	4.4

[1] 5 = very satisfied, 4 = satisfied, 3 = neither satisfied or dissatisfied, 2 = dissatisfied, and 1 = very dissatisfied

Another source of employer satisfaction is from companies that participate in the College of Agriculture and Life Sciences Ag Career Day event held every fall and spring semester in which soon-to-be graduates of the four program options interact with perspective employers. Over 260 companies participated in this event in the fall of 2019. The Director of Career Services for College of Agriculture and Life Sciences receives feedback from those participating in the event. Two of the questions asked of participating employers in October 2108 and 2019:

1. The professionalism (communicated effectively, demeanor, and evidence of skills beyond technical knowledge) of the students with whom I interacted with [1 = did not meet, 2, 3 = met, 4, or 5 = exceeded] my expectations.
2. The students with whom I interacted with today gave evidence of technical principles in their discipline that [1 = did not meet, 2, 3 = met, 4, or 5 = exceeded] my expectations.

50 participating companies responded in 2018 and 45 in 2019. All responding companies indicated that the professionalism of the students they interacted with met or exceeded their expectations (average responses for 2018 and 2019 were 4.3 and 4.4, respectively). The responding companies also indicated that students gave evidence of technical principles that met or exceeded their expectations (average responses for 2018 and 2019 were 4.1 and 4.4, respectively). No participating company responded with anything less than “met expectations.” This is further evidence that employers are satisfied with graduates of the College of Agriculture and Life Sciences, including graduates of our AST and ITEC program options.

Importance of Learning Outcomes

Employer attitudes related to the importance of the specific program learning outcomes for each of the program options were obtained from the External Advisory Committee, as described in Standard 5. The data in Tables 16.2 and 16.3 summarizing their attitudes are taken from Tables 5.2, 5.3, 5.4 and 5.5.

Table 16.2 summarizes employer attitudes towards the common learning outcomes. There was a general consensus that the common learning outcomes were “very important” to “essential” (a rating > 3.5) for all options. The lowest rated common learning outcomes were (j) “a knowledge of contemporary issues” with a rating just below “very important.” None of the common

outcomes were deemed "unnecessary" or "useful but not necessary," except (h) "broad education" and (j) "a knowledge of contemporary issues" for the AST-MS option.
Table 16.3 summarizes employer attitudes towards the option-specific learning outcomes. There was a general consensus that all were "important" to "essential" (a rating > 4.0) for all options, except for the AST-MS option. On average they rated outcomes (l) and (m) slightly below important.

Based on feedback from employers as represented by the External Advisory Council, the learning outcomes for each option are important and appropriate. Discussion with the External Advisory Council is needed to examine their views on the general and option specific outcomes for the AST-MS option and to incorporate their feedback into any future changes to program outcomes.

Table 16.2. Employer attitudes[1] related to the importance of common learning outcomes in as expressed by the External Advisory Council (from Tables 5.2 and 5.3).

Common Learning Outcomes	AST-ABM	AST-MS	ITEC-M	ITEC-OS
(a) ability to apply knowledge of mathematics, science, technology and applied sciences;	3.0	3.8	4.2	5.0
(b) an ability to design and conduct experiments, as well as to analyze and interpret data;	3.7	4.3	3.7	4.5
(c) ability to formulate or design a system, process or program to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;	4.0	4.0	4.0	4.0
(d) ability to function on multi-disciplinary teams;	3.7	4.5	4.3	4.0
(e) ability to identify and solve applied science problems;	3.5	4.5	3.7	4.0
(f) understanding of professional and ethical responsibility;	4.5	4.0	4.0	4.0
(g) an ability to communicate effectively	4.5	5.0	4.7	4.0
(h) the broad education necessary to understand the impact of solutions in a global economic, environmental, and societal context;	3.3	2.5	3.5	4.0
(i) recognition of the need for, and an ability to engage in life-long learning;	4.5	3.3	3.8	4.5
(j) a knowledge of contemporary issues	3.0	2.5	3.0	4.0
(k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice	4.5	3.8	3.5	4.0

[1]Respondents rated the importance of each outcome to the option program (1 = unnecessary, 2 =useful but not necessary, 3 = important, 4 = very important, 5 = essential). Table values are the means of the ratings.

Table 16.3 Employer attitudes[1] related to the importance of option specific learning outcomes as expressed by the External Advisory Council (from Tables 5.4 and 5.5)

Option Specific Learning Outcomes	Mean rating
Agricultural Systems Technology - Agriculture and Biosystems Management (AST-ABM)	
(l) an ability to develop, implement, and evaluate best management practices for human and natural resource systems for producing, processing and marketing bio-based products worldwide	4.0
(m) an ability to integrate and apply agricultural and biosystems engineering technologies in the bio-based industries	4.0
(n) an understanding of the complex systems that sustain our water, air, soils, and food	4.0
Agricultural Systems Technology - Machine System (AST-MS)	
(l) an ability to specify, manage, and test machine systems in the context of complete agricultural, biological production or processing systems	2.8
(m) an understanding of the technology and application of machine systems including power and information flows, function and interaction with biological materials	2.8
(n) an ability to perform energy and cost analyses of complete machine systems to ensure the success and sustainability of an enterprise	3.0
Industrial Technology - Manufacturing (ITEC-M)	
(l) an ability to develop, implement, and evaluate manufacturing processes and facilities	4.9
(m) an ability to apply computer aided design and manufacturing, control systems, and automation systems to industrial settings	4.0
(n) an ability to implement and analyze the use of manufacturing technologies to enhance production, quality, and profitability of manufacturing systems	4.6
Industrial Technology - Occupational Safety (ITEC-OS)	
(l) an ability to develop, implement, and evaluate occupational safety and health programs for businesses and organizations	5.0
(m) an ability to identify and analyze hazards and loss producing conditions in work environments	5.0
(n) an ability to eliminate or control occupational hazards using appropriate technologies, administrative interventions, and training for behavior modification	5.0

[1]Respondents rated the importance of each outcome to the option program (1 = unnecessary, 2 =useful but not necessary, 3 = important, 4 = very important, 5 = essential). Table values are the means of the ratings.

Standard 17

Standard 17 - Advisory Committee Approval of Overall Program: A functioning industrial advisory committee shall exist for each program/option. If more than one program of study or program option is available, then appropriately qualified industrial representatives shall be added to the committee or more than one committee shall be maintained.

17.1 - Policies for the advisory committee shall exist that include: (a) criteria for member selection; (b) procedures for selecting members; (c) length of member appointment; (d) committee responsibilities; (e) frequency of meetings (at least one per year); and (f) methods of conducting business.
17.2 - A roster of advisory committee members and minutes of advisory committee meetings shall be made available to the visiting team.
17.3 - Evidence shall exist showing the advisory committee participates in program outcome and program learning outcomes validation and the evaluation of overall program success.

SUMMARY RESPONSE

The department has an active External Advisory Council that serves the role of industrial advisory committee. This 18-member strong group is composed of persons who have distinguished themselves in the multiple fields associated with our department – including all four option programs covered by this accreditation self-study. The department clearly links specific members of the EAC to option programs and in so doing are able to get more meaningful feedback from them.

DETAILED RESPONSE

The Agricultural and Biosystems Engineering department has an External Advisory Council (EAC) that exist as our industrial advisory committee. The EAC serves as an external voice for all academic programs offered by the department and has participated in the general outcomes and competencies validation processes along with other activities that strengthen the programs being offered by the department. The EAC is separated into four option-specific operational groups for discussions and activities specific to options. The identity of the EAC members in each of the four option specific groups are shared in the roster at the end of the section.

17.1 Policies for the advisory committee

17.1.a. Criteria for Member Selection

Membership of the council is expected to be representative of the diverse activities and constituencies of the department. The EAC is composed of a maximum of 20 members, with at least half residing within the state of Iowa.

17.1.b. Procedures for Selecting Members

The members are appointed by the Department Chair of the Agricultural and Biosystems Engineering Department with advice from current EAC members and the Agricultural and Biosystems Engineering faculty.

17.1.c. Length of Member Appointment

The term of membership is three years with a maximum of two consecutive terms. Terms are staggered so that five members will be appointed/reappointed each year. Retiring members are eligible for reappointment after a one-year period. The membership year begins at adjournment of the spring meeting of the council and extends to adjournment of the next spring meeting.

17.1.d. Council Responsibilities

The EAC is a group of industrial, business, legislative, and professional leaders who are interested in the vitality of Agricultural and Biosystems Engineering department at Iowa State University. The council helps ABE to strengthen its learning, research, and outreach programs, improve its facilities, expand its base of support, and serve its alumni. Council members actively participate in the continual assessment of ABE progress and the development of ABE/industry/stakeholder partnerships.

17.1.e. Frequency of Meetings

The EAC normally meets in the spring and in the fall of each academic year. In addition to the two regular meetings held each year, special meetings of the council and of its committees may be called by the EAC chair.

17.1.f. Methods of Conducting Business

The Agricultural and Biosystems Engineering Department Chair is an ex-officio member of the council. The office of the Agricultural and Biosystems Engineering Department Chair acts as secretariat for the council.

The officers of the council consist of the chair, chair-elect, and past chair; they are elected from the membership of the council. The term of service of the officers is one year in a period from June 1-May 31. They are eligible for re-election for one additional term. The officers are chosen without regard for their normal period of service on the council, and their appointment is automatically extended until the end of their tenure in office if their three-year term as member expires during their term of service.

The EAC chair presides over meetings of the council and provides guidance in achievement of its goals. The EAC chair-elect presides over council meetings in the absence of the EAC chair and has responsibility for coordinating the activities of the ad-hoc committees of the council, with the exception of the nominating committee. The EAC past-chair serves as chair of the nominating committee. Members of the nominating committee are appointed annually by the EAC chair.

Election of the EAC chair-elect takes place at the spring meeting of the council. A simple majority of votes cast by members present is required for election.

The EAC chair, in collaboration with the Agricultural and Biosystems Engineering Department Chair, sets the dates for meetings of the council. The Office of the Agricultural and Biosystems Engineering Department Chair is responsible for arrangements and, in collaboration with the chair, prepares the agenda for each meeting and mails it to all members of the council at least ten days prior to each meeting. At the end of each meeting, the council makes suggestions for the agenda for the next meeting. The council normally acts as a committee of the whole, but sub-committees may be appointed by the chair to undertake specific assignments.

Revisions to the bylaws can be proposed by any council member and by the ABE Department Chair. Proposed revisions must be distributed in writing to all members of the council at least ten days prior to the meeting where action on the proposals will be taken. A two-thirds majority of all members present is required for approval.

Minutes of EAC

The minutes of the EAC meeting and the EAC Bylaws are available upon request.

17. 2 Roster of EAC

The membership of the EAC includes 19 individuals:

LeQuetia Ancar	Brett Bell	Mark Cooper	Jim Eisenmenger
Mike Gauss	Barry Hager	Keith Heiar	Ken Hoefling
Jon Lyon	Emy Marroquin	Matt Miller	Carl Orr
Christian Orr	Miguel Rangel	Kyle Riley	Kevin Stiles
Stacy Thorson	Travis Van Genderen	Ryan Witt	

Roster of EAC Assignments by Option

The members of the EAC are assigned into option specific operational groups by the four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS). These assignments are listed in Tables 17.1 to 17.4.

17.1 Members of the EAC, AST-ABM option sub-committee

Brett Bell	Chief Operating Officer Landus Cooperative	Brett.bell@landuscooperative.com
Christian Osborn	State Conservation Engineer NRCS	Christian.osborn@usda.gov
Kyle Riley	Water Resources Engineer Polk County Public Works Dept.	Kyle.Riley@polkcountyiowa.gov
Kevin Stiles	Executive Director Iowa Poultry Association Iowa Egg Council	kevins@iowapoultry.com

Table 17.2 Members of the EAC, AST-MS option sub-committee

Mike Gauss	President Kent Nutrition Group	Mike.Gauss@kentww.com
Barry Hager	Global M.E., Leader John Deere Seeding Group	HagerBarryJ@JohnDeere.com
Stacy Thorson	Seed Technology & Innovation, Team Lead Corteva Agriscience	Stacy.Thorson@corteva.com
Travis Van Genderen	Director, Supply Chain AGCO – Jackson Operations	Travis.VanGenderen@agcocorp.com
Ryan Witt	Mechanical Design Manager Ag Leader Technology	rwitt@agleader.com

Table 17.3 Members of the EAC, ITEC-M option sub-committee

Mark Cooper	VP Product Quality & Reliability Vermeer Corporation	mcooper@vermeer.com
Jim Eisenmenger	Manager, Systems & Application Engineering Danfoss Power Solutions	jeisenmenger@danfoss.com
Keith Heiar	Manufacturing Strategy Manager Caterpillar, Inc.	Heiar_keith_j@cat.com
Ken Hoefling	Operating Partner LFM Capital	ken@lfmcapital.com
Jon Lyon	Global Program Manager General Mills	Jon.Lyon@genmills.com
Matt Miller	Process Engineer Pella Corporation	Milleram1@pella.com

17.4 Members of the EAC, ITEC-OS option sub-committee

LeQuetia Ancar	Assistant Director, Student Services Multicultural Liaison Officer College of Engineering, ISU	lancar@iastate.edu
Emy Marroquin	Safety Specialist Flint Hills Resources	Emy.Marroquin@fhr.com
Carl Orr	Senior Vice Preside of Operations Lifecore Biomedical, Inc.	orrfarmsmn@gmail.com
Miguel Rangel	Project Manager PMI Iowa	mar@pmiiowa.com

Standard 18

Standard 18 - Outcome Measures Used to Improve Program: Evidence shall be presented showing how both direct and indirect outcome measures have been used to improve the overall program/option*. Evidence that program stakeholders participate in this process must be demonstrated. Outcome measures (standards 14-16) and advisory Board input (standard 17) **must** be used to improve the program. Measures must include a **combination** of the following:

- Graduate Satisfaction with Program/Option
- Employment of Graduates
- Job Advancement of Graduates
- Employer Satisfaction with Job Performance of Graduates
- Graduate Success in Advanced Programs
- Student Success in Passing Certification Exams
- Course-based Direct Measures
- Other criteria established by the institution's Regional Accreditation activities.
- Evidence must exist showing how the Advisory Committee Approval of Program have been used to improve the overall program/option based on data collected and analyzed.

SUMMARY RESPONSE

Since the last accreditation visit, multiple measures have resulted in several program changes, ranging from minor adjustments to major revisions. The Technology Curriculum Committee is the driver for these changes, and considers data gathered from exit interviews and surveys, employer evaluations of interns, and advice from the external advisory board, faculty, and students.

DETAILED RESPONSE

Changes Made to the Program

As part of the continuous improvement processes and data collection related to continuous improvement, several curricular changes were made. Although the Technology Curriculum Committee guides the changes, the impetus for the changes come from multiple sources. These include: faculty, student, and employer feedback, suggestions from the External Advisory Council, college-level outcomes assessment, and other mechanism. To address improvements needed in the sophomore-level manufacturing processes course, a survey of manufacturing employers was undertaken in 2017. The findings from that survey drove changes in the second year manufacturing coursework, described in further detail below.

Major improvements and changes made between 2015 and 2019 are outlined below. Changes are presented in terms of the options the change will impact and are summarized in the following tables using the ATMAE template.

Continuous Curricular Improvement Process

The continuous curricular improvement process that the ABE department uses for all four options (AST-ABM, AST-MS, ITEC-M, and ITEC-OS) programs is outlined below. Key aspects include:

1. In consultation with constituents and our External Advisory Council, the mission, goals and objectives of the program are reviewed (and changed as necessary) every three years. From this process, the desired student learning outcomes are developed, taking into account ATMAE accreditation criteria.
2. Each TSM and supporting course in the curriculum is examined to determine which of the outcomes it addresses. The curriculum as a whole is examined to ensure adequate coverage of the outcomes. Should there be gaps in coverage, the curriculum is re-examined to determine if different courses are needed, or if courses within the department need to be changed or added to ensure all the outcomes are adequately addressed.
3. The Technology Curriculum Committee determines from the outcomes-competency matrix which competencies are addressed in each of the courses taught in our department. We thus know which competencies should be focused on in each course. Faculty members designate key assignments in each course that students can use to demonstrate these competencies.
4. TSM teaching faculty are given the opportunity each year to add, subtract or modify their course to better meet student needs or departmental outcomes. Changes to the curriculum programs (i.e. degree plan scope and sequence changes) are made in the fall semester, while additions or changes to course description and course title are made in the spring semester. The Technology Curriculum Committee approves all changes and the ABE faculty vote on the slate of changes.
5. The primary evidence of students achieving the outcomes (or in this case, achieving the competencies) is direct evidence of performance: workplace evaluations of students on internships, employer evaluation of graduates two or more years after graduation, graded homework, and student performance in their capstone experience (TSM 415 and 416). Indirect measures (e.g., senior exit surveys, student evaluation of instruction, post graduate surveys, program reviews, advisor evaluations and placement statistics) are reviewed as background information but are not the basis of judgment for the attainment of outcomes. The Technology Curriculum Committee members do not use course grades as an assessment measure because they are not objective measures of student performance relative to individual outcomes.
6. The direct and indirect measures are reviewed by the Technology Curriculum Committee to identify strengths and weaknesses of the program, and in consultation with the external advisory council, make recommendations for change. The faculty as a whole (curriculum changes) or individual faculty (specific courses) implements the recommendations.

Table 18.1 Improvements made to technology programs

	Program Improvements
	AST-ABM, AST-MS
What was Done	In 2017-2018, TSM 333 was changed to TSM 433.
Why it was Done	Based on feedback from the instructor, external stakeholders, and students, the content of the course was judged to be at the senior-student level. Offering the course at a 400-level also opened up the opportunity to dual-list the course at the 500-level, facilitating its offering as a graduate course.
Supporting Evidence	Course content was judged to be at a higher level than junior level (i.e. 300 level). Input was sought from external industry partners and instructors.

	Program Improvements
AST-ABM	
What was Done	TSM 322 was previously 2 credits, but was increased to 3 credits in the 2019-2020 catalog, increasing the contact hours from 2 hours of lecture to 3 hours of lecture per week.
Why it was Done	To better align the content of the course with its 1-credit laboratory and to add needed content to the course, 1 credit was added to the lecture.
Supporting Evidence	Changes were based on feedback from the instructor, curriculum committee, and industry stakeholders

	Program Improvements
AST-ABM	
What was Done	Addition of TSM 455, Feed Processing and Technology, to AST-ABM option core. Change took effect in 2019-2020 catalog.
Why it was Done	Based on needs of grain and feed industry and the ability to offer this content to students because of the feed technology minor coursework (which includes TSM 455), the Technology Curriculum Committee felt that TSM 455 would add needed knowledge and background for a student group who will likely use it in their professional positions in feed and grain.
Supporting Evidence	A large number of AST-ABM graduates work in the feed and grain industry and would benefit from the knowledge taught in this course. The course provides students an introduction to feed technology, perhaps encouraging students to pursue a minor in feed technology.

	Program Improvements
ITEC-M	
What was Done	TSM 241, Introduction to Manufacturing Processes for Plastics, was created using and expanding on content in plastics from TSM 240. The course first appeared in the 2018-2019 catalog for the ITEC-M only.
Why it was Done	An industry survey indicated that students could use additional preparation in metals. A decision was made to expand on metals in TSM 240, pushing the plastics content out of the course. To ensure the curriculum would continue to address plastics content, a new 2-credit course was created, with 1 hour of weekly lecture and one 2-hour lab.
Supporting Evidence	A survey was completed in May of 2017 to compare the needs of the manufacturing industry with the expected skills and knowledge of technology graduates. Approximately 15 firms were surveyed. In some cases, multiple contacts were surveyed within a single firm. Skills and knowledge were measured using an importance/performance scale, asking which content areas were most/least important and which areas students were most/least proficient. Content was modified for TSM 240 and 241 based on the findings from this survey.

	Program Improvements
AST-MS, ITEC-M, ITEC-OS	
What was Done	TSM 240 remained at 3 credits, but changed its content to focus more on advanced manufacturing processing involving metals. The modified course was first offered as part of the 2018-2019 catalog.
Why it was Done	An industry survey completed in 2017 indicated that students could use additional preparation in metals. The course was revised to include more in-depth coverage of metals in class and in the laboratory.
Supporting Evidence	A survey was completed in May of 2017 to compare the needs of the manufacturing industry with the expected skills and knowledge of technology graduates. Approximately 15 firms were surveyed. In some cases, multiple contacts were surveyed within a single firm. Skills and knowledge were measured using an importance/performance scale, asking which content areas were most/least important and which areas students were most/least proficient. Content was modified for TSM 240 and 241 based on the findings from this survey.

	Program Improvements
AST-ABM, AST-MS, ITEC-M, ITEC-OS	
What was Done	TSM 214, Managing Technology Projects, was created and added to the curriculum in all options. The course was officially added to the 2017-2018 catalog, but the curricular change was in place beginning in the 2016-2017 catalog.
Why it was Done	The course was added to address a deficit in student project management knowledge and background. TSM 214 was designed to complement existing coursework and experience in capstone (TSM 415/416) and in the internship experience (TSM 397/399).
Supporting Evidence	Employer feedback, data from the ABE External Advisory Council, and faculty interest and expertise drove the creation and development of TSM 214. Capstone faculty were heavily involved in the creation of the initial syllabus and course scope, structure and sequence.

	Program Improvements
AST-ABM, AST-MS, ITEC-M, ITEC-OS	
What was Done	TSM 415 was renamed, content was revised, and a credit was added to make the course a 2-credit course titled, Applied Project Management in Technology.
Why it was Done	This improvement was undertaken to support the project management sequence, beginning with TSM 214, continuing with the internship courses TSM 397/399, into the capstone sequence TSM 415/416. Changes to the course included a higher focus on case-based project management instruction and the application of project management principles (drawn from the Project Management Institute or PMI) to the capstone project.
Supporting Evidence	Feedback from employers, the ABE External Advisory Council, and others who hire technology students supported the inclusion of additional concepts in project management within the technology degree programs.

	Program Improvements
AST-ABM, AST-MS, ITEC-M, ITEC-OS	
What was Done	TSM 416 was renamed to Technology Capstone and 2 credits were removed to lower the emphasis on the capstone experience, in line with a process more focused on project management.
Why it was Done	The change was undertaken to support the project management sequence, beginning with TSM 214, continuing with the internship courses TSM 397/399, into the capstone sequence TSM 415/416. Changes to the course included a stronger focus on project management-based problem solving as it related to the capstone project.
Supporting Evidence	Feedback from employers, the ABE External Advisory Council, and others who hire technology students supported the addition of additional concepts of project management in the technology degree programs.

ACCREDITED BY ATMAE The Association of Technology, Management, and Applied Engineering	**Program Improvements**
AST-ABM, AST-MS, ITEC-M, ITEC-OS	
What was Done	A primary goal of the department in the last 5 years has been to increase the capacity of our technology programs, through increased access to courses and laboratories. A primary constraint for offering additional courses was instructor time. Using a variety of mechanisms, sections of courses were offered with TA, staff, and faculty resources to better meet student needs. The following courses were increased in terms of when/how often they were offered: Core courses now offered in fall/spring semesters: TSM 111, TSM 270, TSM 310, TSM 363, TSM 370 Option courses now offered in fall/spring semesters: TSM 337, TSM 440, TSM 443, TSM 444, TSM 465 Option courses now offered once/year rather than on rotating every other year basis: TSM 376, TSM 470, TSM 471, TSM 477
Why it was Done	As student enrollment increased and student entry into the program varied, the lack of course offerings was adding unnecessary time to students' time-to-degree. This is particularly important to the largest group of students ITEC-M, three-quarters who transfer into ITEC from another major. They often have 2-3 years of schooling already and have limited enthusiasm or funding for any more time than is necessary to complete the degree. Spreading the course load out in the final 2 semesters generally improves student learning as students are not bogged down with 18-20 credits of rigorous, senior-level coursework.
Supporting Evidence	Wait lists for courses often had enough students to fill another section and according to adviser feedback, students were required to stay on as long as another 12 months or more to wait to take required courses. Exit survey data were another data source supporting decisions to expand capability in course offerings.

Standard 19

Standard 19 - Program Responsibility to Provide Information to the Public: The program must make available to the public via website, information on student performance and achievement as may be determined appropriate by the institution and/or the program. Information on student performance and achievement may also be provided in hard-copy forms as may be determined appropriate by the institution and/or the program. Sources of potential information include, but are not limited to: student graduation rates from the program; average starting salaries; mean grade point averages; promotions achieved; time to secure first position; average years to complete the degree; and student awards/scholarships received. Institutions are required to provide the hyperlink of where this information is located.

SUMMARY RESPONSE

The Program Education Objectives (PEOs), Student Outcomes (SOs), annual student enrollment and graduation data are posted and made accessible to the public on the ABE website (http://www.abe.iastate.edu/abe-department/), on the Accreditation (https://www.abe.iastate.edu/accreditation/) page which includes links to complete information for the Agricultural Systems Technology and Industrial Technology (https://www.abe.iastate.edu/accreditation/agricultural-systems-technology-and-industrial-technology/) programs. Please see below for posted data.

DETAILED RESPONSE

Table 19.1. Undergraduate Enrollment and Graduation Data: AST-ABM

Academic year	Fall enrollment	Annual Graduation Data	Placement Rate	Average Starting Salary in U.S. Dollars
2018-2019	38	16	100	55,000
2017-2018	31	9	100	49,000
2016-2017	35	16	100	52,000

Table 19.2. Undergraduate Enrollment and Graduation Data: AST-MS

Academic year	Fall enrollment	Annual Graduation Data	Placement Rate	Average Starting Salary in U.S. Dollars
2018-2019	113	39	92	54,900
2017-2018	131	33	94	53,000
2016-2017	153	56	96	47,000

Table 19.3. Undergraduate Enrollment and Graduation Data: ITEC-M

Academic year	Fall enrollment	Annual Graduation Data	Placement Rate	Average Starting Salary in U.S. Dollars
2018-2019	248	71	82	57,200
2017-2018	253	79	91	55,000
2016-2017	261	62	93	55,000

Table 19.4. Undergraduate Enrollment and Graduation Data: ITEC-OS

Academic year	Fall enrollment	Annual Graduation Data	Placement Rate	Average Starting Salary in U.S. Dollars
2018-2019	26	11	81	48,000
2017-2018	32	11	100	54,000
2016-2017	32	2	50	n/a